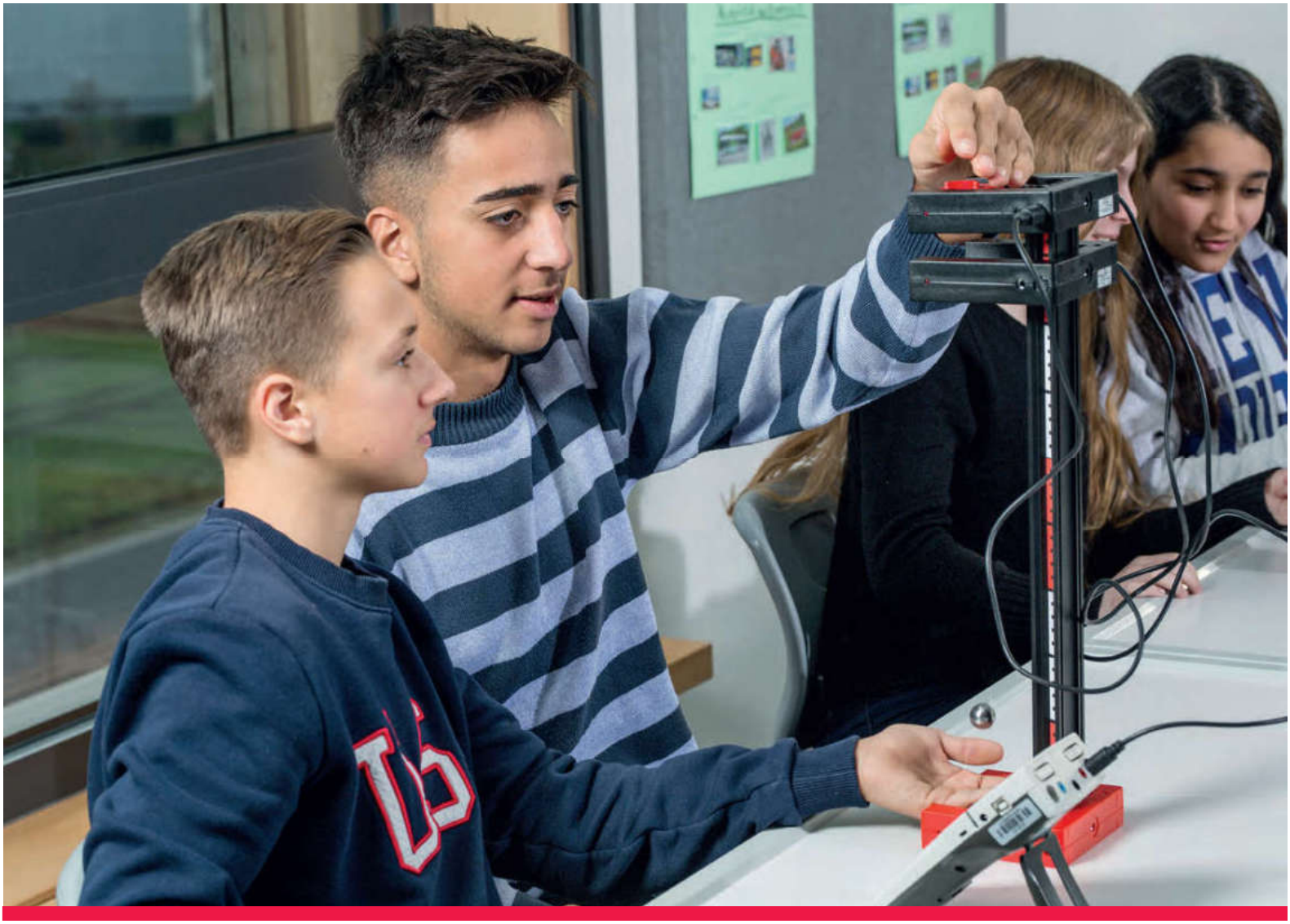
LEYBOLD®

SCIENCE LAB – STUDENT EXPERIMENTS SYSTEM



S.A.R.L. SYSTEMES DIDACTIQUES

LD DIDACTIC

LD DIDACTIC GROUP

Experimentation is our passion

A COMPETITIVE ADVANTAGE IN A HIGHLY COMPETITIVE WORLD

We believe in the importance of education as a fundamental driver of personal, national and global development. In a highly specialised world, knowledge has become a decisive factor: Skilled personnel are in greater demand than ever. Investing in the practical training of your students, you equip them with important science skills that the labour market requires.

THE SECRET OF SUCCESS IS THE MIX OF THEORY & PRACTICE

Experimentation has always been a core competence of scientists and ensures to really understand STEM phenomena.

The planning, carrying out and recording of experiments is an important element of a well-founded education in science. In order to reinforce newly acquired knowledge, experiments must be well matched to the theory.

THE PASSION FOR TEACHING EQUIPMENT IS IN OUR DNA

From the very beginning in 1850 we at LEYBOLD concentrate on how to make academic content understandable and tangible for students at different levels of education. Therefore we are proud that for generations our training and educational systems have made a significant contribution to knowledge transfer in natural sciences.

However, for 170 years of experience we have found that you can achieve a lot when keeping pace with customer needs: we continuously challenge ourselves to preserve our high quality standards and develop our products and services in line with changing curricula and new technologies.

PREMIUM QUALITY MADE BY LEYBOLD, FEEDBACK & ELWE

The LD DIDACTIC Group is a leading global manufacturer of high quality STEM teaching and training system.

We can supply all from a single source: Teaching systems, experiment literature and documentation for STEM as well as training and didactic seminars.

LEYBOLD® Feedback ELWE® TECHNIK

Headquarter Huerth, Germany

CONTENTS

WWW.LEYBOLD-SHOP.COM

Get students excited about STEM subjects

SCIENCE LAB

NATURAL SCIENCES

- **Best solution for STEM education**
  Skill enhancing: Problem solving and planning, observation and analysis learning processes
- **Save time**
  Fast search of experiments and distribution of the student worksheets
- **Easy preparation**
  At home or on the go: Cloud solution makes all information accessible from everywhere
- **Supports every teaching style**
  Work fully digital or with pen and paper - the system fits to each way of teaching
- **For excellent teaching results**
  Adjust the content to the level of the student by using the Lab Docs Editor

PHYSICS
BIOLOGY
CHEMISTRY
TECHNOLOGY
ENGINEERING

COMPLETE SOLUTION

+ Curricular consulting
+ Teacher/lecturer training
+ Lab management

ACQUIRE DIGITAL & EXPERIMENTAL SKILLS

1

STORAGE SYSTEM & DEVICES

2

EXPERIMENT INSTRUCTIONS

3

DATA LOGGING

Developed in collaboration with didactic institutes from the University of Cologne.

WHAT ARE THE FEATURES OF OUR SCIENCE LAB?

- Experiments developed according to the latest didactic research
- Fundamental & professional experiments
- High-quality and innovative devices
- Developed for experimenting in student groups
- Experimental units fit into prescribed timeframe (class/lectures)
- Experiments are easy to understand and safe
- Reduced preparation time for teachers/lecturers

- Ideal in combination with the universal student measuring device - Mobile-CASSY 2 WiFi - for all topics due to various sensors specially designed for student experiments
- Customisable, interactive experiment instructions with teacher/lecturer and student sections
- Pre-formed storage for quick completeness checks
- Durable due to robust & sturdy materials
- Innovative design enables easy storage and quick use

Sophisticated storage system

QUICK & EASY HANDLING

- With and without lid symmetrically stackable
- Front and rear moulded grips for easy removal and transport
- Systematic arrangement of the devices

EXTRA STABLE & ROBUST DESIGN
SPACE-SAVING STORAGE

HARD-WEARING & HIGH-QUALITY

- All the materials from the tray to the divider
- Knock and bump-resistant
- Washable and easy to clean
- No discolouration with sun exposure

DUST-PROTECTING LID

- Additional safety for devices in the tray and during transport
- Lid fits on and under the tray for easy handling and low space requirements

EVERYTHING AT A GLANCE

- Labelling on front and back of the tray
- Clear labels, recognisable from a distance
- Personalise the labels for student groups
- Waterproof
- Labels are in a protective cover

CLEARLY ARRANGED INVENTORY PLAN

- Quick identification of the right equipment and efficient clean-up
- Easy check completeness before and after experimenting
- Online accessable by using QR code (available for printing)

EASY & INTUITIVE USE FOR STUDENTS

UNIQUE MARKING

A
- Clear structure of the experiment collection due to unique colour codes and abbreviated set identifiers
  - By subject
  - By subject/topic area
  - By topic

B
- Quick and easy locating by combining the colour coding with the abbreviations of the individual trays

C
- QR code: directly to all product information and detailed inventory plan

D
- Direct assignment to student groups using the customisable label

2

Lab Docs – Digital & interactive experiment instructions

DIGITAL PREPARATION

- Online portal – Organisation & management of experiments and devices
- LD management system LeyLab may contain LD and own experiment instructions

DIGITAL DISTRIBUTION

- Easily access from all students' tablets and smartphones using a QR code

DIGITAL EVALUATION & PROTOCOL

Interactive usage

- Answer questions
- Analyse
- Write digital protocols
- Save
- Share with the teacher/lecturer

DIGITAL EXPERIMENTING

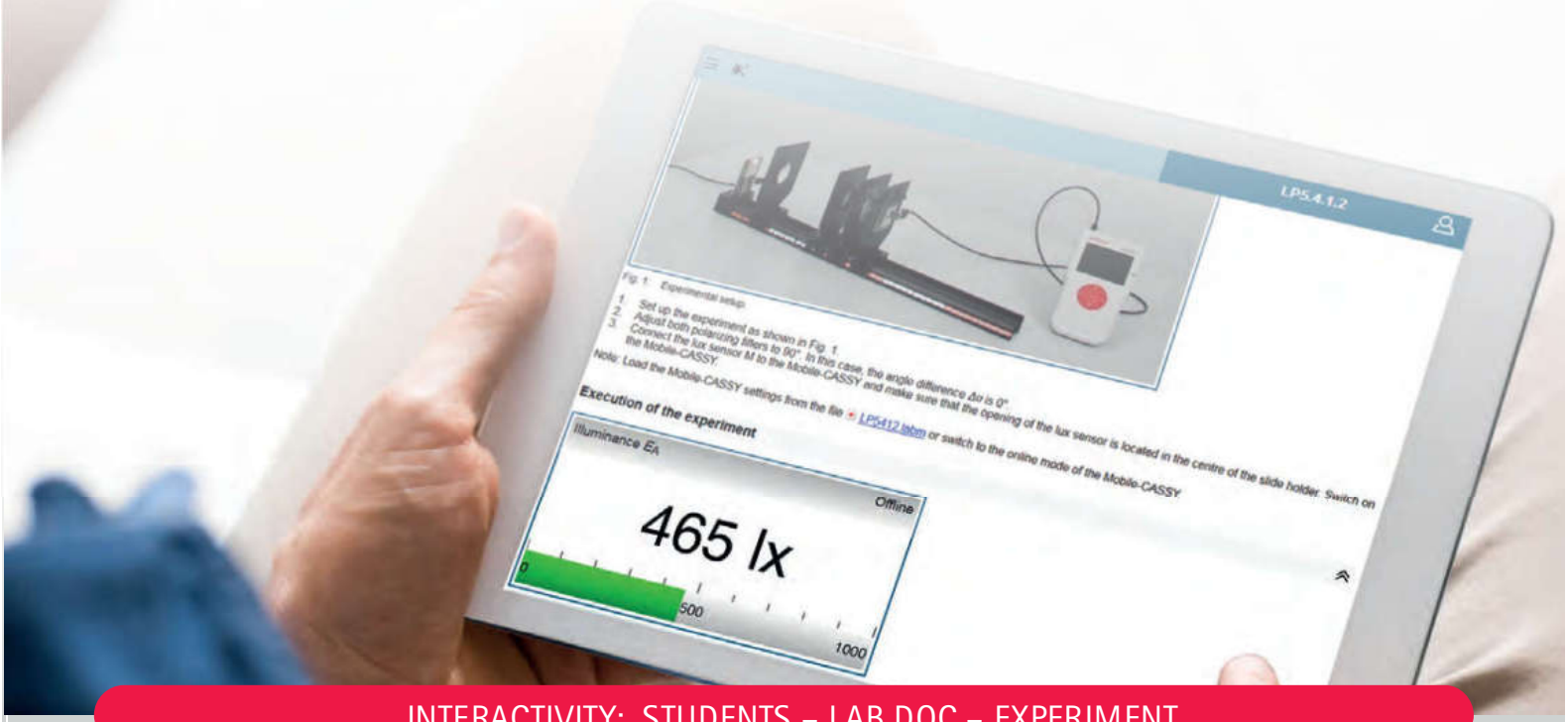
- Opening the Lab Doc
- Setting up experiment

DIGITAL DATA ACQUISITION

Interactive with Mobile-CASSY 2 WiFi

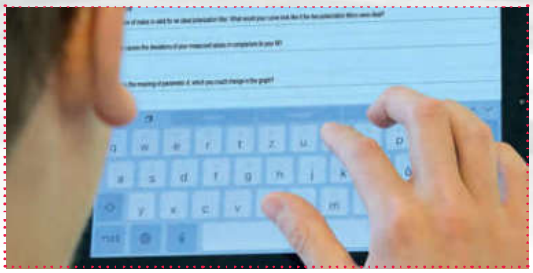
- Perform experiment & measurement
- Measured values in tables & diagrams in real time

How does a Lab Doc work?



INTERACTIVITY: STUDENTS – LAB DOC – EXPERIMENT

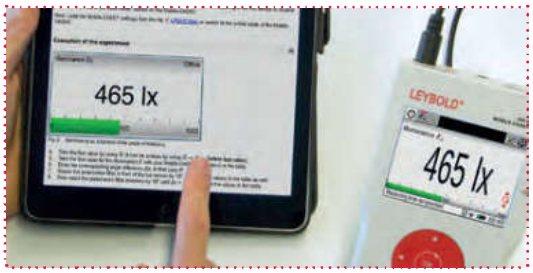
Every student answers the questions in the individual Lab Doc on their tablet, smartphone or laptop and analyses the measurements. Then the individual protocol can be stored and shared.



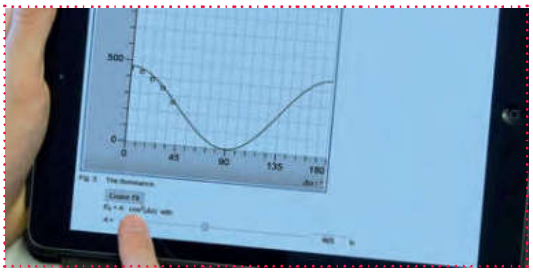
Enter answers directly

Enter the measured values manually, diagrams are created automatically

MANUAL INPUT

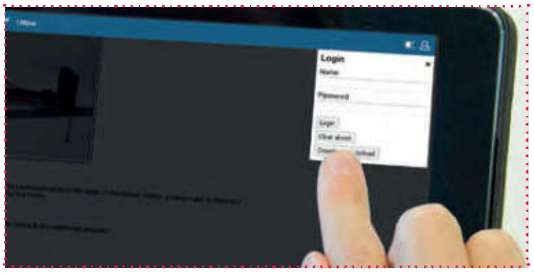


Live measured values from the Mobile-CASSY 2 WiFi are transmitted to measuring instruments, tables & diagrams



Smart diagrams, selection of alignments by touch

INTERACTIVE MEASURING INSTRUMENTS



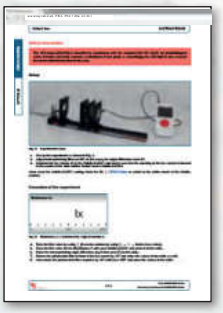
Save and share the protocols, stored data can be reloaded at any time (e.g. for further editing at home)

DIGITAL PROTOCOL

Worksheet sections

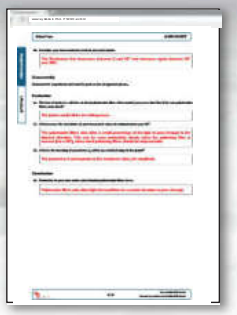
Effortless preparation, straightforward implementation

STUDENT SECTION



- Short and easy-to-follow experiment descriptions with direct student addressing
- Sufficient space for student's answers
- Modular design allows for many options for specialisation and working speeds
- Contains instructions and a to be completed worksheet
- Systematic illustration of the experimental set-up and performing

TEACHER/LECTURER SECTION



- Designed for useful prescribed timeframes
- Tailored to the respective age group
- Recommendations for the use of experiments and their goals as well as a classification in the subject-related context
- Detailed accompanying information for preparation, naming of possible sources of error and safety measures
- Worksheet contains sample answers and sample measurements as well as sample evaluations for planning classes or lectures
- Classification of experiments according to level, degree of difficulty, preparation time and duration

LAB DOC - ALL IN ONE

1. Set-up instructions and assignments of tasks
2. Measured values (table, diagram)
3. Data evaluation (answers, alignments of measured values)

This produces: a complete digital protocol

All information about the experiment is in the Lab Doc of each student. No additional programs or apps are needed to analyse the measured values.

Work fully digital on all platforms or traditionally with paper

DIGITAL – FOR THE PAPERLESS CLASS/LECTURE

- The digital version can be accessed from any student device

TRADITIONAL – PRINTED HANDOUTS

- Download as a PDF file for printing

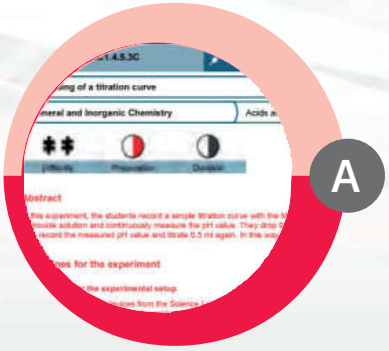
iOS LINUX macOS

- For all platforms
- Any tablet, smartphone or PC
- Solutions for any IT infrastructure
- Allows for BYOD
- No installation necessary

2

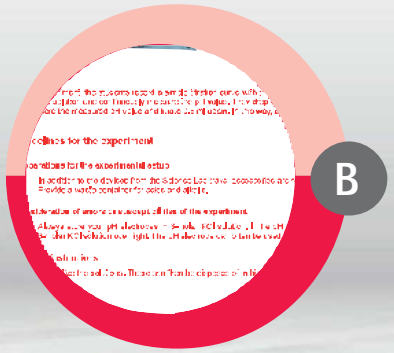
Detailed structure

of innovative experiment instructions Lab Docs



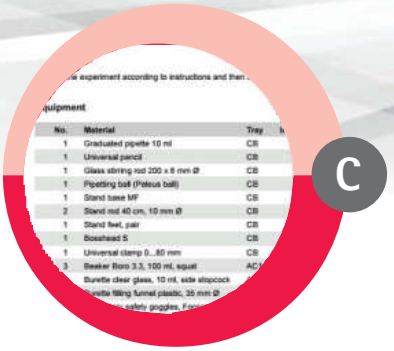
LEGEND

- Experiment title and subject
- Age/degree
- Difficulty level
- Preparation time for teachers/lecturers
- Experiment duration



INFORMATION FOR TEACHER/LECTURER

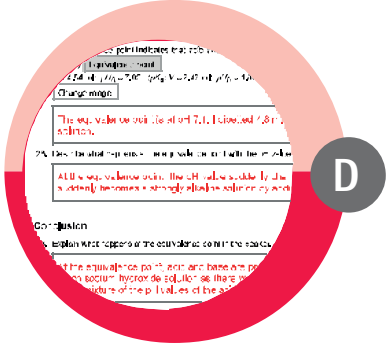
- Abstract
- Didactical considerations
- Guidelines for the experiment



INSTRUCTIONS FOR STUDENTS

TEACHER/LECTURER SECTION INCLUDES ADDITIONAL INFORMATION IN RED

- Introduction
- Assignment
- Equipment
- Safety instructions
- Setup
- Experimental procedure



WORKSHEET FOR STUDENTS

TEACHER/LECTURER SECTION WITH SAMPLE MEASURED VALUES & ANSWERS IN RED

- Observation
- Disassembly
- Evaluation
- Conclusion
- Additional tasks

Lab Docs Editor

Create new and edit existing Lab Docs

QUICKLY AND EASILY EDIT AND CREATE EXPERIMENT INSTRUCTIONS

ADAPT PURCHASED LAB DOCS FROM LITERATURE PACKAGES

MAKE YOUR EXISTING INSTRUCTIONS SUITABLE FOR THE DIGITAL CLASS/LECTURE

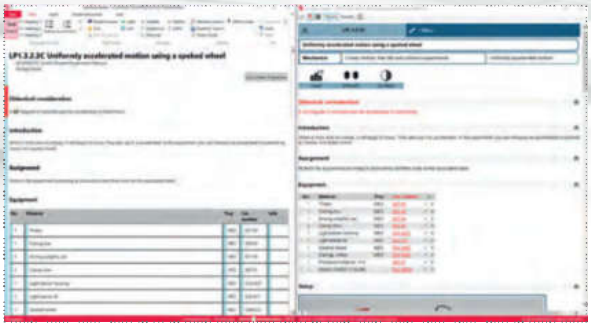
CREATE BRAND NEW INSTRUCTIONS OF YOUR OWN

DIGITAL, INTERACTIVE AND IN A FUTURE-PROOF FORMAT

- Easy-to-use tool, HTML skills are not needed
- Design experiment instructions easily and adapt to your own needs
- Responsive layout - adapts to any screen size
- Central availability for all colleagues
- Measured values tables & diagrams with or without integration of a Mobile-CASSY interface

COMPREHENSIVE EDITABILITY

- Edit & delete assignments
- Modify instructions
- Add text
- Integrate and adapt interactive diagrams & tables
- Insert images, vector graphics, hyperlinks, etc.
- Prepare and create equipment lists
- Create formulas



MANY USEFUL FUNCTIONALITIES

- Changes are immediately visible in the web browser
- Convenient view of student & teacher/lecturer section
- Export as PDF possible
- Export to LeyLab for centralised management
- Distribution of Lab Docs using QR code

Innovative measuring technology

with the ultimate student measuring device

MOBILE-CASSY 2 WIFI

THE ULTIMATE STUDENT MEASURING DEVICE

- For all measuring tasks and subjects in physics, chemistry & biology
- Measure and analyse all in one
- With WiFi to connect to school/university WiFi or set up your own access point
- Large display for high-contrast diagrams
- Measure voltage, current, power, energy and temperature directly with the device - no accessories needed
- Compatible with all CASSY sensors S and M
- Automatic sensor detection
- Fast recording of measured values - up to 500,000 values per second

FLEXIBLE USE - YOU HAVE THE CHOICE:

STANDALONE DEVICE

- Ready-to-use
- Measure and analyse directly on the device

TABLET OR SMARTPHONE

- With WiFi connection
- Experimenting with interactive Lab Docs or
- Measuring and analysis in the CASSY app

PC OR LAPTOP

- Connection via USB or WiFi
- Experimenting with interactive Lab Docs or
- Measuring, analysis and evaluation in CASSY Lab 2 software

WITH WHITEBOARD

- Via the VNC Client or
- Measuring and analysis in the CASSY app or in CASSY Lab 2 software
- Presentation of single measuring results

No digital classroom (yet)?

Digital student experiments can also be carried out exclusively with the Mobile-CASSY 2 WiFi.

The student measuring device can set up a so-called access point. This WiFi network allows then the interaction with tablets or smartphones.

CASSY SENSORS AT A GLANCE

The CASSY sensors M are the ideal completion for LEYBOLD student experiments with the Mobile-CASSY 2 WiFi.

- Affordable sensor family, specially developed for student experiments
- Sensors with several measurement parameters and/or ranges
- Automatic parameter setting
- Immediate measurement with simple set-up
- Range can be continuously expanded with further sensors
- Including over 50 CASSY S Sensors
- Supported by the Lab Docs and the CASSY app


MICROPHONE M
(524 442)


RELAIS M
(524 446)


PH ADAPTER S
(524 0672)


ELECTRO-
CHEMISTRY BOX M
(524 450)


CONDUCTIVITY
ADAPTER S
(524 0671)


GM ADAPTER M
(524 440)


VOLTAGE SENSOR M,
±30 V (524 438)


LUX SENSOR M
(524 444)

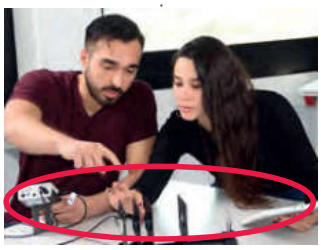

MAGNETIC FIELD SENSOR M,
±100 mT (524 436)


FORCE SENSOR M,
±50 N (524 434)


LIGHT BARRIER M
(524 431)

INTERACTIVY BETWEEN MEASURING TECHNOLOGY AND LAB DOC

Up to three devices (tablet/smartphone/laptop) can be connected to one Mobile-CASSY 2 WiFi (= 1 student group)



Wireless connection

Lab Doc

Once connected to Mobile-CASSY 2 WiFi, the settings for the experiment are transferred (measurement parameters or ranges etc.).

Measurement values are directly put into tables and diagrams of the Lab Doc.

Mobile-CASSY 2 WIFI

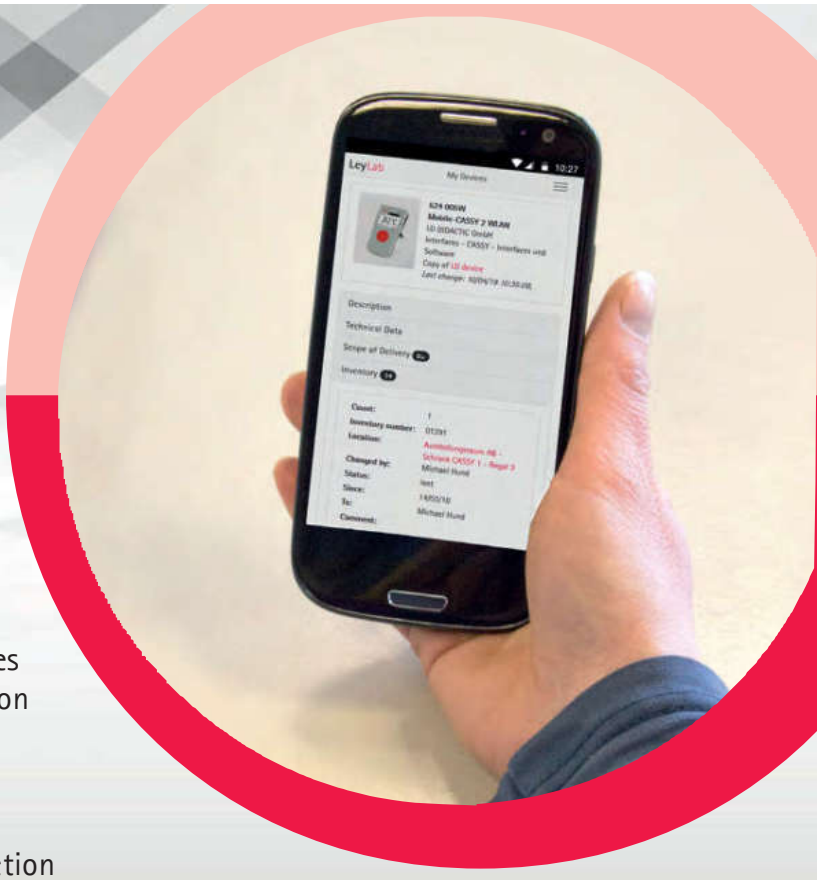
LeyLab - Easy and time-saving organisation and management

LEYLAB

- Complete online portal
- For organisation & management of experiments and devices
- No installation needed
- For all platforms, tablets, smartphones and PC's

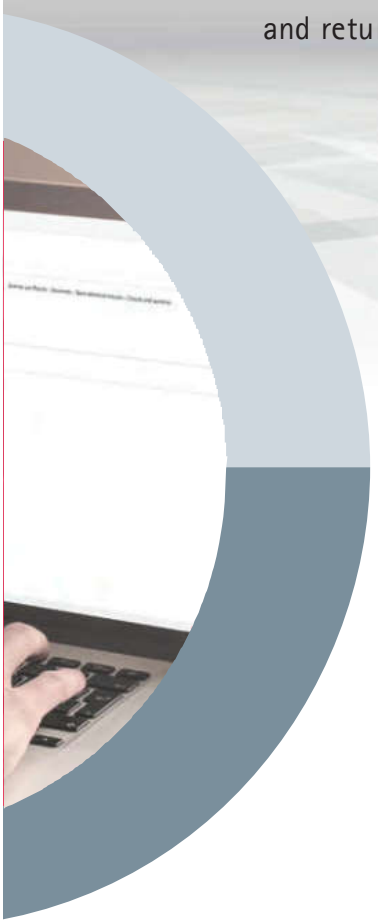
EXPERIMENT COLLECTION

- Anytime and from anywhere access to the whole LD experiments catalogue with all the relevant information for every experiment
- Find desired experiment quickly and reliably
- Set-up own experiment collection
- Easily expand the LD experiments
- Easily create own, new experiments
- Collaborate with colleagues
- Intelligently link devices
- Additional documents are where you need them for the experiment
- Collection of all kinds of documents like PDFs, videos or links to websites or apps; can be shared with students



DEVICE COLLECTION

- Entire inventory at a glance
- Direct overview of all available devices including quantity and storage location
- Save time searching for equipment
- Detailed information on every item
- Easy inventory of the complete collection
  - LD devices and other manufacturers' devices
  - With barcode functionality
- Clear inventory management with borrowing and return function



LICENCE MANAGEMENT

- Manage all LD software and literature in one place
- Licence codes are safely stored in the cloud so they are not lost and can be used to install software on new hardware

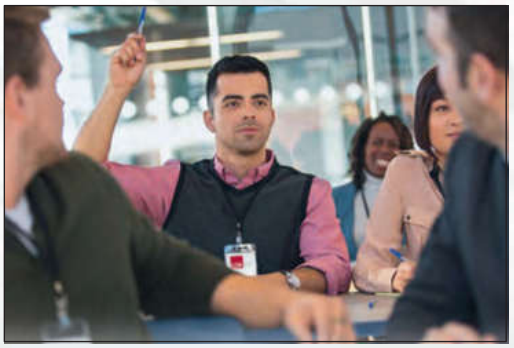
GUEST ACCESS

- Third party access to LeyLab is possible
- Share information with teachers/lecturers from other institutes
- Enables a centralised organisation (e.g. by ministry) of many institutes and therefore a more efficient use of the equipment, documents, etc.

LEYBOLD DIDACTIC ACADEMY

The path to teaching excellence

You get customised training programs to ensure sustainable facilities and resources



- Specialised training programs for teachers, lecturers and trainers
- Methodological, didactic and technical training
- Content and training focus is chosen on requirements
- Practical work is central point, incl. whole process to perform experiments
- Organisation & maintenance of equipment
- Seminar has external parts at well-known schools, universities and institutions
- Insights into German didactic standards and trends
- Comprehensive guides and seminar documentation
- Possibility to achieve qualification to train other teachers, lecturers or trainers

LDA LEYBOLD DIDACTIC ACADEMY

REFERENCE PROJECT MEXICO

The university "Universidad Autónoma del Estado de Hidalgo" achieved a higher educational level for natural science teachers in implementing experiments in natural science classes. The university teachers also obtained sustainable know-how with regard to lab management in order to further educate other school teachers in Mexico.

The seminar took place in the labs at LEYBOLD, the University of Cologne and an extracurricular place of learning.




The LD solution: much more than hardware

We guarantee a repair or replacement solution for at least 10 years after purchase - for the majority of our range even longer.

SEMINAR ON LAB MANAGEMENT AND LAB WORK FOR SUSTAINABLE NATURAL SCIENCE EDUCATION

SOLUTION

6 day seminar for all natural sciences

- Lab management & organisation
- Maintenance of lab equipment
- Lab safety
- Integration of lab work in organisational & content-related learning process
- Data logging
- Theory of natural science didactics and latest trends
- Practical lab work, incl. preparation, set-up, evaluation and documentation of experiments
- Transfer of theoretical content through experiments to students

ADVANTAGES

- Exciting new insights into German & international didactic standards and trends in science education
- Deepened knowledge on lab management and new understanding of work flow processes
- Step-by-step guides to integrate experiments in science classes
- Motivational expertise and inspiration
- High increase of practical lab work experience
- Achieved qualification to train other teachers/lecturer
- International exchange of didactic know-how

Structure of the catalogue

To make it easier for you to use our catalogue, we would like to explain how our catalogue is structured using sample pages.

The structure of the chapters and pages is laid out in the same way throughout as follows:

C PRODUCT PAGES

Subject area and explanation

Highlight experiment

Overview of topics and sets

Highlight experiment

Subject area

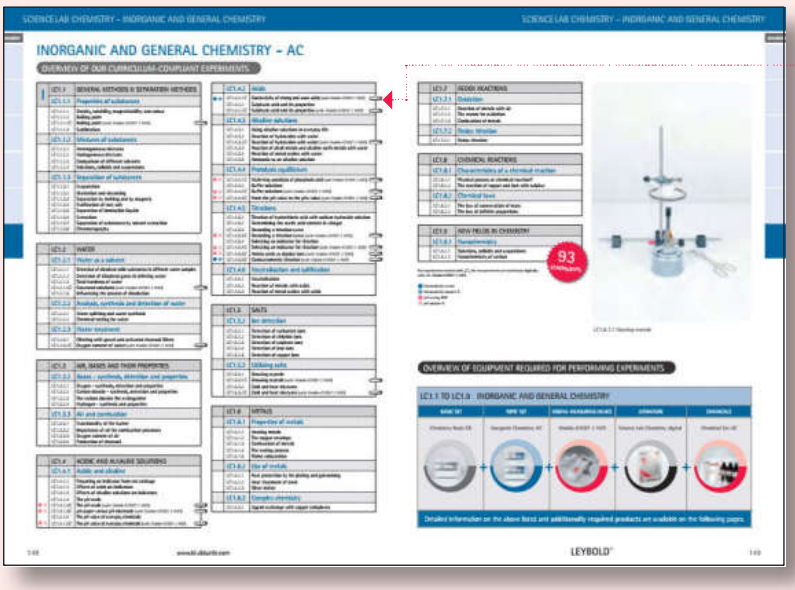
Subject

Chapter

Subchapter

List of all experiments

Marking and explanation of **sensors** *required to perform the experiments.*



Marking of **digital** *experiments, where Mobile-CASSY 2 WiFi is used*

Overview of equipment required for performing experiments

A COMPLETE OVERVIEW OF SUBJECTS

General overview of the individual subject areas as well as a bullet point list of the curriculum-compliant topics.

B BASIC SET EXPLANATION

Description of the basic set which is required for several subject areas.

Detailed information on the individual Science Lab set, incl. scope of delivery, etc.

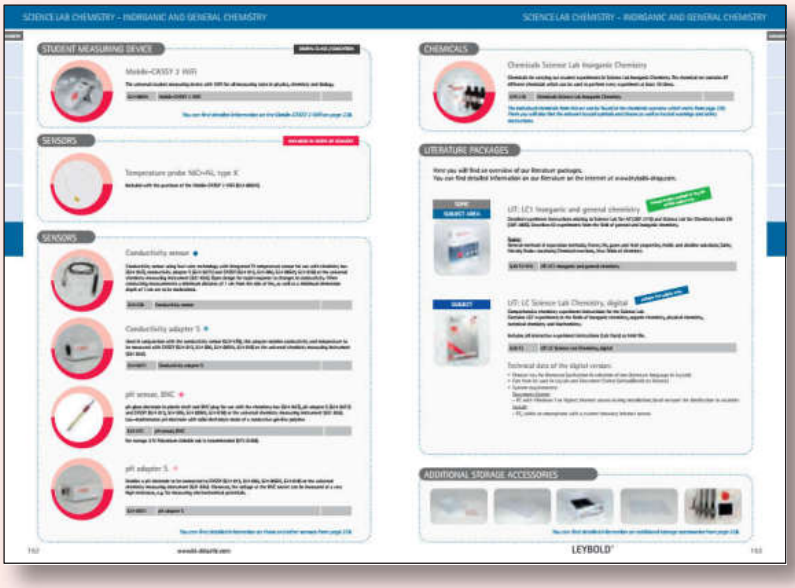
QR code for each Science Lab set (for more information)

Overview of advantages

Overview of additionally required material per student, working group and class/lecture to perform experiments

Student measuring device

Sensors



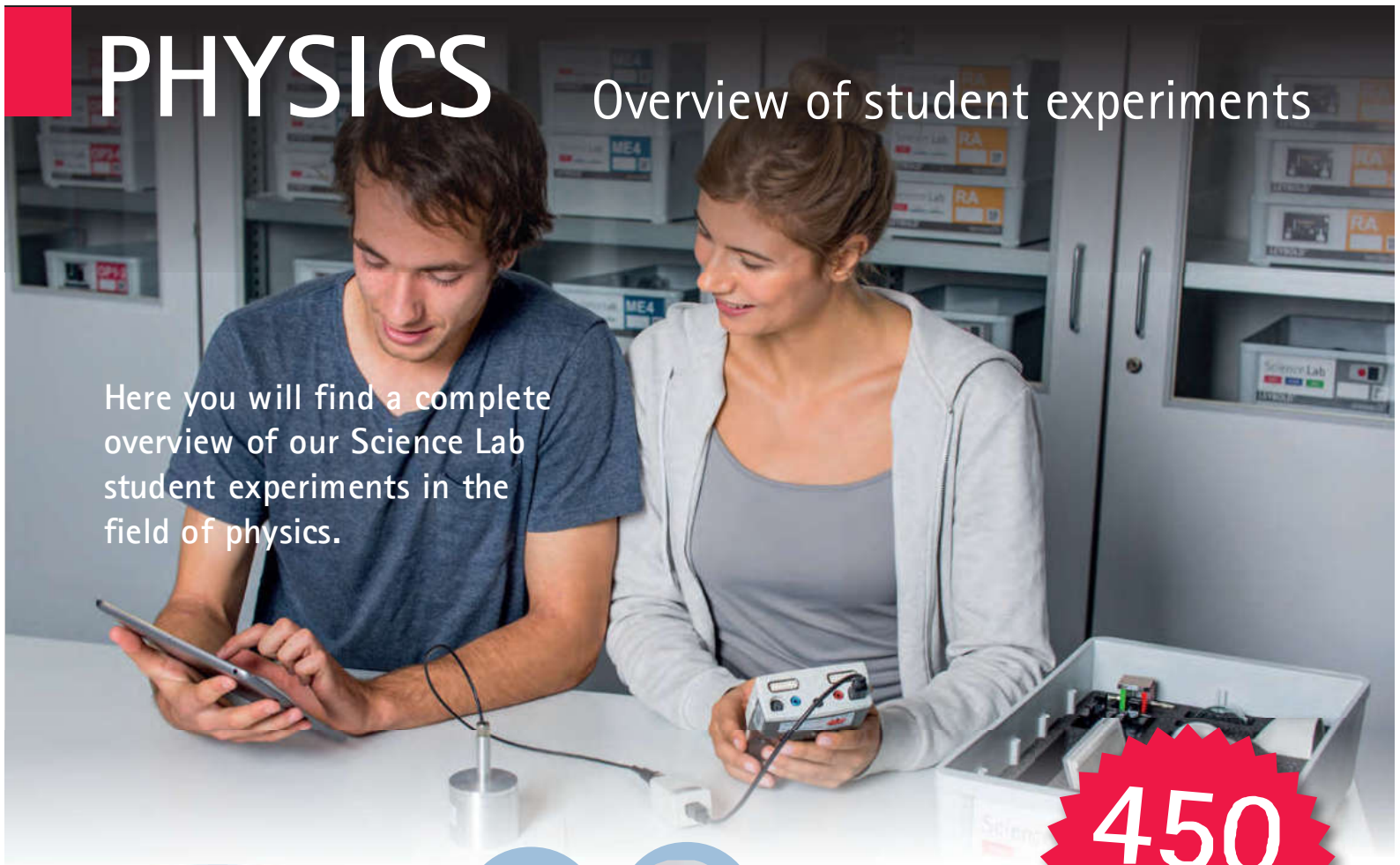
Overview of chemicals

Overview of literature packages

Additional storage accessories

PHYSICS

Overview of student experiments



Here you will find a complete overview of our Science Lab student experiments in the field of physics.

450 EXPERIMENTS IN TOTAL

MECHANICS

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIMENTS	DETAILS FROM
LP1.1	MEASURING METHODS, PROPERTIES OF MATTER AND LIQUID	Measurement of length and time; Measurement of mass and density; Pressure in liquids; Forces acting on bodies in liquids; Forces on the surface of liquids	15	PAGE 26
LP1.2	FORCES, SIMPLE MACHINES AND OSCILLATIONS	Mechanics of solid bodies; Deformation due to a force; Composition and decomposition of forces; Levers; Pulley and inclined plane; Harmonic oscillations; Forces oscillations and standing waves; Superposition of waves	41	PAGE 32
LP1.3	LINEAR MOTION, FREE FALL AND COLLISION EXPERIMENTS	Uniform motion; Uniformly accelerated motion; Newton's laws; Free fall; Experiments on elastic collisions; Experiments on inelastic collisions; Conservation of momentum	20	PAGE 38
LP1.4	ACOUSTICS	Propagation of sound; Oscillations and sounds; Noise analysis; Resonance and beating; Speed of sound	21	PAGE 44

ENERGY

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIMENTS	DETAILS FROM
LP2.1	HEAT	Expansion of heat; Heat transfer; Thermal insulation; Heat capacities; Aggregation states and transitions	36	PAGE 52
LP2.2	RENEWABLE ENERGIES	Solar energy; Wind energy; Peltier effect; Energy storage; Energy conversion and efficiency	29	PAGE 58
LP2.3	FUEL CELLS	Reversible PEM fuel cell; The electrolyser; The fuell cell	20	PAGE 64

ELECTRICITY

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIMENTS	DETAILS FROM
LP3.1	ELECTROSTATICS	Contact electricity; Forces acting between charges; Electrostatic induction; Charge storage; Electrostatic interaction; Insulators and conductors; Equipotential lines; Plate capacitor	25	PAGE 72
LP3.2	MAGNETISM	Magnetic forces and fields; Magnetic induction; Magnetic fields	12	PAGE 78
LP3.3	BASIC ELECTRICAL CIRCUITS AND ELECTROCHEMISTRY	Electrical circuits and switches; Electrical measurement methods; Ohmic resistance; Special resistors; Voltage sources; Electrical application circuits; Electrochemistry	40	PAGE 84
LP3.4	ELECTROMAGNETISM AND INDUCTION	Electromagnetism; Electromagnetism applications; Induction; Transformers; Applications of induction; Coils in direct and alternating current circuits	21	PAGE 90
LP3.5	MOTORS AND GENERATORS	Generators; Electric motors	14	PAGE 96

ELECTRONICS

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIMENTS	DETAILS FROM
LP4.1	BASIC ELECTRONICS CIRCUITS	Capacitors; Relay circuits; Diodes; Transistors; Diode circuits; Flip-flops; Amplifier circuits; Solar cells	42	PAGE 102

OPTICS

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIMENTS	DETAILS FROM
LP5.1	RAY OPTICS AND GEOMETRICAL OPTICS	Propagaton of light and shadow formation; Light and shadow in nature; Reflection in mirrors; Light refraction; Dispersing light and recombination of the spectrum; Lenses and lens aberrations; Optical instruments for angular magnification; Optical instruments and the eye	46	PAGE 110
LP5.2	CHROMATICS	Examination of the light paths through a prism; Spectral colours; Colour mixing	11	PAGE 116
LP5.3	WAVE OPTICS	Diffraction on diffraction objects; Diffraction on complementary apertures	7	PAGE 122
LP5.4	POLARISATION	Polarisation filters; Photoelastic double refraction; Polarisation due to reflection and diffraction; Polarisation due to scattering; Optical activity	8	PAGE 128

ATOMIC AND NUCLEAR PHYSICS

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIMENTS	DETAILS FROM
LP6.2	ENVIRONMENTAL RADIOACTIVITY	Introduction to radioactivity; Investigating the influence of sample properties and the size of the measurement window; Environmental radioactivity; Statistics of radioactive decay; Radiation shielding; Distance; Investigating the radiation in a magnetic field; Half-life	42	PAGE 136

Science Lab

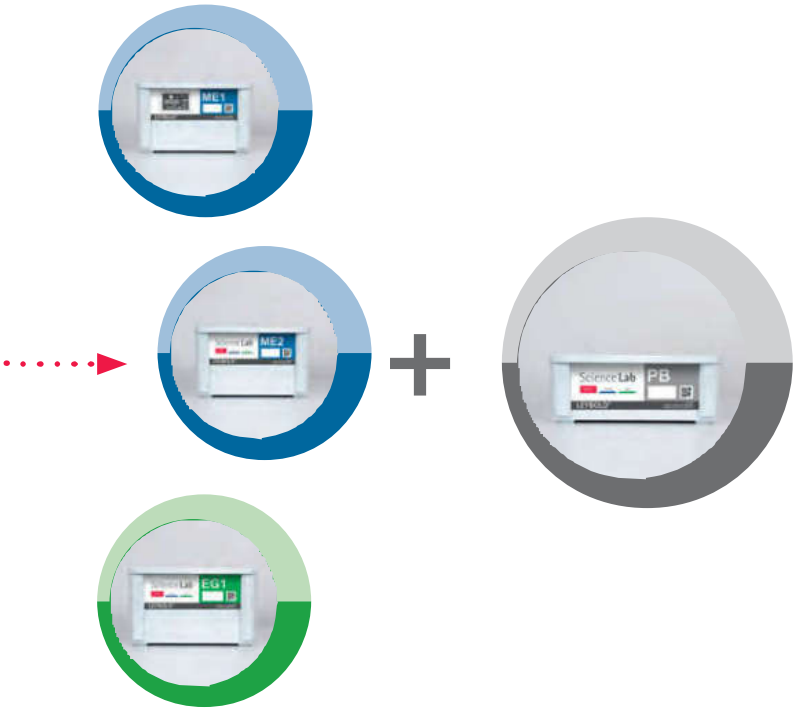
Physics Basic PB (207 100S)

BASIC SET FOR OUR INNOVATIVE STUDENT EXPERIMENT SYSTEM FOR PHYSICS

- This Basic Set contains **the basic devices** which are regularly needed for student experiments in physics.
- Each device has its own specified space in the pre-formed storage tray.
- In combination with the experiment set ME1 (207 111S) students can perform 15 experiments; with the experiment set ME2 (207 112S) 41 experiments and with the set EG1 (207 121S) 36 experiments can be realised.
- One Basic Set for the fields of mechanics and energy in physics and a maximum of two trays on the student workstation.

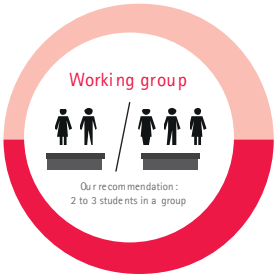
ADVANTAGES

- The Basic Set contains the material required for **one work group** consisting of 2-3 students.
- Experiments from the Science Lab Physics can then be carried out with only one additional set, depending on the topic.
- Same devices = always the same handling: no need to re-learn devices for every topic.



Science Lab Physics Basic PB (Set)

Student experiment set of the student experiment system Science Lab in the field of physics.
Basic equipment for mechanics and energy experiments. Set-up material for one working group in pre-formed tray.
The individual trays are stackable and can optionally be closed with a lid (647 003) .
The equipment set Science Lab Physics Basic PB, in combination with the Mechanics Sets ME1 (207 111S), ME2 (207 112S) and the Energy Set EG1 (207 121S), enables the performance of experiments at school, college and university level for worldwide curriculums.



Scope of delivery:

Count	Name
1	Bosshead S
2	Stand base MF
2	Support block
1	Stand rod 25 cm, 10 mm Ø
2	Stand rod 40 cm, 10 mm Ø
1	Pointer, pair
1	Universal pencil
1	Tape measure 2 m / 1 mm
1	Dynamometer, tension and compression, 1.5 N
3	Support clip, for plugging in
6	Weight, 50 g
1	Leaf spring 370 mm
1	Aluminium block
1	Tray, low
1	Universal bosshead
1	Scissors 125 mm, round-ended
1	Metal plate
1	Cord
1	Stopwatch, digital
207 100S	Science Lab Physics Basic PB (Set)

Additionally required:

Count	Cat.-No.	Name
1	207 111S	Science Lab Mechanics ME1 (Set)
1	207 112S*	Science Lab Mechanics ME2 (Set)
1	207 121S*	Science Lab Energy EG1 (Set)

* alternative

Additionally recommended:

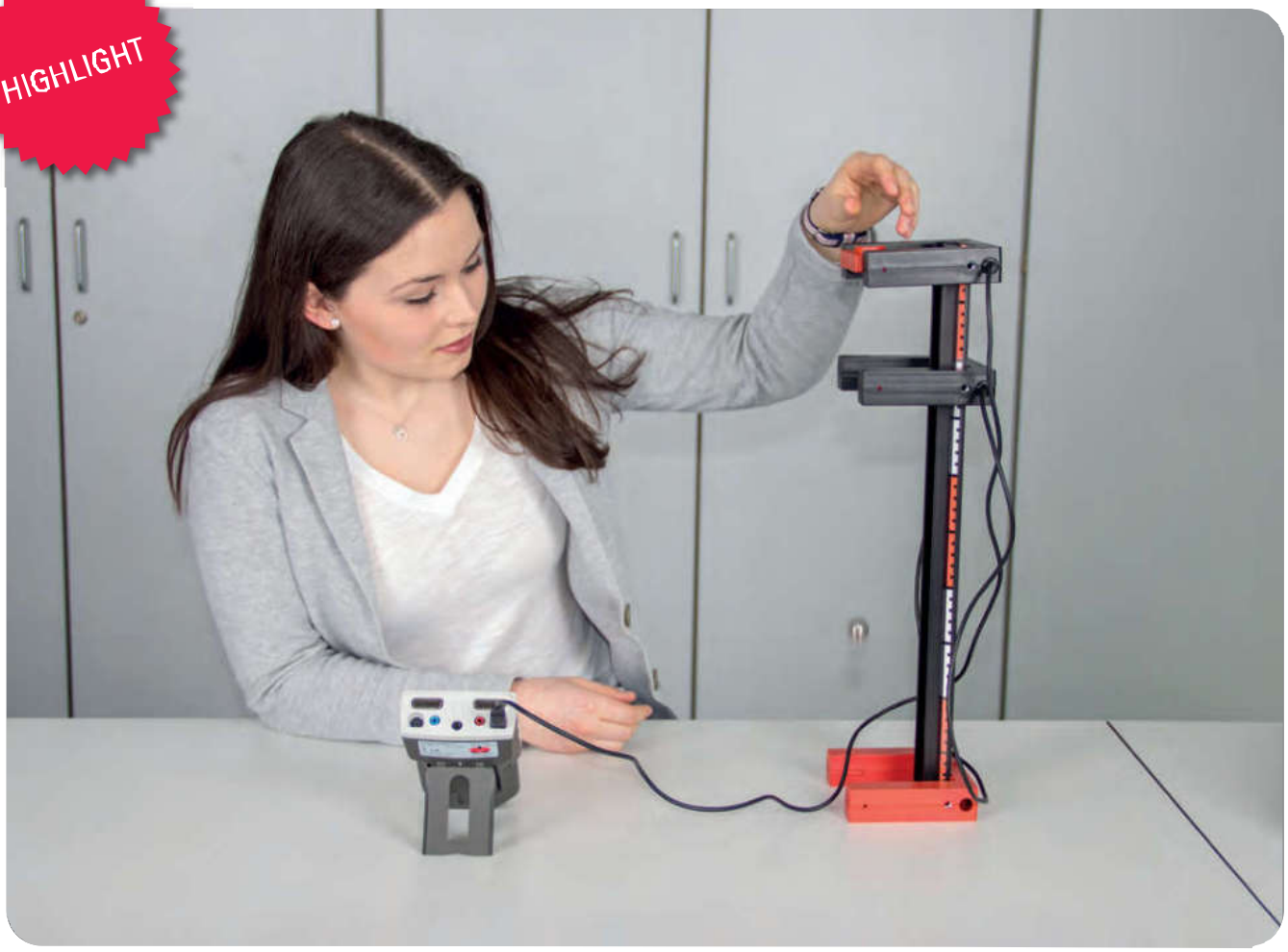
Count	Cat.-No.	Name
1	647 003	Lid for tray

MECHANICS

Every physical variable also has a unit. To make students aware of this, the Science Lab for *Mechanics* starts with some very basic experiments on the topic of length and density. This also gives students the opportunity to concentrate completely on the description of the experiment protocol. Forces and oscillations as well as linear motion are included under the topic of mechanics. Here, time differences and velocities can be measured with the help of two light barriers. The topic of acoustics completes the mechanics section. From analysing noises to measuring the speed of sound - there is something for every age group.

One Basic Set and four Mechanics Sets provide *four* topic areas with 97 experiments. This perfect combination of experiments is suitable for perceivable experiments as well as for digital analysis with the Mobile-CASSY 2 WiFi and different sensors. For fast-working students additional tasks are available.

HIGHLIGHT



LP1.3.4.1C Determining the acceleration of gravity by plotting a *s*(t) diagram

Objects fall down when dropped. The gravitational acceleration involved can be measured in this experiment.
For this experiment you will need the set **Science Lab Mechanics ME3 (207 113S)**.

Overview of topics and sets

EXPERIMENT TOPICS		REQUIRED SETS	NO. EXPERIMENTS	DETAILS
LP1.1	**MEASURING METHODS, PROPERTIES OF MATTER AND LIQUID**			
LP1.1.1	MEASUREMENT OF LENGTH AND TIME	Basic PB + Mechanics ME1  207 100S 207 111S	15	PAGE 26
LP1.1.2	MEASUREMENT OF MASS AND DENSITY			
LP1.1.3	PRESSURE IN LIQUIDS			
LP1.1.4	FORCES ACTING ON BODIES IN LIQUIDS			
LP1.1.5	FORCES ON THE SURFACE OF FLUIDS			
LP1.2	**FORCES, SIMPLE MACHINES AND OSCILLATIONS**			
LP 1.2.1	MECHANICS OF SOLID BODIES	Basic PB + Mechanics ME2  207 100S 207 112S	41	PAGE 32
LP 1.2.2	DEFORMATION DUE TO A FORCE			
LP 1.2.3	COMPOSITION AND DECOMPOSITION OF FORCES			
LP 1.2.4	LEVERS			
LP 1.2.5	PULLEY AND INCLINED PLANE			
LP 1.2.6	HARMONIC OSCILLATIONS			
LP 1.2.7	FORCED OSCILLATIONS AND STANDING WAVES			
LP 1.2.8	SUPERPOSITION OF WAVES			
LP1.3	**LINEAR MOTION, FREE FALL AND COLLISION EXPERIMENTS**			
LP 1.3.1	UNIFORM MOTION	Mechanics ME3  207 113S	20	PAGE 38
LP 1.3.2	UNIFORMLY ACCELERATED MOTION			
LP 1.3.3	NEWTON'S LAWS			
LP 1.3.4	FREE FALL			
LP 1.3.5	EXPERIMENTS ON ELASTIC COLLISIONS			
LP 1.3.6	EXPERIMENTS ON INELASTIC COLLISIONS			
LP 1.3.7	CONSERVATION OF MOMENTUM			
LP1.4	**ACOUSTICS**			
LP 1.4.1	PROPAGATION OF SOUND	Mechanics ME4  207 114S	21	PAGE 44
LP 1.4.2	OSCILLATIONS AND SOUNDS			
LP 1.4.3	NOISE ANALYSIS			
LP 1.4.4	RESONANCE AND BEATING			
LP 1.4.5	SPEED OF SOUND			

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

MECHANICS - ME1

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors		
	LP1.1	**MEASURING METHODS, PROPERTIES OF MATTER & LIQUID**
	LP1.1.1	Measurement of length and time
	LP1.1.1.1	Length measurement
	LP1.1.1.2	Calculating the volume of regularly shaped bodies
	LP1.1.1.3	Time measurement
	LP1.1.2	Measurement of mass and density
	LP1.1.2.1	Determining the density of regularly shaped bodies
	LP1.1.2.2	Determining the density of irregularly shaped bodies
	LP1.1.2.3	Determining the density of liquids
	LP1.1.3	Pressure in liquids
	LP1.1.3.1	Connected vessels
	LP1.1.3.2	Hydrostatic pressure
	LP1.1.3.3	The effects of air pressure
	LP1.1.4	Forces acting on bodies in liquids
	LP1.1.4.1	Buoyancy force as a function of depth of immersion and body mass
	LP1.1.4.2	Buoyancy force as a function of the density of a fluid
	LP1.1.4.3	Archimedes' principle
●	LP1.1.4.3C	Archimedes' principle (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.1.4.4	Sinking - floating suspended in a liquid - floating on a liquid
	LP1.1.5	Forces on the surface of fluids
	LP1.1.5.1	Capillary action

15 EXPERIMENTS

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

● Force sensor M, ±50 N

LP1.1.4.3 Archimedes' principle

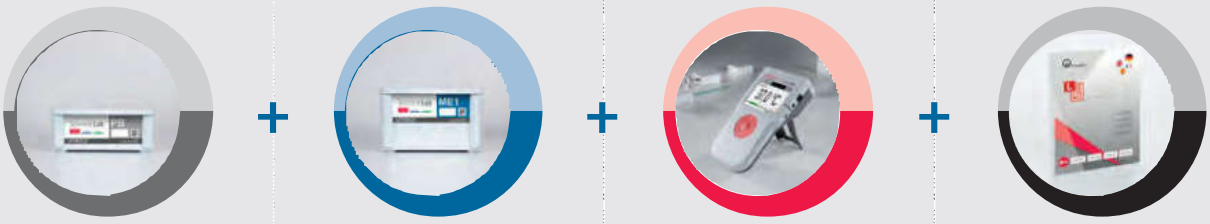
LP1.1.3.2 Hydrostatic pressure

Students use a U-tube manometer and a pressure probe to detect that hydrostatic pressure is increasing in proportion to depth.
For this experiment you will need the sets **Science Lab Physics Basic PB (207 100S)** and **Science Lab Mechanics ME1 (207 111S)**.

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP1.1 MEASURING METHODS, PROPERTIES OF MATTER AND LIQUID

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Physics Basic PB	Mechanics ME1	Mobile-CASSY 2 WiFi	Science Lab Mechanics digital



Detailed information on the above listed and **additionally required equipment** is available on the following pages.

Science Lab Mechanics ME1 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray.
With the equipment set ME1, together with the Science Lab Physics Basic PB (207 100S), 15 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics measuring methods, properties of matter and liquids. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Funnel PE 40 mm Ø
1	Vernier callipers
1	Rubber rings, set of 8
1	Double pipe support
2	Transparent tube with 2 caps
1	Pressure probe
1	Steel balls in can
1	Capillary apparatus
1	Measuring cylinder 100 ml
1	Tray, high

Count	Name
1	Beaker, PP, 250 ml, squat
1	Petri dish 60 mm
1	Connector, straight, 6/8 mm Ø
1	Plastic tube 240 x 25 mm Ø
1	Universal clamp 0...80 mm
1	Silicone tubing 7 mm Ø, 1 m
1	Rubber stopper with hole, 17...23 mm Ø
1	Rubber stopper solid, 19...24 mm Ø
1	Round tin with cap
207 111S	Science Lab Mechanics ME1 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 100S	Science Lab Physics Basic PB (Set)	
1	315 234	Electronic balance MAULtronic S	Measurement of mass and density experiments (LP1.1.2)
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	524 434	Force sensor M, ±50 N	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 711	LIT: LP1 Science Lab Mechanics, digital	

OVERVIEW OF ADVANTAGES

- Students learn about units of measurement
- Simple calculations to determine densities
- Includes a "pressure probe" for measuring the hydrostatic pressure
- Devices can be combined to perform many different experiments
- Acquired skills: writing experiment protocols; differentiation between observation, measurement and evaluation

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

Force sensor M, ±50 N

For measuring force components up to ±50 N (e.g. spring pendulum or centrifugal force components) with Mobile-CASSY 2 WiFi (524 005W). Its rigid design enables the measurement of force components in any position of the force sensor.

524 434	Force sensor M, ±50 N

You can find detailed information on this and other sensors from page 229.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP1.1 Measuring methods, properties of matter & liquids

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set ME1 (207 111S) and Science Lab Physics Basic PB (207 100S). Describes 15 experiments from the fields of measuring methods, properties of matter and liquids.

Topics:
Measurement of length and time; Measurement of mass and density; Pressure in liquids; Forces acting on bodies in liquids; Forces on the surface of liquids

520 7111EN	LIT: LP1.1 Measuring methods, properties of matter & liquids	

SUBJECT AREA

LIT: LP1 Science Lab Mechanics, digital

Includes only ONE subject area

Comprehensive physics experiment instructions in the field of mechanics for the Science Lab.
Contains 97 experiments on measuring methods, properties of matter and liquid; forces, simple machines and oscillations; linear motion, free fall and collisions experiments; acoustics.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 711	LIT: LP1 Science Lab Mechanics, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

Includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

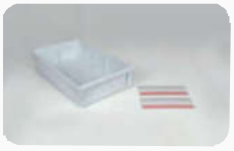
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





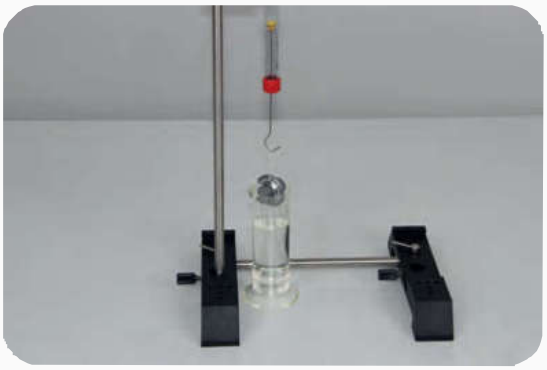
You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

Introducing physical variables

IMPRESSIVELY ILLUSTRATED IN EXPERIMENTS

- Comprehensible introduction to the first physical variables
- Effective experiments which quickly teach content-related skills and make students enthusiastic about physics classes/lectures
- Creates links between "weighing" as an everyday experience with physics-related questions of "gravitational force"



SAFE AND EASY TO UNDERSTAND

- Easy-to-use devices
- Manageable number of devices
- Quick set-up

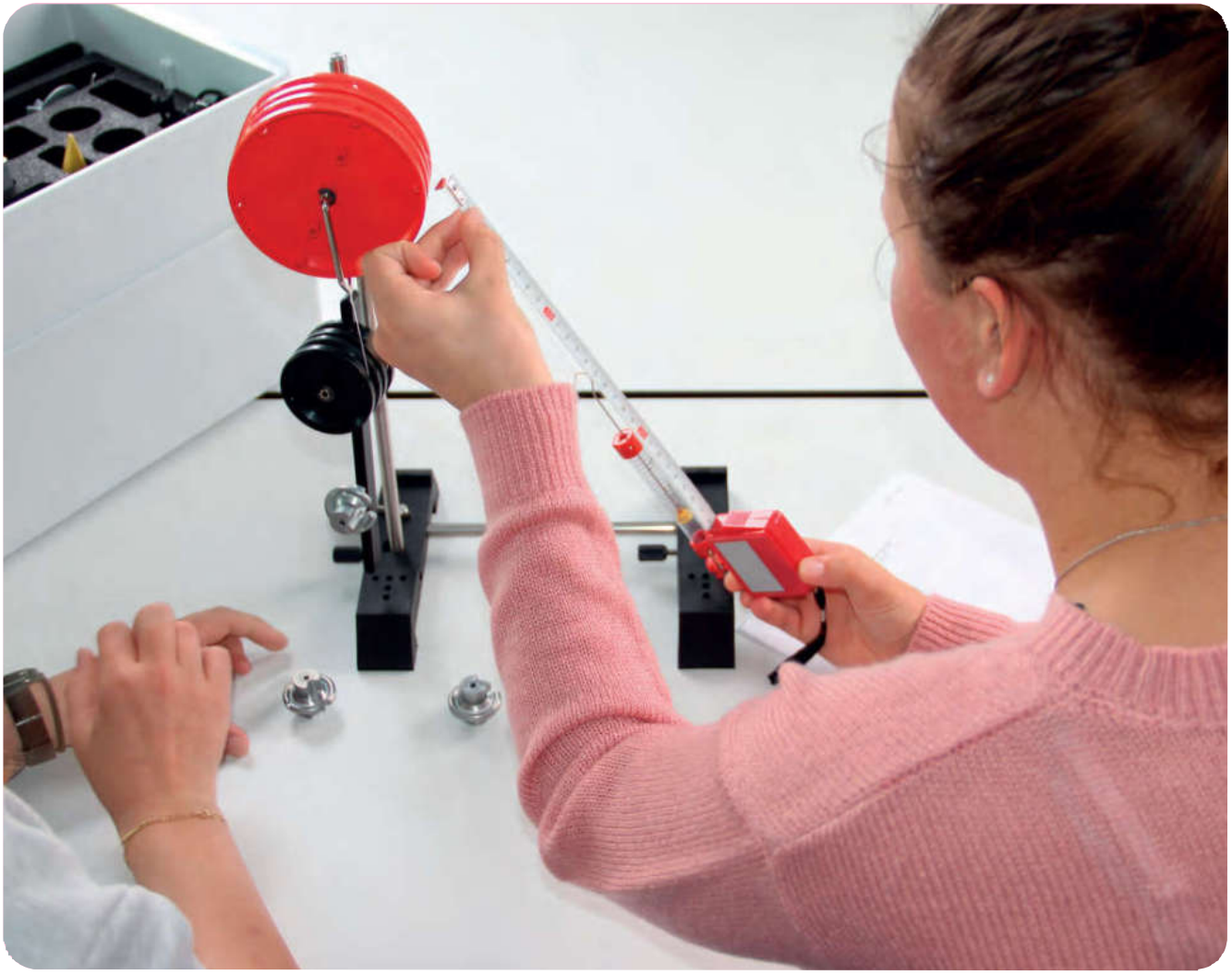
MECHANICS – ME2

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors		
	LP1.2	**FORCES, SIMPLE MACHINES AND OSCILLATIONS**
	LP1.2.1	Mechanics of solid bodies
	LP1.2.1.1	Types of friction generated by solid bodies
	LP1.2.1.2	Sliding friction (quantitative)
	LP1.2.1.3	Centre of gravity
	LP1.2.1.4	Stability
	LP1.2.2	Deformation due to a force
	LP1.2.2.1	Elongation of a helical spring (Hooke's law)
	LP1.2.2.2	Elongation of a rubber ring
	LP1.2.2.3	Deflection of a leaf spring
	LP1.2.3	Composition and decomposition of forces
	LP1.2.3.1	Composition of forces in the same or opposing directions
	LP1.2.3.2	Composition of forces in specified amounts
	LP1.2.3.3	Decomposition of a force into force components
	LP1.2.4	Levers
	LP1.2.4.1	Two-sided lever
	LP1.2.4.2	Two-sided lever with several forces acting upon it
	LP1.2.4.3	Beam balance
	LP1.2.4.4	One-sided lever
	LP1.2.4.5	Shaft-mounted wheel
	LP1.2.4.6	Belt-driven gear
	LP1.2.5	Pulley and inclined plane
	LP1.2.5.1	Fixed pulley
	LP1.2.5.2	Movable pulley
	LP1.2.5.3	Hoist with two pulleys
	LP1.2.5.4	Block and tackle 1 (open type)
●	LP1.2.5.4C	Block and tackle 1 (open type) (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.2.5.5	Block and tackle 2 (compact type)
●	LP1.2.5.5C	Block and tackle 2 (compact type) (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.2.5.6	Forces on an inclined plane
●	LP1.2.5.6C	Forces on an inclined plane (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.2.5.7	Work on an inclined plane
●	LP1.2.5.7C	Work on an inclined plane (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.2.5.8	Conversion of energy
	LP1.2.6	Harmonic oscillations
	LP1.2.6.1	Thread pendulum (mathematical pendulum)
●	LP1.2.6.1C	Thread pendulum (mathematical pendulum) (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.2.6.2	Rod pendulum (physical pendulum)
●	LP1.2.6.2C	Rod pendulum (physical pendulum) (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.2.6.3	Helical spring pendulum
●	LP1.2.6.3C	Helical spring pendulum (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.2.6.4	Oscillation patterns
	LP1.2.7	Forced oscillations and standing waves
	LP1.2.7.1	Forced oscillations of pendulums
	LP1.2.7.2	Oscillations on a mechanically coupled rod pendulum
	LP1.2.7.2C	Oscillations on a mechanically coupled rod pendulum (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.2.7.3	Frequencies of standing thread waves
	LP1.2.7.4	Standing helical spring waves – nodes and anti-nodes as a function of the excitation frequency
	LP1.2.8	Superposition of waves
	LP1.2.8.1	Superposition of waves of the same frequency

41 EXPERIMENTS

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi. ● Force sensor M, ±50 N ● Light barrier M

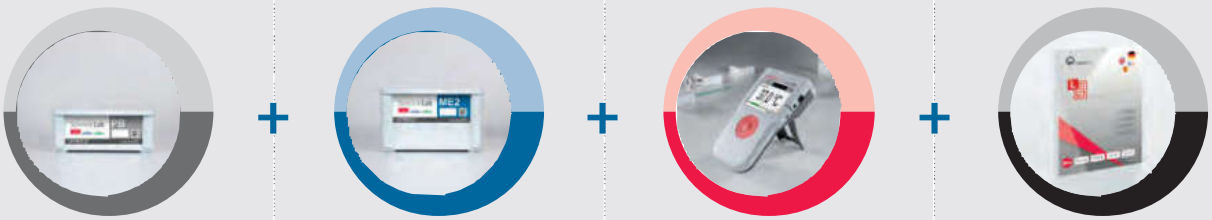


LP1.2.5.5 Block and tackle 2 (compact type)

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP1.2 FORCES, SIMPLE MACHINES AND OSCILLATIONS

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Physics Basic PB	Mechanics ME2	Mobile-CASSY 2 WiFi	Science Lab Mechanics digital



Detailed information on the above listed and **additionally required equipment** is available on the following pages.

Science Lab Mechanics ME2 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray.
With the equipment set ME2, together with the Science Lab Physics Basic PB (207 100S), 41 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics forces, simple machines and oscillations. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Dynamometers, tension and compression, 3 N
1	Plug-in axle
1	Double scale
1	Lever 37.5 cm
1	Load hook
1	Coupling plug 4 mm
1	Rubber rings, set of 8
2	Pulley Ø 50 mm, plug-in
2	Pulley Ø 100 mm, plug-in
2	Pulley bridge

Count	Name
2	Balance pan with stirrup
2	Bar pendulum 31.5 cm
1	Clamping block for pendulums
1	Helical spring 10 N/m
1	Helical spring 25 N/m
1	Set of weights 1 g to 50 g
1	Tray, high
1	Rubber cords 3 m

207 112S	Science Lab Mechanics ME2 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 100S	Science Lab Physics Basic PB (Set)	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
2	524 431	Light barrier M	
1	524 434	Force sensor M, ±50 N	
1	501 45	Connecting lead 19 A, 50 cm, red/blue, pair	
1	522 621	Function generator S 12	Forced oscillations and standing waves experiments (LP1.2.7)
1	579 42	Motor with rocker, STE 2/19	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 711	LIT: LP1 Science Lab Mechanics, digital	

OVERVIEW OF ADVANTAGES

- The term "lever" is illustrated with the help of a beam scale
- Versatile assembly options with our rollers: from fixed rollers to pulleys and gear units
- Experiments with manual induction of vibrations are equally possible as with controlled frequency (using an additional motor)
- Acquired skills: setting up more complex experiments

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

Force sensor M, ±50 N ●

For measuring force components up to ± 50 N (e.g. spring pendulum or centrifugal force components) with Mobile-CASSY 2 WiFi (524 005W). Its rigid design enables the measurement of force components in any position of the force sensor.

524 434	Force sensor M, ±50 N

Light barrier M ●

Cascadable photoelectric barrier for measuring period durations, travelling time, paths and velocities on the student track or during free fall with Mobile-CASSY 2 WiFi (524 005W).

524 431	Light barrier M	

You can find detailed information on these and other sensors from page 229.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP1.2 Forces, simple machines and oscillations

Printed version available in may file

Detailed experiment instructions relating to Science Lab Set ME2 (207 112S) and Science Lab Physics Basic PB (207 100S). Describes 41 experiments from the fields of forces, simple machines and oscillations.

Topics:
Mechanics of solid bodies; Deformation due to a force; Composition and decomposition of forces; Levers; Pulley and inclined plane; Harmonic oscillations; Forced oscillations and standing waves; Superposition of waves

520 7112EN	LIT: LP1.2 Forces, simple machines and oscillations	

SUBJECT AREA

LIT: LP1 Science Lab Mechanics, digital

Includes only ONE subject area

Comprehensive physics experiment instructions in the field of mechanics for the Science Lab.
Contains 97 experiments on measuring methods, properties of matter and liquid; forces, simple machines and oscillations; linear motion, free fall and collisions experiments; acoustics.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 711	LIT: LP1 Science Lab Mechanics, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

Includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

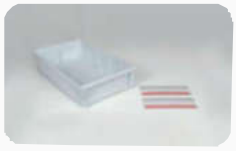
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





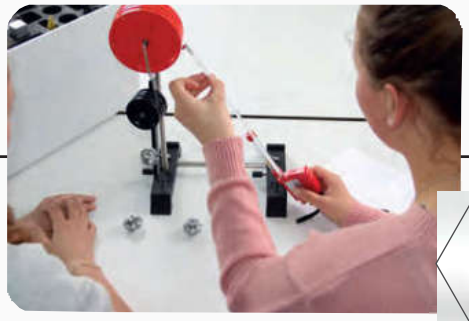
You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

The fantastic four

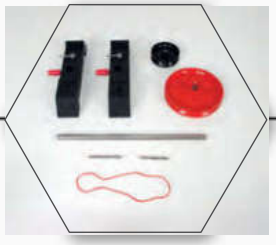
JUST A FEW STEPS TO EXCITING EXPERIMENTS

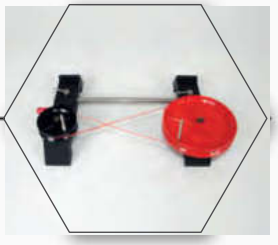
BLOCK & TACKLE



LOOSE PULLEY

BELT DRIVE





INCLINED PLANE

The pulley is also used in student experiments on electricity.

MECHANICS – ME3

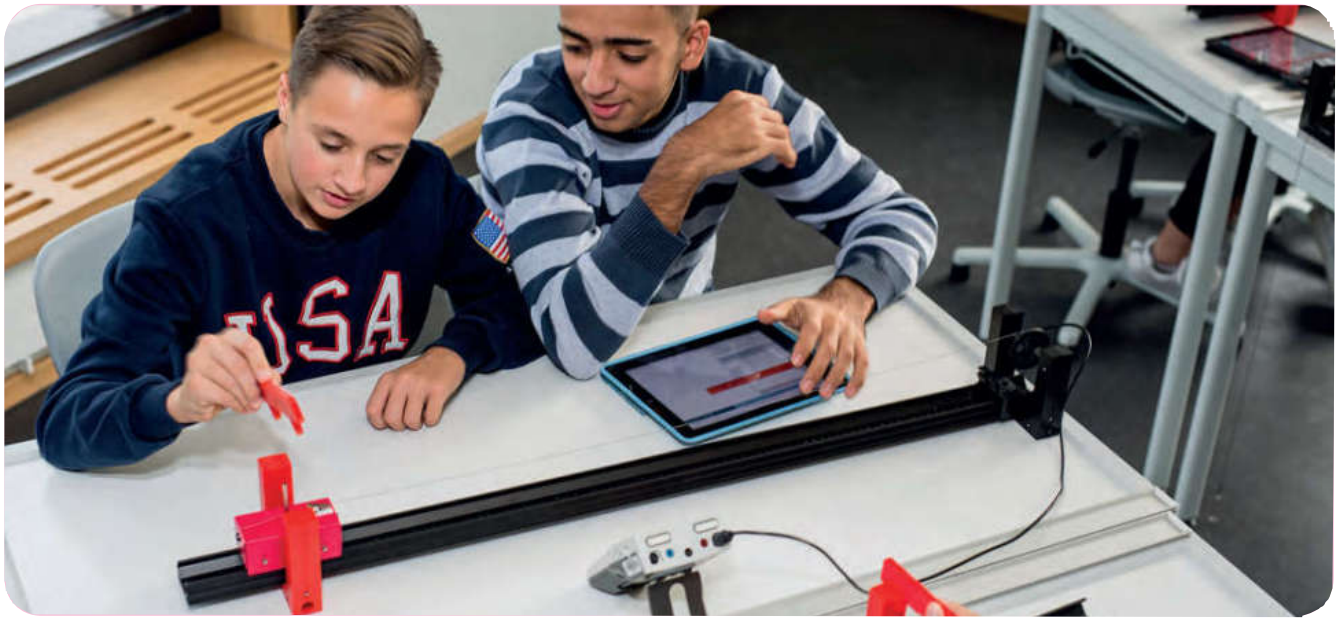
OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors		
	LP1.3	**LINEAR MOTION, FREE FALL AND COLLISION EXPERIMENTS**
	LP1.3.1	Uniform motion
●	LP1.3.1.1C	Relation between distance and time (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.1.2C	Effect of friction - measurement of speeds (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.3.2	Uniformly accelerated motion
●	LP1.3.2.1C	Relation between distance and time (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.2.2C	Instantaneous speed (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.2.3C	Uniformly accelerated motion using a spoked wheel (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.2.4C	Relation between velocity and time (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.3.3	Newton's laws
●	LP1.3.3.1C	Relation between force and acceleration (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.3.2C	Relation between mass and acceleration (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.3.4	Free fall
●	LP1.3.4.1C	Determining the acceleration of gravity by plotting a $s(t)$ diagram (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.4.2C	Determining the acceleration of gravity by plotting a $v(t)$ diagram (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.3.5	Experiments on elastic collisions
●	LP1.3.5.1C	Elastic collisions between two moving trolleys of equal mass (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.5.2C	Elastic collisions between moving and stationary trolleys of equal mass (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.5.3C	Elastic collisions between moving and stationary trolleys ($m_1 < m_2$) (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.5.4C	Elastic collisions between moving and stationary trolleys ($m_1 > m_2$) (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.3.6	Experiments on inelastic collisions
●	LP1.3.6.1C	Inelastic collisions between two moving trolleys of equal mass (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.6.2C	Inelastic collisions between moving and stationary trolleys of equal mass (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.6.3C	Inelastic collisions between moving and stationary trolleys ($m_1 < m_2$) (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.6.4C	Inelastic collisions between moving and stationary trolleys ($m_1 > m_2$) (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.3.7	Conservation of momentum
●	LP1.3.7.1C	Explosive collisions in the case of trolleys of equal mass (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.3.7.2C	Explosive collisions in the case of trolleys of different mass (with Mobile-CASSY 2 WiFi) DIGITAL

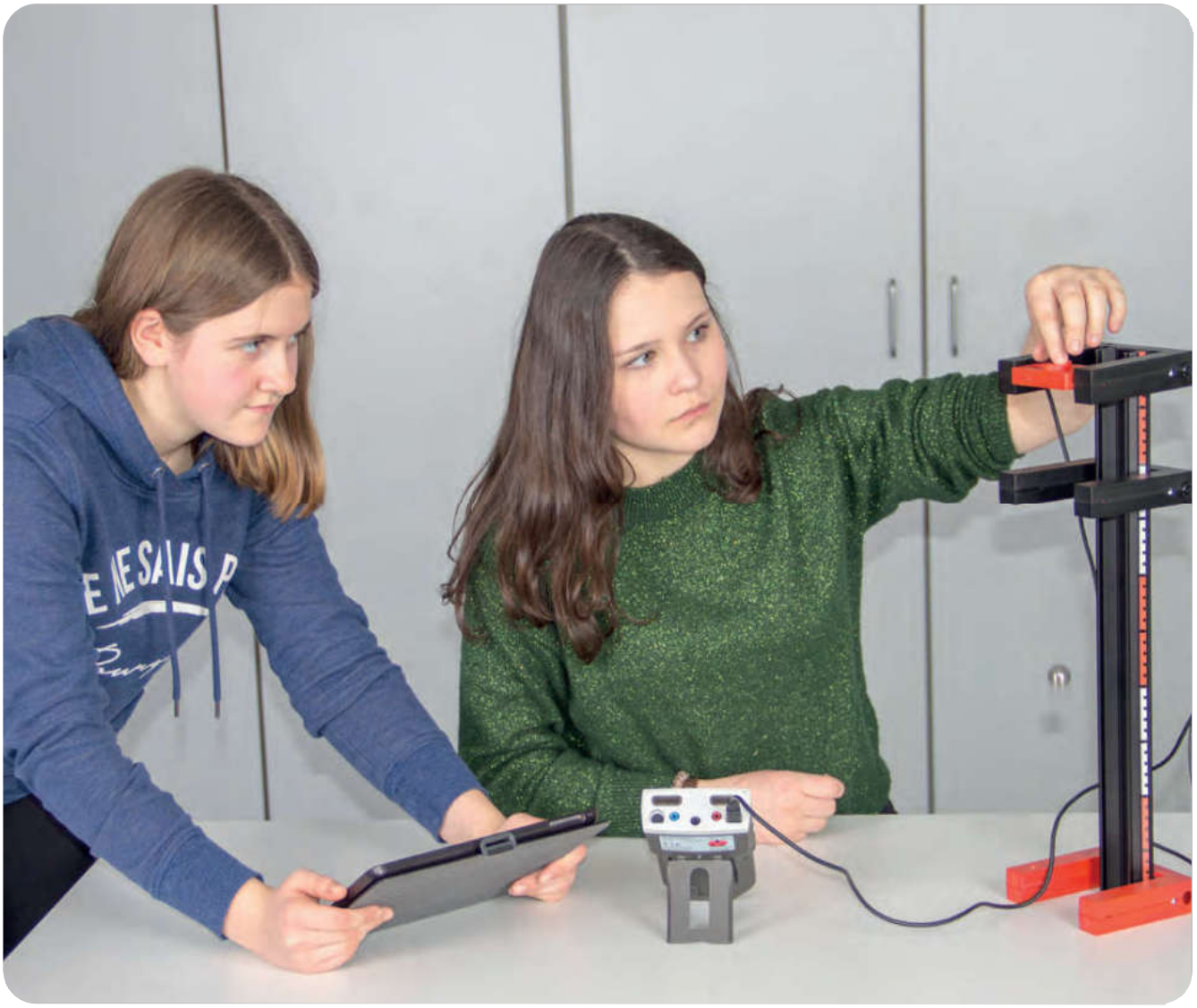
20 EXPERIMENTS

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

● Light barrier M



LP1.3.2.3C Uniformly accelerated motion using a spoked wheel



LP1.3.4.1C Determining the acceleration of gravity by plotting a s(t) diagram

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP1.3 LINEAR MOTION, FREE FALL AND COLLISION EXPERIMENTS

TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Mechanics ME3	Mobile-CASSY 2 WiFi	Science Lab Mechanics digital
		

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Mechanics ME3 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray. With the equipment set ME3, together with the Mobile-CASSY 2 WiFi (524 005W), 20 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics dynamic and motion. While working out the curriculum required topics, they are also trained in communication and assessment skills. And the combination with the Mobile-CASSY 2 WiFi (524 005W) enables the students to learn digitally.

Scope of delivery:

Count	Name
1	Fishing line
1 out of	Plasticine
1	Trolley
1	Spring and buffer
1	Driving weights, set
1	Additional weight 100 g
1	Additional weight 50 g
1	Steel ball 20 mm
2	Clamp rider

Count	Name
2	Light barrier M
1	Light barrier housing
1	Spoked wheel
1	Start jig, trolley
1	Start jig, ball
1	Tray, low
1	Extension pin

207 113S	Science Lab Mechanics ME3 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	460 81	Precision metal rail, 100 cm	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	337 00	Trolley	Collision experiments (LP1.3.5, LP1.3.6, LP1.3.7)

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 711	LIT: LP1 Science Lab Mechanics, digital	

Additionally recommended per working group

Count	Cat.-No.	Name	Description
1	460 82	Precision metal rail, 50 cm	

OVERVIEW OF ADVANTAGES

- Light barrier with flexible mounting, e.g. for spoke wheel or start release (very precise switching due to small opening)
- Cascadable light barriers are included in the set
- Experiments in horizontal construction (Movements on a track) and in vertical construction (Free fall) possible
- Light precision metal rail is easy to handle and available in different lengths
- Trolley with low-friction operation, protected wheel bearings and roll-away protection
- Elastic and inelastic collision

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

INCLUDED IN SCOPE OF DELIVERY

Light barrier M

Cascadable photoelectric barrier for measuring period durations, travelling time, paths and velocities on the student track or during free fall with Mobile-CASSY 2 WiFi (524 005W).

You can find detailed information on this and other sensors from page 229.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP1.3 Linear motion, free fall & collision experiments

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set ME3 (207 113S). Describes 20 experiments from the fields of linear motion, free fall and collision experiments.

Topics:
Uniform motion; Uniformly accelerated motion; Newton's laws; Free fall; Experiments on elastic collisions; Experiments on inelastic collisions; Conservation of momentum

520 7113EN	LIT: LP1.3 Linear motion, free fall and collision experiments	

SUBJECT AREA

LIT: LP1 Science Lab Mechanics, digital

Includes only ONE subject area

Comprehensive physics experiment instructions in the field of mechanics for the Science Lab.
Contains 97 experiments on measuring methods, properties of matter and liquid; forces, simple machines and oscillations; linear motion, free fall and collisions experiments; acoustics.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 711	LIT: LP1 Science Lab Mechanics, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

Includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

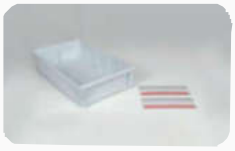
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

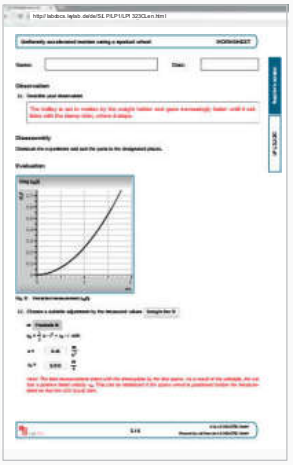
Benefit from digital measurement technology with Lab Docs

WORKSHEETS CAN BE ACCESSED AT ALL TIMES ON TABLET, SMARTPHONE OR LAPTOP

Experiment LP1.3.2.3C
Uniformly accelerated motion using a spoked wheel

TEACHER SECTION

- With sample answers and example measurements

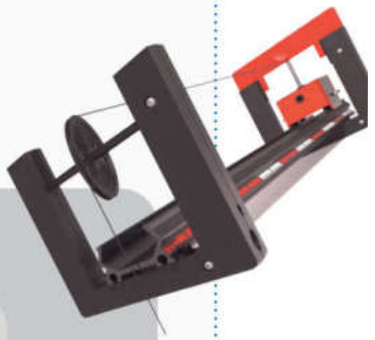


STUDENT SECTION

- While measuring, live measured values are transferred from the Mobile-CASSY 2 WiFi to the Lab Doc and ...
- displayed in the interactive measuring instruments, tables and diagrams in real time

In our example, you can see the currently measured distance s = 0.285 m both in the Mobile-CASSY 2 WiFi display and in the Lab Doc.

A SYSTEM FOR HORIZONTAL AND VERTICAL MOTION



HORIZONTAL: TRACK

Experiments on uniform and accelerated motion and experiments on collisions

VERTICAL: FREE FALL

Free fall experiments

- Devices such as the light barrier are used in many experiments and are familiar to students, meaning it takes less time to set up the experiment
- Efficient use of materials

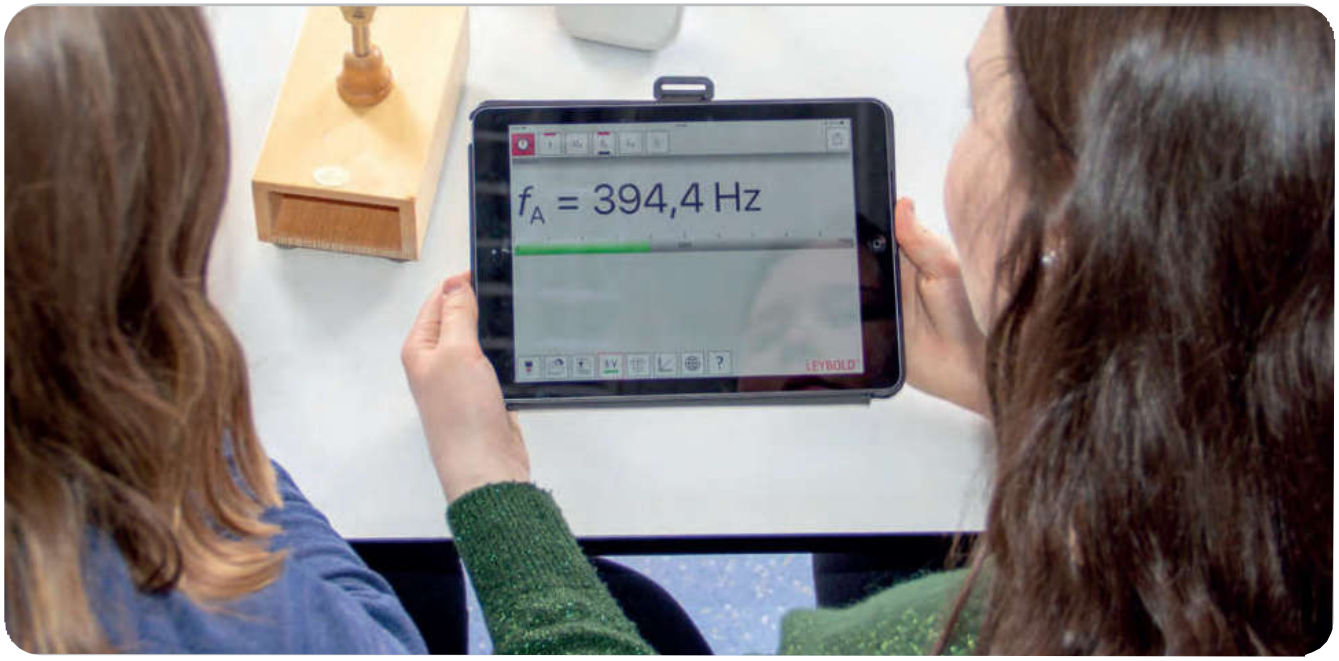
MECHANICS – ME4

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

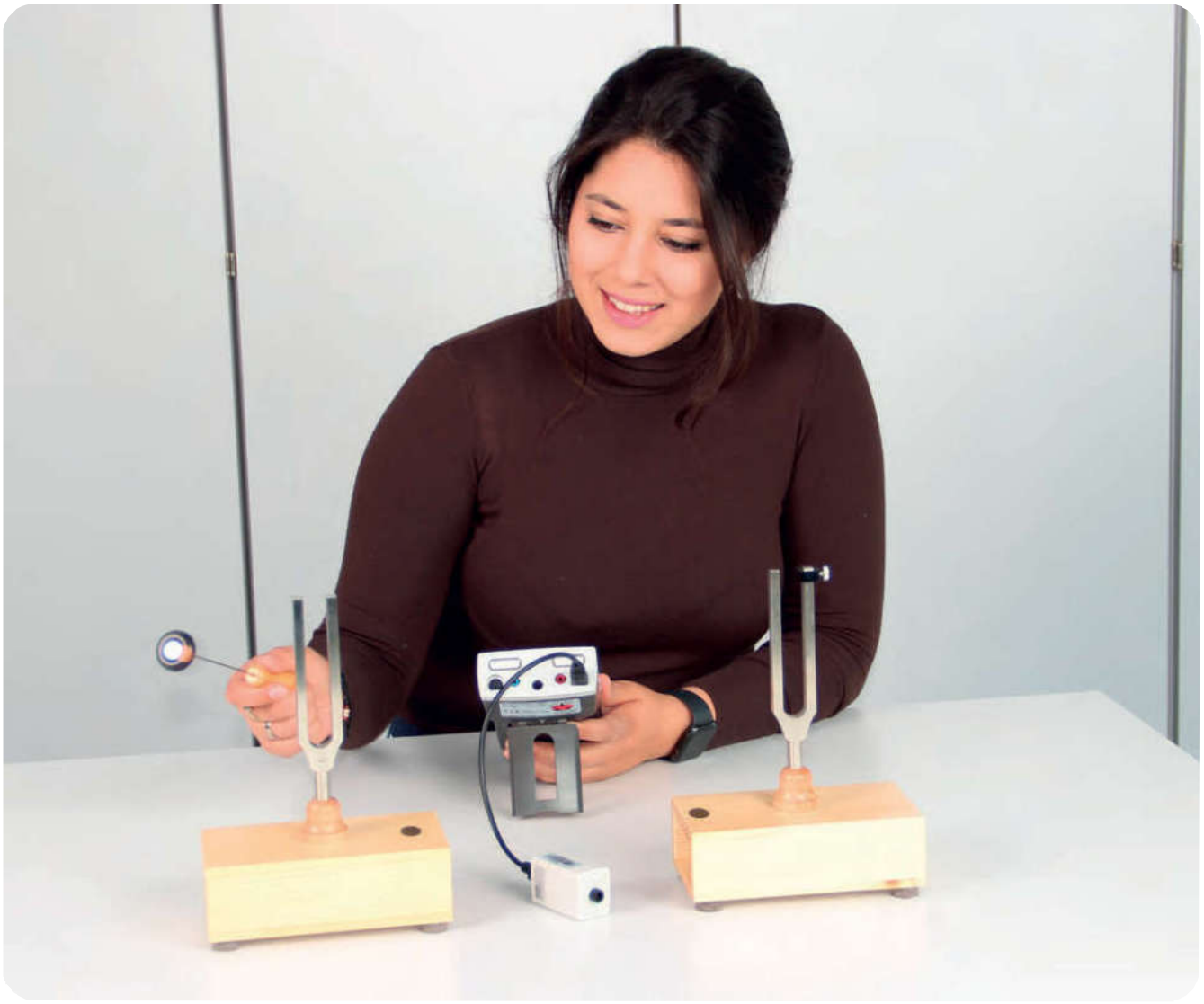
Sensors		
	LP1.4	**ACOUSTICS**
	LP1.4.1	**Propagation of sound**
	LP1.4.1.1	Propagation of sound in the air
	LP1.4.1.2	Propagation of sound in solids
	LP1.4.1.3	Propagation of sound in water
	LP1.4.2	**Oscillations and sounds**
	LP1.4.2.1	Oscillations of a tuning fork 1
	LP1.4.2.2	Oscillations of a tuning fork 2
	LP1.4.2.3	Sound generation 1
	LP1.4.2.4	Sound generation 2
●	LP1.4.2.5C	Oscillation patterns (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.4.3	**Noise analysis**
●	LP1.4.3.1C	Measuring sound levels (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.4.3.2	Noise vs. music
	LP1.4.3.3	Noise protection
●	LP1.4.3.3C	Noise protection (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.4.3.4	Reflection of sound
●	LP1.4.3.4C	Reflection of sound (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.4.3.5C	Measurement of frequencies (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.4.4	**Resonance and beating**
	LP1.4.4.1	Resonating bodies
	LP1.4.4.2	Transmitter-receiver principle
	LP1.4.4.3	Beat
●	LP1.4.4.3C	Beat (with Mobile-CASSY 2 WiFi) DIGITAL
	LP1.4.5	**Speed of sound**
●	LP1.4.5.1C	Measurement of the speed of sound (with Mobile-CASSY 2 WiFi) DIGITAL
●	LP1.4.5.2C	Measurement of the speed of sound with 2 microphones (with Mobile-CASSY 2 WiFi) DIGITAL

21 EXPERIMENTS

For experiments marked with „C“, the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi. ● Microphone M



LP1.4.3.5C Measurement of frequencies



LP1.4.4.3C Beat

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP1.4 ACOUSTICS

TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Mechanics ME4	Mobile-CASSY 2 WiFi	Science Lab Mechanics digital
		

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Mechanics ME4 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray.
With the equipment set ME4, 21 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics acoustic oscillations and sound. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Tubing 8 mm Ø, 1 m, plastic
1	Ruler 15 cm
1	Rubber rings, set of 8
1	Resonance tuning fork
1	Adapter cable 9 V/4 mm
3	Test tube DURAN 16 x 160 mm
1	Tray, high

Count	Name
1	Beaker, PP, 250 ml, squat
2	Funnel PP 75 mm Ø
1	Rubber balloons, set of 10
1	Battery 9 V (block)
1	Sound absorber

207 114S	Science Lab Mechanics ME4 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	414 42	Resonance tuning fork	Resonance and beating experiments (LP1.4.4)
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
2	524 442	Microphone M	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 711	LIT: LP1 Science Lab Mechanics, digital	

OVERVIEW OF ADVANTAGES

- With Mobile-CASSY 2 WiFi and the microphone M, even challenging acoustics experiments are possible (e.g. vibrations)
- Investigation of own materials during noise analysis possible
- Acquired skills: Comparison of self-measured values with literature values using the speed of sound

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

Microphone M

For measuring sound level, frequency and the voltage of acoustic signals with Mobile-CASSY 2 WiFi (524 005W).

524 442	Microphone M	

You can find detailed information on this and other sensors from page 229.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP1.4 Acoustics

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set ME4 (207 114S). Describes 21 experiments from the field of acoustics.

Topics:
Propagation of sound; Oscillations and sounds; Noise analysis; Resonance and beating; Speed of sound

520 7114EN	LIT: LP1.4 Acoustics	

SUBJECT AREA

LIT: LP1 Science Lab Mechanics, digital

includes only ONE subject area

Comprehensive physics experiment instructions in the field of mechanics for the Science Lab.
Contains 97 experiments on measuring methods, properties of matter and liquid; forces, simple machines and oscillations; linear motion, free fall and collisions experiments; acoustics.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 711	LIT: LP1 Science Lab Mechanics, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

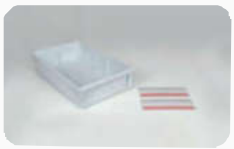
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES

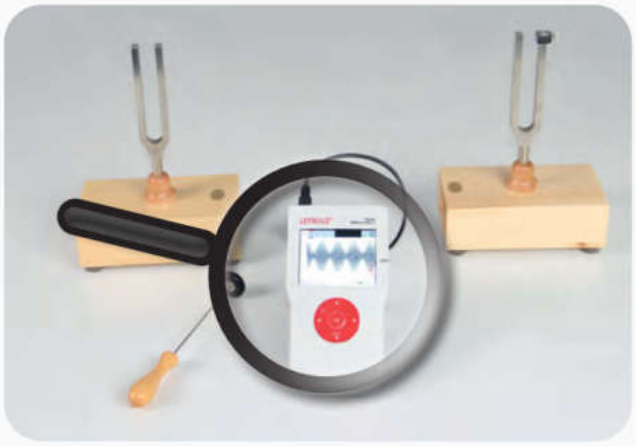




You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

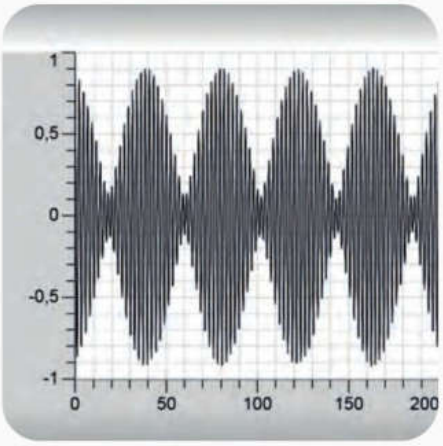
Make acoustic phenomena visible with Mobile-CASSY 2 WiFi



VISUALISE BEATS IN REAL TIME

- The beats resulting from the superposition of two oscillations can be measured and displayed easily on Mobile-CASSY 2 WiFi
- The complex graph with increasing and decreasing amplitude can only be detected digitally and with a fast measuring system

Explore well-known everyday experiences and physical phenomena using digital measuring devices



THE IDEAL STUDENT MEASURING DEVICE MOBILE-CASSY 2 WIFI

- Automatic recognition of microphone M sensor
- Easy connection to Lab Doc "Beats"
- Settings imported from Lab Doc
- Quick recording of measured values
- Measured values are directly transferred to the Lab Doc tables and diagrams
- Students have the measured values and the beat corresponding graph visualisation in their own digital protocol
- Can also be used as a standalone device with its large, graphics-capable display for high-contrast diagrams

ENERGY

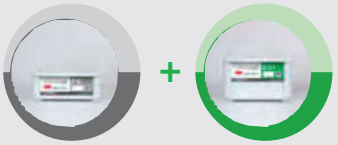
Energy is a topic that everyone has heard of. On the one hand, our Science Lab deals with the classic field of heat and, on the other hand, it also looks at renewable energies. The storage of energy with a fuel cell is additionally included. Section by section, the various components are examined in the experiments, ultimately setting up and tracing entire energy chains in one experiment.

One Basic Set and *three* Energy Sets provide three topic areas with a total of 85 experiments. The optimum selection of experiments, suitable for all academic years, is designed so that the experiments can be conducted qualitatively and quantitatively. Additionally, there is a high level of relevance for everyday life in the topic of renewable energies, thus providing a lot of motivation for students.

LP2.2.2.1C Measuring the voltage of a wind turbine

Students will measure the voltage of a wind turbine for different wind speeds and different distances between the wind machine and the turbine. For this experiment you will need the set **Science Lab Energy EG2 (207 122S)**.

Overview of topics and sets

EXPERIMENT TOPICS		REQUIRED SETS	NO. EXPERIMENTS	DETAILS FROM
LP2.1	**HEAT**			
LP2.1.1	EXPANSION OF HEAT	Basic PB + Energy EG1  207 100S 207 121S	36	PAGE 52
LP2.1.2	HEAT TRANSFER			
LP2.1.3	THERMAL INSULATION			
LP2.1.4	HEAT CAPACITIES			
LP2.1.5	AGGREGATION STATES AND TRANSITIONS			
LP2.2	**RENEWABLE ENERGIES**			
LP2.2.1	SOLAR ENERGY	Energy EG2  207 122S	29	PAGE 58
LP2.2.2	WIND ENERGY			
LP2.2.3	PELTIER EFFECT			
LP2.2.4	ENERGY STORAGE			
LP2.2.5	ENERGY CONVERSION AND EFFICIENCY			
LP2.3	**FUEL CELLS**			
LP2.3.1	REVERSIBLE PEM FUEL CELL	Energy EG2 + Energy EG3  207 122S 207 123S	20	PAGE 64
LP2.3.2	THE ELECTROLYSER			
LP2.3.3	THE FUEL CELL			

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

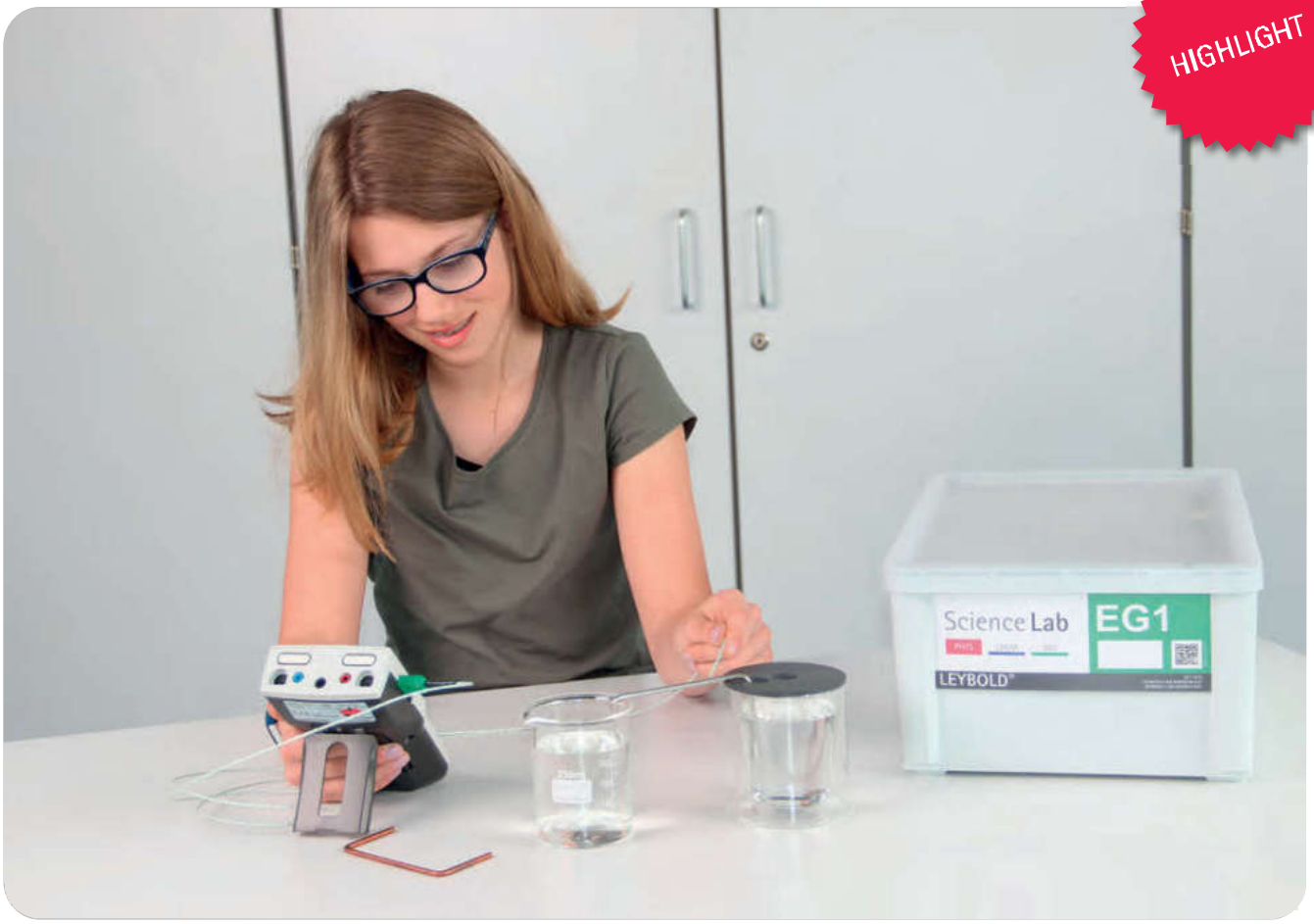
ENERGY – EG1

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

LP2.1	HEAT	
LP2.1.1	Expansion of heat	
LP2.1.1.1	Thermal properties of water	
LP2.1.1.2	Calibration of a thermometer	
LP2.1.1.3	Linear expansion of solids	
LP2.1.1.4	Thermal properties of a bimetal	
LP2.1.1.5	Heating air (at a constant pressure) Boyle-Mariotte	
LP2.1.1.6	Heating air (at constant volume)	
LP2.1.1.6C	Heating air (at constant volume) (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.2	Heat transfer	
LP2.1.2.1	Heat sensitivity	
LP2.1.2.2	Heat transfer in fluids	
LP2.1.2.3	Temperature dependence of the Brownian molecular movement	
LP2.1.2.3C	Temperature dependence of the Brownian molecular movement (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.2.4C	Thermal conductivity in solid bodies (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.2.5	Heat transfer in gases	
LP2.1.3	Thermal insulation	
LP2.1.3.1	Heating of water	
LP2.1.3.1C	Heating of water (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.3.2	Cooling of water	
LP2.1.3.2C	Cooling of water (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.3.3	Assembling a calorimeter	
LP2.1.3.3C	Assembling a calorimeter (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.4	Heat capacities	
LP2.1.4.1	Temperature of mixtures	
LP2.1.4.1C	Temperature of mixtures (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.4.2	Specific heat capacity of water	
LP2.1.4.2C	Specific heat capacity of water (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.4.3	Specific heat capacity of solid bodies	
LP2.1.4.3C	Specific heat capacity of solid bodies (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.4.4	Heat capacity of a calorimeter	
LP2.1.4.4C	Heat capacity of a calorimeter (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.5	Aggregation states and transitions	
LP2.1.5.1	Temperature changes during heating	
LP2.1.5.1C	Temperature changes during heating (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.5.2	Fusion heat of ice	
LP2.1.5.2C	Fusion heat of ice (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.5.3	Condensation of steam	
LP2.1.5.3C	Condensation of steam (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.5.4	Temperatures of water-salt mixtures	
LP2.1.5.4C	Temperatures of water-salt mixtures (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.1.5.5	Distillation	

For experiments marked with „C“, the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

36 EXPERIMENTS



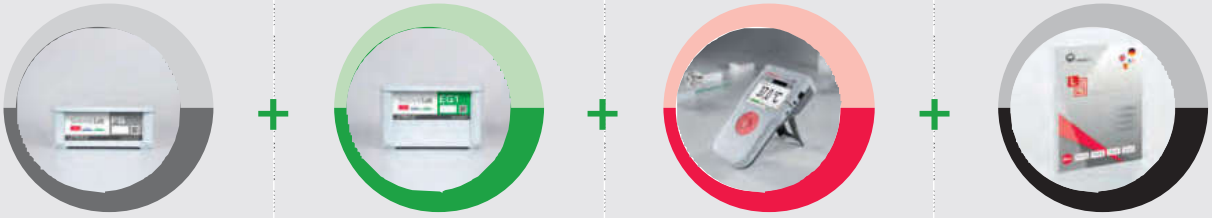
LP2.1.2.4C Thermal conductivity in solid bodies

Students will investigate thermal conductivity in solid bodies. They will monitor heat transfer from a warm to a cold water bath. Copper and steel are the materials used. For this experiment you will need the sets **Science Lab Physics Basic PB (207 100S)** and **Science Lab Energy EG1 (207 121S)**.

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP2.1 HEAT

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Physics Basic PB	Energy EG1	Mobile-CASSY 2 WiFi	Science Lab Energy digital



Detailed information on the above listed and **additionally required equipment** is available on the following pages.

Science Lab Energy EG1 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray.
With the equipment set EG1, together with the Science Lab Physics Basic PB (207 100S), 36 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics heat. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Bosshead S
1	Colouring, red, 10 g
1	Funnel PE 40 mm Ø
1	Double scale
1	Double pipe support
2	Transparent tube with 2 caps
1	Plastic riser tube
1	Bimetallic strip
1	Pointer for linear expansion
1	Aluminium tube 400 mm x 8 mm Ø
1	Iron tube 400 mm x 8 mm Ø
1	Stirring thermometer -30...+110 °C, ungraduated
1	Stirring thermometer -10...+110 °C
1	Lid for glass calorimeter
1	Heat conducting rod steel

Count	Name
1	Heat conducting rod copper
1	Glass calorimeter
1	Blade wheel
1	Measuring cylinder 100 ml
1	Immersion heater 12 V/10 W
1	Wire gauze 120 mm x 120 mm
1	Tray, high
1	Beaker, Boro 3.3, 250 ml, squat
1	Petri dish 60 mm
1	Erlenmeyer flask, Boro 3.3, 50 ml, narrow neck
1	Connector, straight, 6/8 mm Ø
1	Universal clamp 0...80 mm
1	Stand ring with stem 100 mm Ø
1	Silicone tubing 7 mm Ø, 1 m

207 121S	Science Lab Energy EG1 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

OVERVIEW OF ADVANTAGES

- Investigation of linear expansion and thermal conduction of various materials
- Understanding the functions of a calorimeter
- STEM experiments for heat insulation

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

INCLUDED IN SCOPE OF DELIVERY

Temperature probe NiCr-Ni, type K

Already included in the scope of delivery of the Mobile-CASSY 2 WiFi (524 005W).

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per **student**

Count	Cat.-No.	Name	Description
1	610 010	Laboratory safety goggles, Focomax	

Additionally required per **working group**

Count	Cat.-No.	Name	Description
1	207 100S	Science Lab Physics Basic PB (Set)	
1	521 487	AC/DC Power supply PRO 0...12 V/3 A	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	607 020	Safety gas hose with clamp 0.5 m	Heat experiments (LP2.1.1, LP2.1.2)
1	656 017	Teclu burner, universal	Heat experiments (LP2.1.1, LP2.1.2)

Additionally required per **class**

Count	Cat.-No.	Name	Description
1	520 712	LIT: LP2 Science Lab Energy, digital	

Detailed information on **literature packages** are available on the following pages.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP2.1 Heat

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set EG1 (207 121S) and Science Lab Physics Basic PB (207 100S). Describes 36 experiments from the field of heat.

Topics:
Expansion of heat; Heat transfer; Thermal insulation; Heat capacities; Aggregation states and transitions

520 7121EN	LIT: LP2.1 Heat	

SUBJECT AREA

LIT: LP2 Science Lab Energy, digital

includes only ONE subject area

Comprehensive physics experiment instructions in the field of energy for the Science Lab.
Contains 85 experiments on heat, renewable energies and fuel cells.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 712	LIT: LP2 Science Lab Energy, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

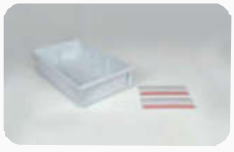
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





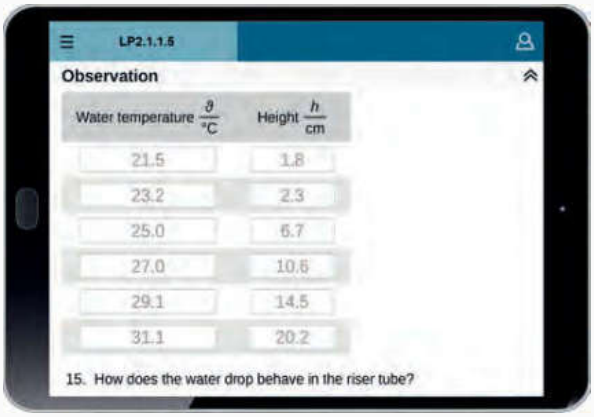
You can find detailed information on additional storage accessories from page 228.

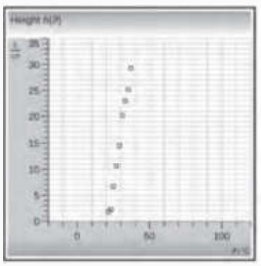
INTRODUCING THE TOPIC

DIGITAL EXPERIMENT INSTRUCTIONS

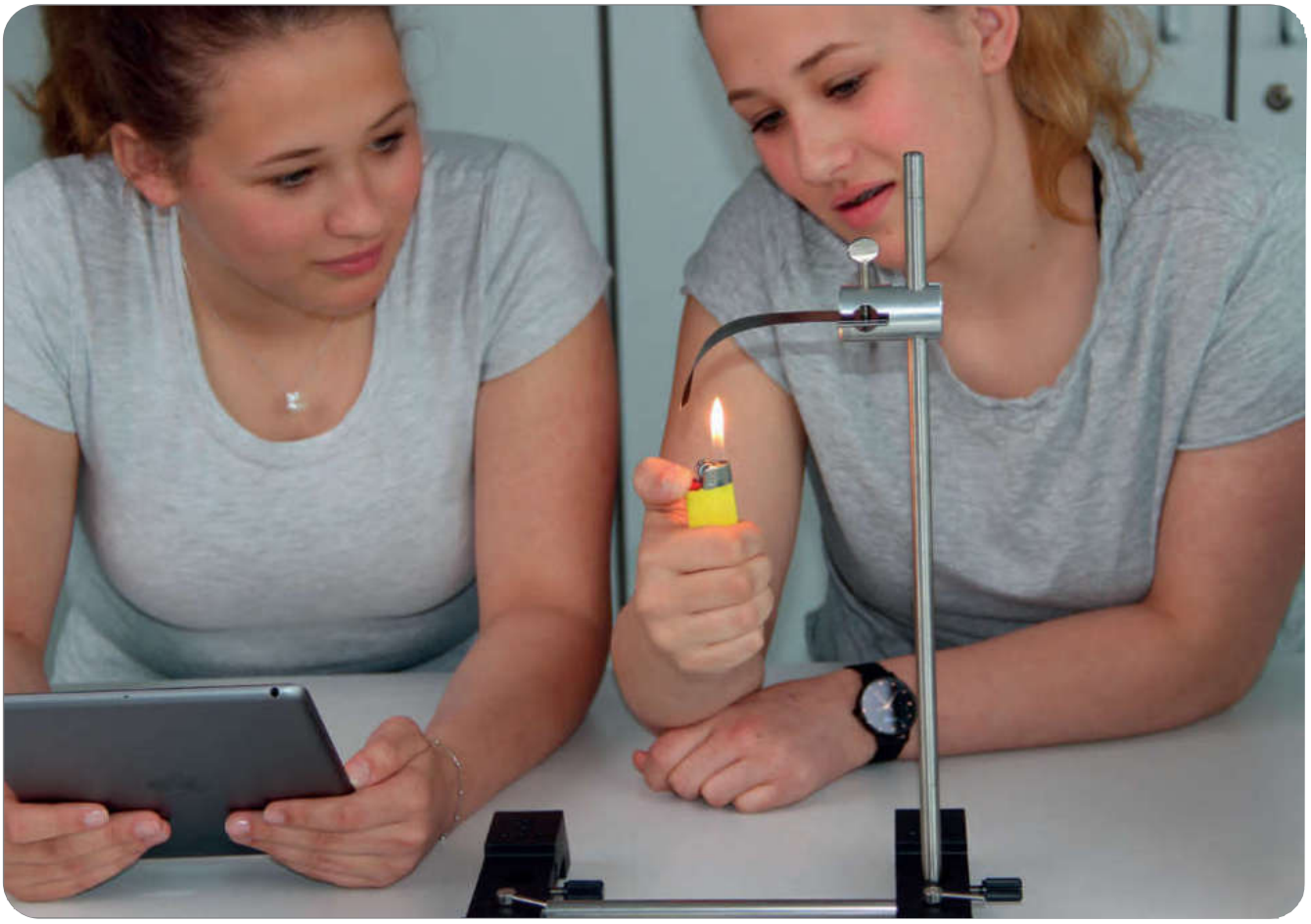
- The measured values can either be entered manually in own Lab Doc or
- They can be transferred directly into the Lab Doc via a connection with the Mobile-CASSY 2 WiFi
- The diagram "Height of the water drop depending on the water bath temperature" is automatically completed with the entered measured values

LP2.1.1.5 Air warming (under constant pressure)





The students investigate the correlation between temperature and volume changes in the air under constant pressure (Gay-Lussac's Law).



LP2.1.1.4 Thermal properties of a bimetal

ENERGY – EG2

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

LP2.2 RENEWABLE ENERGIES

LP2.2.1 Solar energy

LP2.2.1.1	Black and white bodies	
LP2.2.1.1C	Black and white bodies (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.2.1.2	Absorption of heat radiation	
LP2.2.1.2C	Absorption of heat radiation (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.2.1.3	Greenhouse effect	
LP2.2.1.3C	Greenhouse effect (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.2.1.4	Solar cell circuits	
LP2.2.1.4C	Solar cell circuits (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.2.1.5	Examination of a solar module as a function of distance	
LP2.2.1.5C	Examination of a solar module as a function of distance (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.2.1.6	Examination of a solar module as a function of the angle of incidence	
LP2.2.1.6C	Examination of a solar module as a function of the angle of incidence (with Mobile-CASSY 2 WiFi)	DIGITAL

LP2.2.2 Wind energy

LP2.2.2.1	Measuring the voltage of a wind turbine	
LP2.2.2.1C	Measuring the voltage of a wind turbine (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.2.2.2	Wind turbine with different blades	
LP2.2.2.2C	Wind turbine with different blades (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.2.2.3	Wind turbine with varying number of blades	
LP2.2.2.3C	Wind turbine with varying number of blades (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.2.2.4	Wind turbine with varying blade angles	
LP2.2.2.4C	Wind turbine with varying blade angles (with Mobile-CASSY 2 WiFi)	DIGITAL

LP2.2.3 Peltier effect

LP2.2.3.1	Examination of a Peltier element as a heat pump	
LP2.2.3.1C	Examination of a Peltier element as a heat pump (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.2.3.2	Examination of a Peltier element as a voltage source	

LP2.2.4 Energy storage

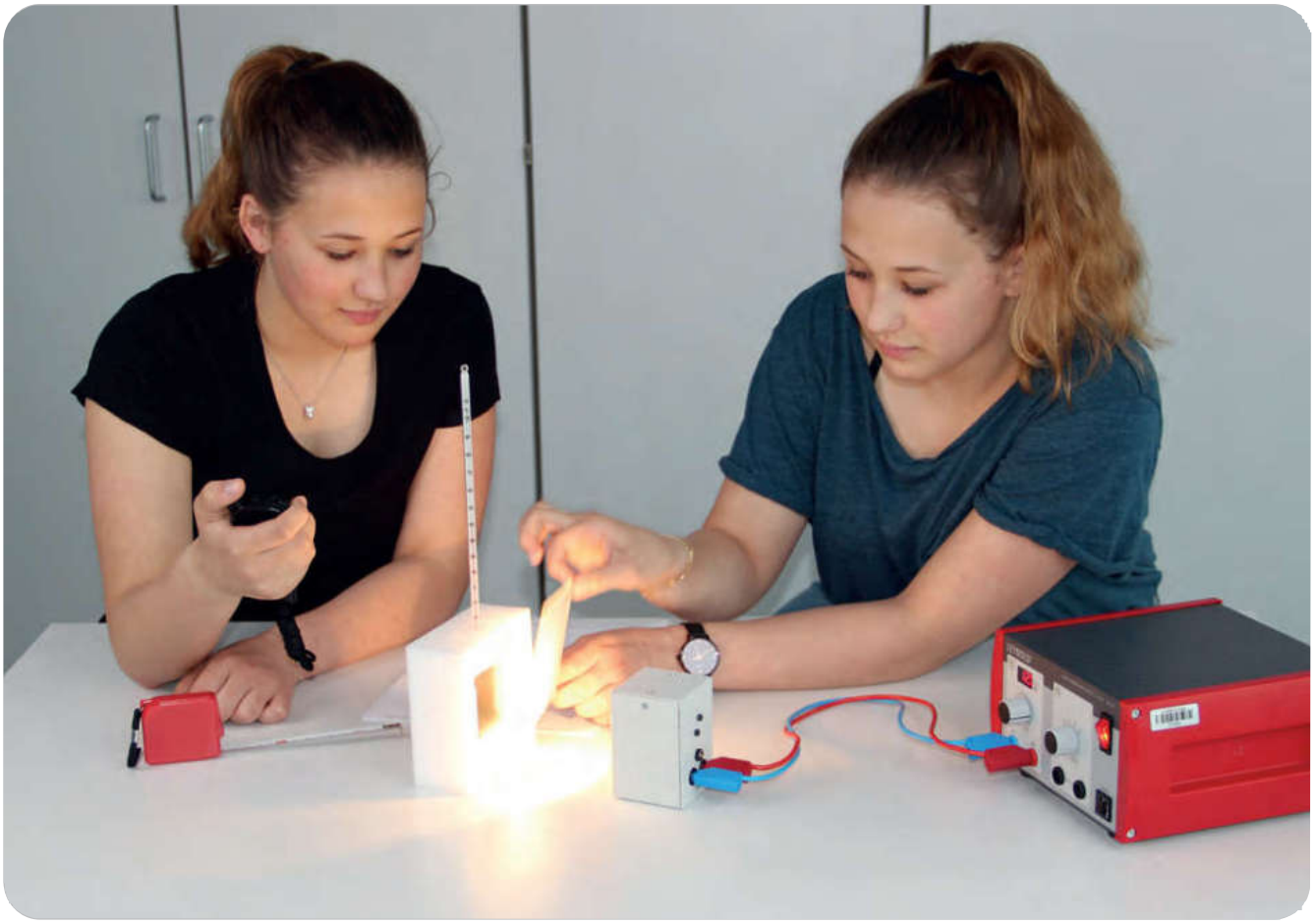
LP2.2.4.1	Charging a capacitor	
LP2.2.4.1C	Charging a capacitor (with Mobile-CASSY 2 WiFi)	DIGITAL

LP2.2.5 Energy conversion and efficiency

LP2.2.5.1	Operating a motor using a solar module	
LP2.2.5.2	Operating a lamp using a solar module	
LP2.2.5.3	Operating a lamp using a generator	
LP2.2.5.3C	Operating a lamp using a generator (with Mobile-CASSY 2 WiFi)	DIGITAL

For experiments marked with „C“, the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

29 EXPERIMENTS



LP2.2.1.3 Greenhouse effect

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP2.2 RENEWABLE ENERGIES

TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Energy EG2	Mobile-CASSY 2 WiFi	Science Lab Energy digital
 +	 +	

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Energy EG2 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray.
With the equipment set EG2 (207 122S), 29 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topic renewable energies. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Tape measure 2 m / 1 mm
2	Stirring thermometer -10...+110 °C
1	Light source 12 V
1	Photovoltaic module
1	Wind machine
1	Wind wheel
1	Peltier element in tank
1	Insulating housing for Leslie body
1	Leslie body
1	Rotor blades, set
2	Safety connecting lead 50 cm, red

Count	Name
2	Safety connecting lead 50 cm, blue
1	Safety connecting lead 50 cm, black
1 out of	Bulb 2.5 V/0.25 W, E10, set of 10
1	Plug-in board safety socket, 20/10
1	Capacitor (electrolytic) 1 F, STE 2/19
1	Lamp holder, E10, top, STE 2/19
1	Immersion heater 12 V/10 W
1	Tray, high
1	Beaker PP, 100 ml, squat
1	Stopwatch, digital
207 122S	Science Lab Energy EG2 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	521 487	AC/DC Power supply PRO 0...12 V/3 A	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
2	531 120	Multimeter LDanalog 20	alternative for analog measurements

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 712	LIT: LP2 Science Lab Energy, digital	

OVERVIEW OF ADVANTAGES

- STEM experiments for renewable energies
- Examination of a wind turbine with regard to shape, number and inclination of the rotors
- Simulation of the greenhouse effect
- Acquired skills: Applying technical language to everyday situations

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

INCLUDED IN SCOPE OF DELIVERY

Temperature probe NiCr-Ni, type K

Already included in the scope of delivery of the Mobile-CASSY 2 WiFi (524 005W).

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP2.2 Renewable energies

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set EG2 (207 122S).
Describes 29 experiments from the field of renewable energies.

Topics:
Solar energy; Wind energy; Peltier effect; Energy storage; Energy conversion and efficiency

520 7122EN	LIT: LP2.2 Renewable energies	

SUBJECT AREA

LIT: LP2 Science Lab Energy, digital

includes only ONE subject area

Comprehensive physics experiment instructions in the field of energy for the Science Lab.
Contains 85 experiments on heat, renewable energies and fuel cells.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 712	LIT: LP2 Science Lab Energy, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

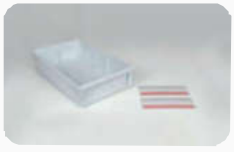
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

An investment in the future: Climate-friendly and sustainable education

UNDERSTANDING RENEWABLE ENERGY

FOR CLIMATE PROTECTION TODAY
AND SHAPING THE ENERGY SUPPLY OF TOMORROW

- Topic areas: Solar energy, wind energy, energy storage and energy conversion
- Hands-on experiments using tangible objects such as the solar module or the miniature wind turbine with the wind machine
- Qualitative investigations and quantitative measurements with digital measuring technology and the help of interactive experiment instructions
- Students experience:
  - Structure and functionality of systems for energy production
  - The laws of physics in relation to energy conversion, production and storage

SOLAR ENERGY

- Solar cells and solar modules
- The conversion of radiation energy (energy from the sun) into electrical energy
- Dependencies on the illumination intensity (distance from the sun) and the angle of incidence (orientation to the sun)

WIND ENERGY

- The conversion of mechanical energy (wind energy) into electrical energy
- The influence of shape, number and adjustment angle of different rotor blades
- Realistic evaluation of efficiency

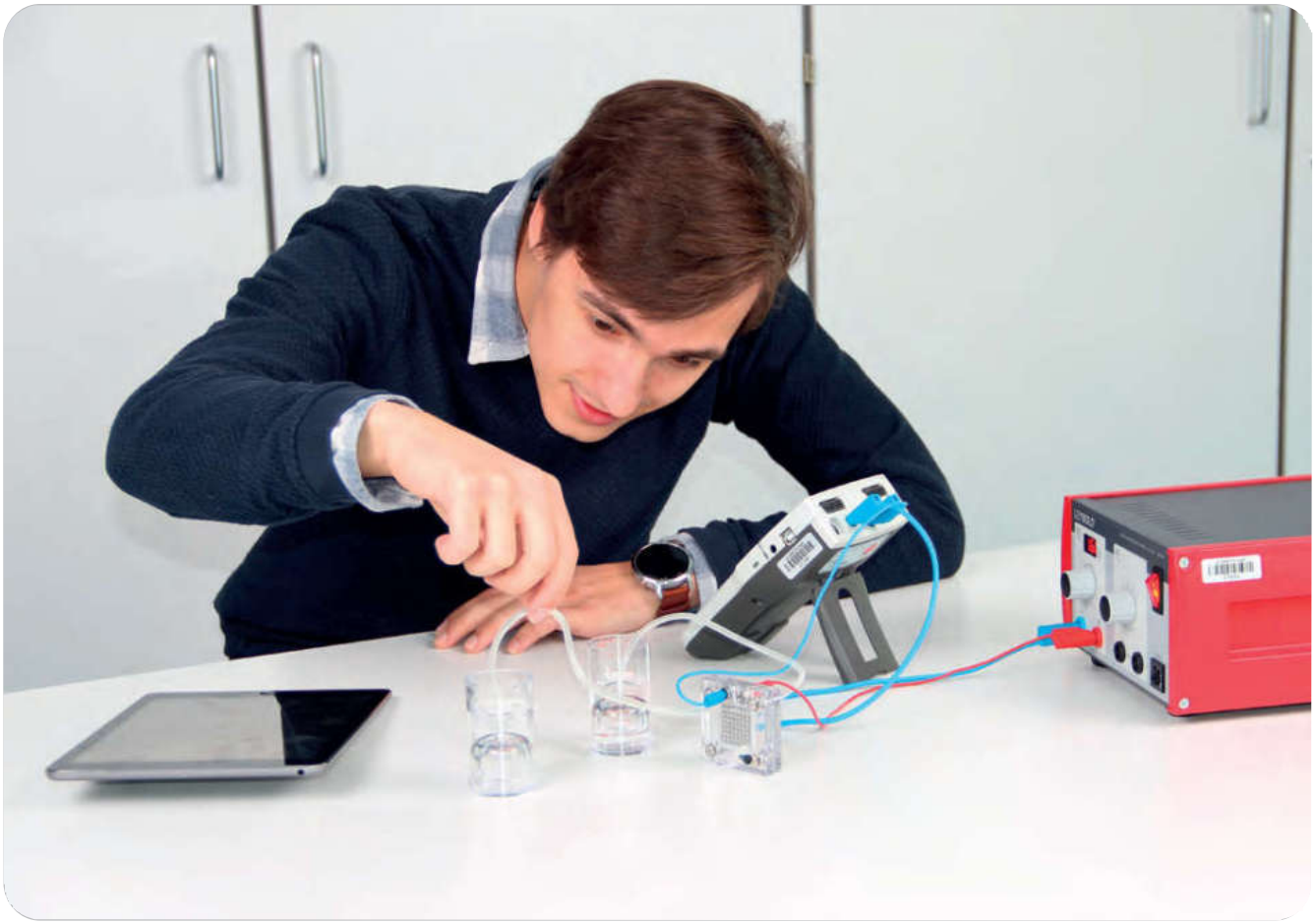
ENERGY – EG3

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

LP2.3	FUEL CELLS	
LP2.3.1	Reversible PEM fuel cell	
LP2.3.1.1	Preparation of a fuel cell	
LP2.3.2	The electrolyser	
LP2.3.2.1	Using a reversible fuel cell as an electrolyser	
LP2.3.2.2	Operating an electrolyser using a solar cell	
LP2.3.2.3	Characteristic curve of the electrolyser	
LP2.3.2.3C	Characteristic curve of the electrolyser (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.3.2.4	Faraday's first law of electrolysis on the electrolyser	
LP2.3.2.4C	Faraday's first law of electrolysis on the electrolyser (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.3.2.5	Determining the Faraday constant	
LP2.3.2.5C	Determining the Faraday constant (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.3.2.6	Energy efficiency on the electrolyser	
LP2.3.2.6C	Energy efficiency on the electrolyser (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.3.3	The fuel cell	
LP2.3.3.1	Conversion of hydrogen and oxygen in a fuel cell	
LP2.3.3.2	Operating a motor using a fuel cell	
LP2.3.3.3	Characteristic curve and performance of a fuel cell	
LP2.3.3.3C	Characteristic curve and performance of a fuel cell (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.3.3.4	Efficiency of a fuel cell	
LP2.3.3.4C	Efficiency of a fuel cell (with Mobile-CASSY 2 WiFi)	DIGITAL
LP2.3.3.5	Energy storage	
LP2.3.3.6	Efficiency of the system: electrolyser and fuel cell	
LP2.3.3.6C	Efficiency of the system: electrolyser and fuel cell (with Mobile-CASSY 2 WiFi)	DIGITAL

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

20 EXPERIMENTS

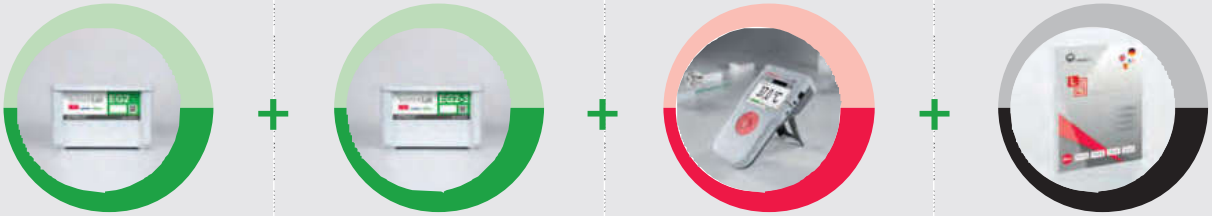


LP2.3.2.1 Using a reversible fuel cell as an electrolyser

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP2.3 FUEL CELLS

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Energy EG2	Energy EG3	Mobile-CASSY 2 WiFi	Science Lab Energy digital



Detailed information on the above listed and **additionally required equipment** is available on the following pages.

Science Lab Energy EG3 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group. The equipment is stored in Science Lab Energy EG2 (207 122S). With the equipment set EG3 (207 123S), together with the Science Lab Energy EG2 (207 122S), 20 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics fuel cells. While working out the curriculum required topics, they are also trained in communication and assessment skills.
In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	H_2+O_2 storage
1	Plate for fuel cell and H_2+O_2 storage
1	Adapter lead 2/4 mm, 30 cm, blue
1	Adapter lead 2/4 mm, 30 cm, red
1	Resistor 5.1 Ohm, STE 2/19

Count	Name
1	Potentiometer 220 Ohm, STE 4/50
1	Silicone tubing, 2 mm diam., 1 m
1	PEM reversible fuel cell
207 123S	Science Lab Energy EG3 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 122S	Science Lab Energy EG 2 (Set)	
1	521 487	AC/DC Power supply PRO 0...12 V/3 A	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
2	531 120	Multimeter LDanalog 20	alternative for analog measurement

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 712	LIT: LP2 Science Lab Energy, digital	
1	675 3400	Water, pure, 1 l	

OVERVIEW OF ADVANTAGES

- Students build models of energy chains
- Included: PEM (electrolyser and fuel cell combined)
- Acquired skills: Getting to know the storage possibilities of renewable energies

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

MOBILE-CASSY 2 WIFI

With the Mobile-CASSY 2 WiFi, voltage *(U)*, current *(I)*, power *(P)* and energy *(E)* can be measured via 4 mm safety sockets.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP2.3 Fuell cells

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set EG3 (207 123S). Describes 20 experiments from the field of fuel cells.

Topics:
Reversible PEM fuel cell; The electrolyser; The fuel cell

520 7123EN	LIT: LP2.3 Fuell cells	

SUBJECT AREA

LIT: LP2 Science Lab Energy, digital

includes only ONE subject area

Comprehensive physics experiment instructions in the field of energy for the Science Lab.
Contains 85 experiments on heat, renewable energies and fuel cells.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 712	LIT: LP2 Science Lab Energy, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

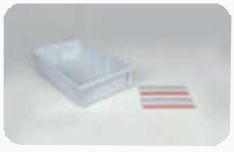
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

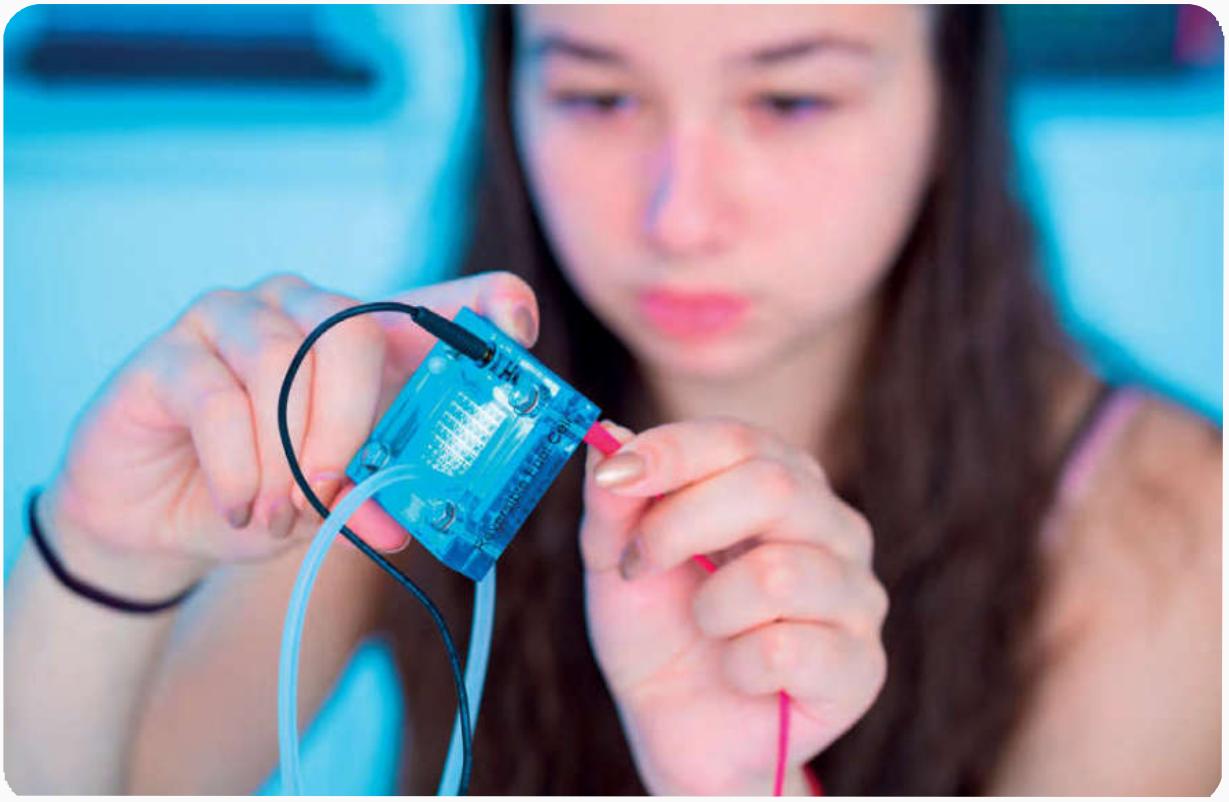
INTRODUCING THE TOPIC

Protect the planet with electricity from renewable energies

UNDERSTANDING FUEL CELL TECHNOLOGY

- Learning about the technology of the future through student experiments
- Fuel cells and their properties
- Electrolysers for splitting water into its elements
- Conversion between chemical and electrical energy with a reversible PEM fuel cell
- Efficiency and assignments on energy storage and energy transportation
- Solution-orientated learning with reference to everyday life, e.g. cars with hydrogen vehicles - advantages and challenges
- Independent qualitative investigations and quantitative measurements with the Mobile-CASSY 2 WiFi as well as the interactive experiment instructions Lab Docs

RENEWABLE ENERGY FOR A FUTURE-PROOF ENERGY SUPPLY



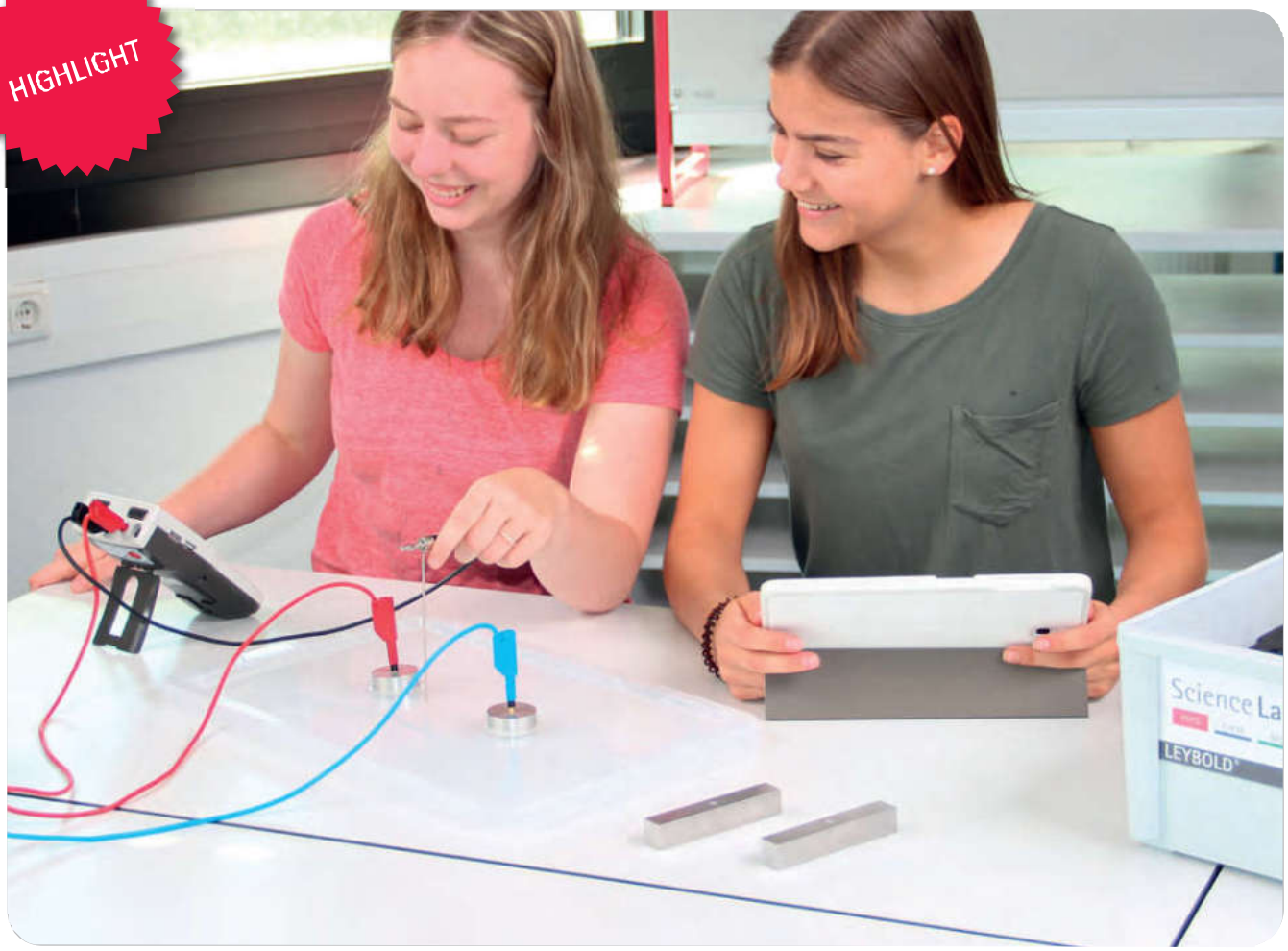
ELECTRICITY/ELECTRONICS

The introduction to *Electricity/Electronics* for the students usually begins with experiments such as the simple electric circuit. They learn the basic principles that are essential for understanding the experiments based on them.

The use of the innovative, modular plug-in board makes it particularly easy to reduce the experiments to a minimum. The safety sockets on the plug-in board enable the use of safety connecting leads. *Five* Electrics Sets provide six topic areas with 154 experiments.

The measurements of current and voltage can be carried out both with the Mobile-CASSY 2 WiFi and with multimeters.

HIGHLIGHT



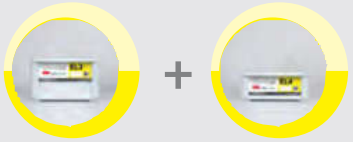
LP3.1.7.1C Equipotential lines between identically shaped electrodes

In this experiment, students record the equipotential lines between two identically shaped electrodes by searching for the points of equal potential difference between the 0 V electrode and the steel needle with the Mobile-CASSY 2 WiFi and depict these points on a graph. For this experiment you will need the set **Science Lab Electrics EL1 (207 131S)**.

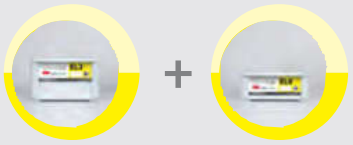
Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

Overview of topics and sets

ELECTRICITY

EXPERIMENT TOPICS		REQUIRED SETS	NO. EXPERIMENTS	DETAILS
LP3.1	**ELECTROSTATICS**			
LP3.1.1	CONTACT ELECTRICITY	Electrics EL1  207 131S	25	PAGE 72
LP3.1.2	FORCES ACTING BETWEEN CHARGES			
LP3.1.3	ELECTROSTATIC INDUCTION			
LP3.1.4	CHARGE STORAGE			
LP3.1.5	ELECTROSTATIC INTERACTION			
LP3.1.6	INSULATORS AND CONDUCTORS			
LP3.1.7	EQUIPOTENTIAL LINES			
LP3.1.8	PLATE CAPACITOR			
LP3.2	**MAGNETISM**			
LP3.2.1	MAGNETIC FORCES AND FIELDS	Electrics EL2  207 132S	12	PAGE 78
LP3.2.2	MAGNETIC INDUCTION			
LP3.2.3	MAGNETIC FIELDS			
LP3.3	**BASIC ELECTRICAL CIRCUITS AND ELECTROCHEMISTRY**			
LP3.3.1	ELECTRICAL CIRCUITS AND SWITCHES	Electrics EL3  207 133S	40	PAGE 84
LP3.3.2	ELECTRICAL MEASUREMENT METHODS			
LP3.3.3	OHMIC RESISTANCE			
LP3.3.4	SPECIAL RESISTORS			
LP3.3.5	VOLTAGE SOURCES			
LP3.3.6	ELECTRICAL APPLICATION CIRCUITS			
LP3.3.7	ELECTROCHEMISTRY			
LP3.4	**ELECTROMAGNETISM AND INDUCTION**			
LP3.4.1	ELECTROMAGNETISM	Electrics EL3 Electrics EL4  207 133S 207 134S	21	PAGE 90
LP3.4.2	ELECTROMAGNETIC APPLICATIONS			
LP3.4.3	INDUCTION			
LP3.4.4	TRANSFORMERS			
LP3.4.5	APPLICATIONS OF INDUCTION			
LP3.4.6	COILS IN DIRECT AND ALTERNATING CURRENT CIRUITS			
LP3.5	**MOTORS AND GENERATORS**			
LP3.5.1	GENERATORS	Electrics EL3 Electrics EL4 Electrics EL5  207 133S 207 134S 207 135S	14	PAGE 96
LP3.5.2	ELECTRIC MOTORS			

ELECTRONICS

EXPERIMENT TOPICS		REQUIRED SETS	NO. EXPERIMENTS	DETAILS
LP4.1	**BASIC ELECTRONIC CIRCUITS**			
LP4.1.1	CAPACITORS	Electrics EL3 Electrics EL6  207 133S 207 136S	42	PAGE 102
LP4.1.2	RELAY CIRCUITS			
LP4.1.3	DIODES			
LP4.1.4	TRANSISTORS			
LP4.1.5	DIODE CIRCUITS			
LP4.1.6	FLIP-FLOPS			
LP4.1.7	AMPLIFIER CIRCUITS			
LP4.1.8	SOLAR CELLS			

ELECTRICS – EL1

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

LP3.1	ELECTROSTATICS	
LP3.1.1	Contact electricity	
LP3.1.1.1	Proof of charge types on friction rods with a glow lamp	
LP3.1.1.2	Proof of charge types on foils and sheets with a glow lamp	
LP3.1.1.3	Contact electricity generated by friction	
LP3.1.2	Forces acting between charges	
LP3.1.2.1	Forces acting between charges on friction rods	
LP3.1.2.2	Forces acting on a charged pendulum pair	
LP3.1.2.3	Operating principle of an electroscope	
LP3.1.3	Electrostatic induction	
LP3.1.3.1	Induction phenomena with conductors and non-conductors	
LP3.1.3.2	Induction phenomena of a pointer	
LP3.1.3.3	Electric induction on a pair of pendulums	
LP3.1.3.4	Induction phenomena on an electroscope caused by friction rods	
LP3.1.4	Charge storage	
LP3.1.4.1	Conductive bodies as charge storage devices	
LP3.1.4.2	Proof of charges on a Faraday cup	
LP3.1.5	Electrostatic interaction	
LP3.1.5.1	Electrostatic forces between friction rod and pendulum	
LP3.1.5.2	Charge transfer through a pendulum	
LP3.1.6	Insulators and conductors	
LP3.1.6.1	Charges on insulators	
LP3.1.6.2	Proof of conductivity with an electroscope	
LP3.1.6.3	Point discharge	
LP3.1.7	Equipotential lines	
LP3.1.7.1	Equipotential lines between identically shaped electrodes	
LP3.1.7.1C	Equipotential lines between identically shaped electrodes (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.1.7.2	Equipotential lines between non-identically shaped electrodes	
LP3.1.7.2C	Equipotential lines between non-identically shaped electrodes (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.1.7.3	Distortion of equipotential lines	
LP3.1.7.3C	Distortion of equipotential lines (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.1.8	Plate capacitor	
LP3.1.8.1	The electric field in a plate capacitor	
LP3.1.8.1C	The electric field in a plate capacitor (with Mobile-CASSY 2 WiFi)	DIGITAL

For experiments marked with „C“, the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

25 EXPERIMENTS

LP3.1.4.2 Proof of charges on a Faraday cup

Students will show that the two different charges can be retained on a Faraday cup and detected with the glow lamp.
For this experiment you will need the set **Science Lab Electrics EL1 (207 131S)**.

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP3.1 ELECTROSTATICS

TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Electrics EL1	Mobile-CASSY 2 WiFi	Science Lab Electricity digital

+

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Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Electrics EL1 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray.
With the equipment set EL1 (207 131S), 25 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics electrostatics and electric fields. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
2	Safety connecting lead 50 cm, red
2	Safety connecting lead 50 cm, blue
3	Adapter 4-mm plug/4-mm socket
1	Crocodile clip, polished
1	Glow lamp, tubular 90 V
1	Electroscope
2	Friction rods, PVC and acrylic
1	Induction plate 8 cm x 4 cm
1	Bar electrodes for 54509, set 2
1	Set of 3 round electrodes for 54509
1	Faraday's cup

Count	Name
1	Clamping plug
1	Tray, high
1	Lid for tray
1	Cord
1	Plastic clips, pair
1	Electrostatic pendulums, pair
1	Microfibre cloth
1	Steel needle
5 out of	Acetate foils 300 x 300 x 0.1 mm, set of 10
207 131S	Science Lab Electrics EL1 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	521 487	AC/DC Power supply PRO 0...12 V/3 A	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	531 120	Multimeter LDanalog 20	alternative for analog measurements

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 713	LIT: LP3 Science Lab Electricity, digital	
1	675 3410	Water, pure, 5 l	Equipotential lines & plate capacitor experiments (LP3.1.7, LP3.1.8)

OVERVIEW OF ADVANTAGES

- Students build their "own" electroscope and learn about its function
- Straightforward experiments for the detection and storage of different charges and electric fields
- All electric and electronic components are in transparent housings for a safe and long term use and labelled with the same electronic symbols as real life devices
- Acquired skills: Design and function of electrical measuring instruments

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

MOBILE-CASSY 2 WIFI

With the Mobile-CASSY 2 WiFi, voltage *(U)*, current *(I)*, power *(P)* and energy *(E)* can be measured via 4 mm safety sockets.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP3.1 Electrostatics

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set EL1 (207 131S). Describes 25 experiments from the field of electrostatics.

Topics:
Contact electricity; Force acting between charges; Electrostatic induction; Charge storage; Electrostatic interaction; Insulators and conductors; Equipotential lines; Plate capacitor

520 7131EN	LIT: LP3.1 Electrostatics	

SUBJECT AREA

LIT: LP3 Science Lab Electricity, digital

Includes only ONE subject area

Comprehensive physics experiment instructions in the field of electricity for the Science Lab.
Contains 154 experiments on electrostatics, magnetism, basic electrical circuits and electrochemistry, electromagnetism and induction, motors and generators and electronics.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 713	LIT: LP3 Science Lab Electricity, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

Includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

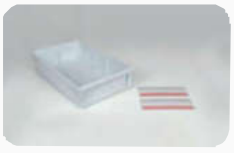
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES



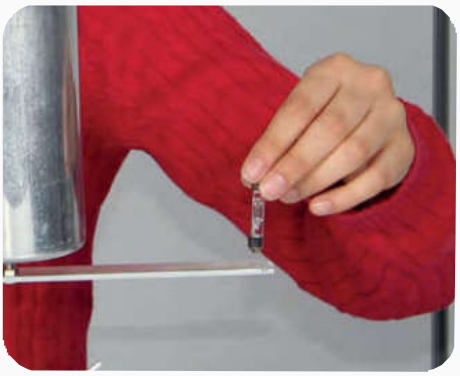


You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

Experiment and research - Discover electrostatic phenomena with fun

Even though the names of the experiments may not sound like fun to students first, the electrostatics experiments vividly illustrate many everyday life experiences.



SOME EXAMPLES OF STUDENT QUESTIONS THAT WILL BE ANSWERED:

- Why do I get an electric shock if I touch a metal door after I have walked on carpet with shoes on?
- Why does that seem to be worse with certain shoes than with others?
- Why does hair stick to a balloon if I rub the balloon on my t-shirt first?

ELECTRICS - EL2

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

LP3.2	MAGNETISM
LP3.2.1	Magnetic forces and fields
LP3.2.1.1	Magnetic and non-magnetic materials
LP3.2.1.2	Position of the magnetic poles on a bar magnet
LP3.2.1.3	Polarity of magnets
LP3.2.2	Magnetic induction
LP3.2.2.1	Magnetisation
LP3.2.2.2	Disassembling magnets
LP3.2.2.3	Combining magnets
LP3.2.3	Magnetic fields
LP3.2.3.1	Demonstration of a magnetic field with iron powder
LP3.2.3.2	Field lines of a bar magnet
LP3.2.3.3	Model experiment on the earth's magnetic field
LP3.2.3.4	Field lines of a horseshoe magnet
LP3.2.3.5	Field lines of attracting magnetic poles
LP3.2.3.6	Field lines of repelling magnetic poles

12 EXPERIMENTS

LP3.2.1.1 Magnetic and non-magnetic materials

LP3.2.3.1 Demonstration of a magnetic field with iron powder

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP3.2 MAGNETISM

TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Electrics EL2	Mobile-CASSY 2 WiFi	Science Lab Electricity digital
		

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Electrics EL2 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray.
With the equipment set EL2, 12 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topic magnetism. While working out the curriculum required topics, they are also trained in communication and assessment skills.
In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
2	Bar magnet
2	Plotting compass
1	Magnetizable rods, set of 4
1	Hemisphere for earth's magnetism
1	Magnetism experimental field
1	Iron yokes, pair
1	Pocket compass

Count	Name
1	Magnetic field indicator
1	Shaker for iron filings
1	Tray, low
1	Iron powder, reduced, 50 g
1	Cord

207 132S	Science Lab Electrics EL2 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	510 55	Direction-finding compass	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 713	LIT: LP3 Science Lab Electricity, digital	

OVERVIEW OF ADVANTAGES

- Understandable experiments to distinguish between attracting and repelling magnetic forces which can be visualised with the help of the magnetism experimental field and iron powder
- Investigation of the Earth's magnetic field in a simple model
- Acquired skills: Explanation of everyday phenomena using simple models

STUDENT MEASURING DEVICE

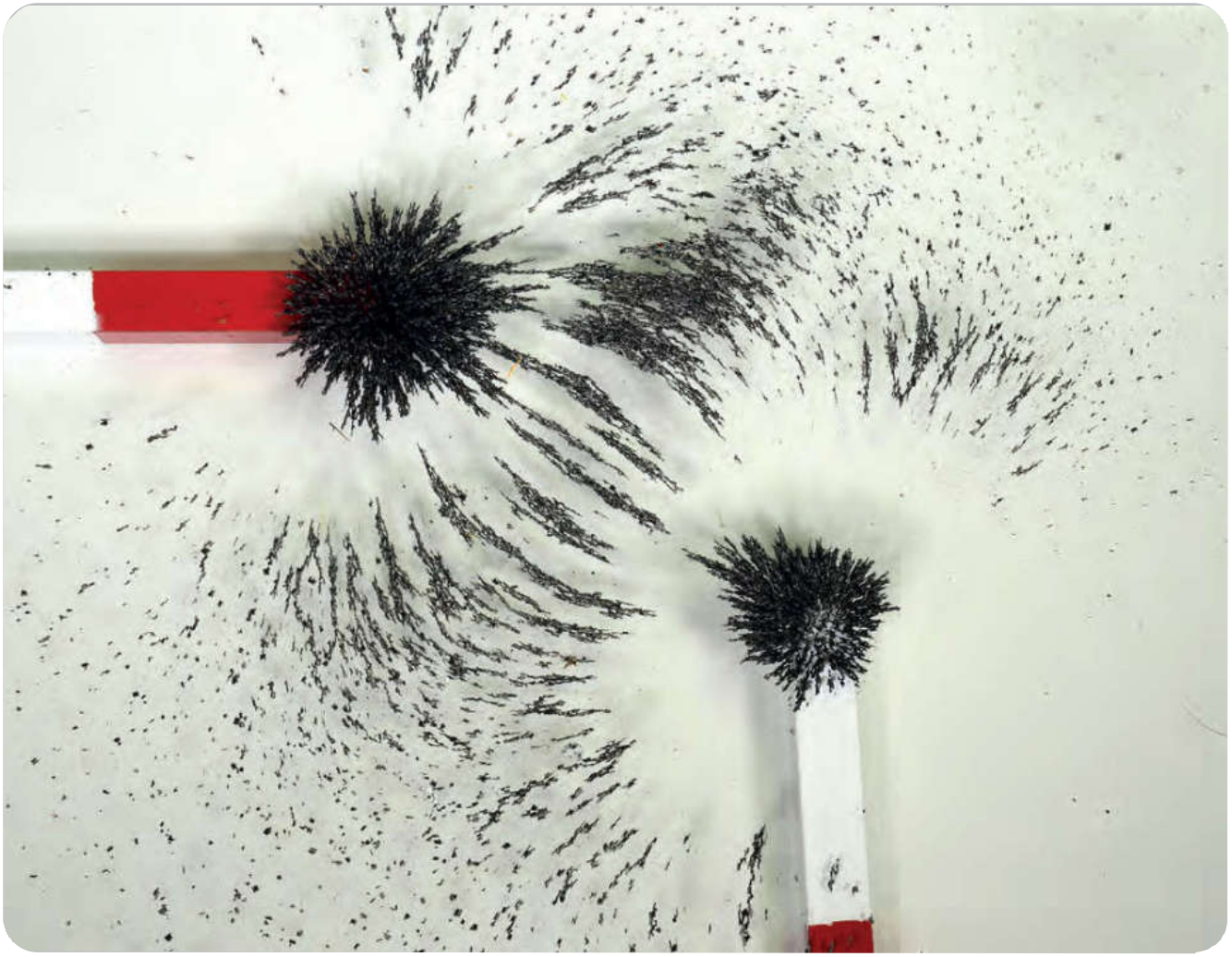
DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.



LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP3.2 Magnetism

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set EL2 (207 132S). Describes 12 experiments from the field of magnetism.

Topics:
Magnetic forces and fields; Magnetic induction; Magnetic fields

520 7132EN	LIT: LP3.2 Magnetism	

SUBJECT AREA

LIT: LP3 Science Lab Electricity, digital

includes only ONE subject area

Comprehensive physics experiment instructions in the field of electricity for the Science Lab.
Contains 154 experiments on electrostatics, magnetism, basic electrical circuits and electrochemistry, electromagnetism and induction, motors and generators and electronics.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 713	LIT: LP3 Science Lab Electricity, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

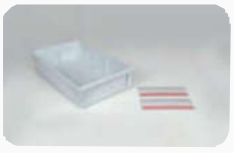
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

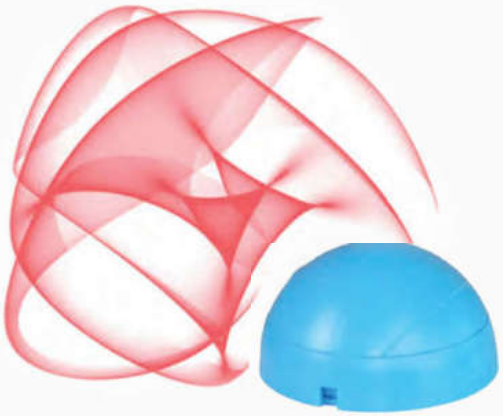
Discover and experience magnetism by yourself

MAKING MAGNETIC FIELDS VISIBLE

DESCRIBING FIELD LINES AND INTERPRETING THE BEHAVIOUR OF MAGNETS

DRAWING CONCLUSIONS ABOUT THE EARTH'S MAGNETIC FIELD

UNDERSTANDING THE FUNCTIONS OF A COMPASS



USING THE HEMISPHERE TO UNDERSTAND THAT THE EARTH IS A DIPOLE

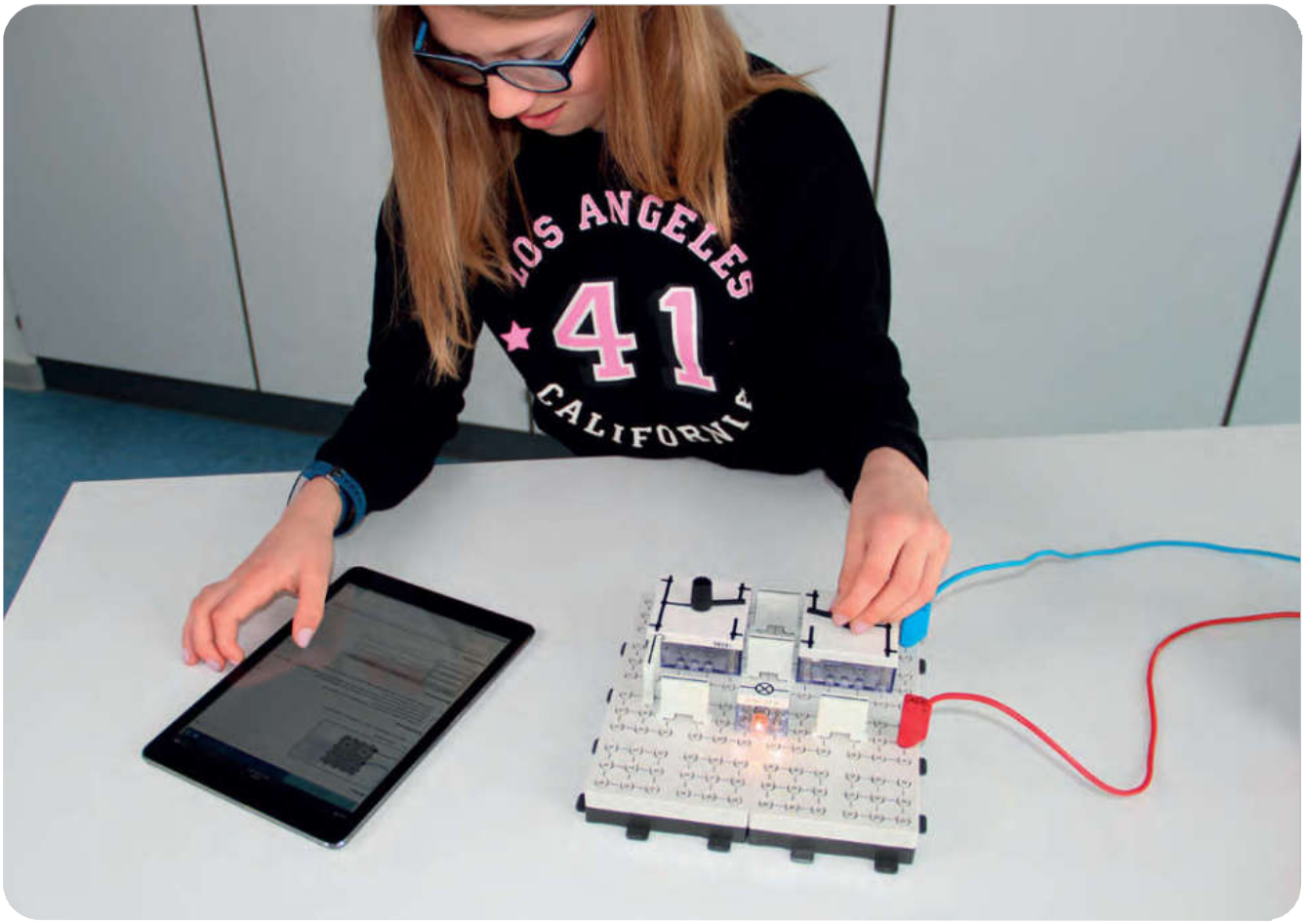
ELECTRICS – EL3

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

LP3.3	BASIC ELECTRICAL CIRCUITS AND ELECTROCHEMISTRY	
LP3.3.1	**Electrical circuits and switches**	
LP3.3.1.1	The simple circuit	
LP3.3.1.2	Conductors and non-conductors (insulators)	
LP3.3.1.3	Switching over	
LP3.3.1.4	Two-way switches	
LP3.3.1.5	AND gate, OR gate	
LP3.3.2	**Electrical measurement methods**	
LP3.3.2.1	Measuring current intensity in a simple circuit	
LP3.3.2.1C	Measuring current intensity in a simple circuit (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.2.2	Measuring voltage in a simple circuit	
LP3.3.2.2C	Measuring voltage in a simple circuit (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.3	**Ohmic resistance**	
LP3.3.3.1	Ohm's law	
LP3.3.3.1C	Ohm's law (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.3.2	How a wire's resistance depends on its material, length and cross-section	
LP3.3.3.2C	How a wire's resistance depends on its material, length and cross-section (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.3.3	Voltage distribution in a current-carrying wire (potentiometer)	
LP3.3.3.3C	Voltage distribution in a current-carrying wire (potentiometer) (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.3.4	Resistors in series	
LP3.3.3.4C	Resistors in series (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.3.5	Resistors in parallel	
LP3.3.3.5C	Resistors in parallel (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.4	**Special capacitors**	
LP3.3.4.1	Temperature-dependent resistors (NTC)	
LP3.3.4.1C	Temperature-dependent resistors (NTC) (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.4.2	Light-dependent resistors LDR (photo-conductive cell)	
LP3.3.4.2C	Light-dependent resistors LDR (photo-conductive cell) (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.5	**Voltage sources**	
LP3.3.5.1	Parallel and series connection of monocells	
LP3.3.5.1C	Parallel and series connection of monocells (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.5.2	Terminal voltage and internal resistance of a voltage source	
LP3.3.5.2C	Terminal voltage and internal resistance of a voltage source (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.6	**Electrical application circuits**	
LP3.3.6.1	Self-heating and temperature sensitivity in wire-wound resistors	
LP3.3.6.1C	Self-heating and temperature sensitivity in wire-wound resistors (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.6.2	Model of a fuse	
LP3.3.6.3	Bimetal switch (model of a fire alarm)	
LP3.3.6.4	Power and work of an electrical current	
LP3.3.6.4C	Power and work of an electrical current (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.7	**Electrochemistry**	
LP3.3.7.1	Conductivity of aqueous solutions (electrolytes)	
LP3.3.7.1C	Conductivity of aqueous solutions (electrolytes) (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.7.2	Relation between current and voltage in an electrolyte	
LP3.3.7.2C	Relation between current and voltage in an electrolyte (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.3.7.3	Galvanising	
LP3.3.7.4	Galvanic cells	
LP3.3.7.4C	Galvanic cells (with Mobile-CASSY 2 WiFi)	DIGITAL

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

40 EXPERIMENTS



LP3.3.1.4 Two-way switches

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP3.3 BASIC ELECTRICAL CIRCUITS AND ELECTROCHEMISTRY

TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Electrics EL3	Mobile-CASSY 2 WiFi	Science Lab Electricity digital

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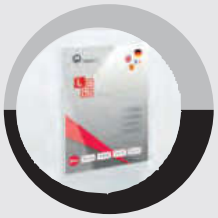


Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Electrics EL3 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray. With the equipment set EL3, 40 experiments at school, college and university level for worldwide curriculums can be performed. The students deal with the topics electrical basic circuits and electrochemistry. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
2	Coupling plug 4 mm
1	Bimetallic strip
2	Safety connecting lead 50 cm, red
2	Safety connecting lead 50 cm, blue
1	Safety connecting lead 50 cm, black
1	Bridging plugs STE 2/19, set of 10
1	Adapter 4-mm plug/4-mm socket
2	Crocodile clip, polished
1	Conductors/insulators, set of 6
1	Wrapping plate for wires
2	Plug-in board safety socket, 20/10
2	Monocell holder STE 2/50
1	Resistor 47 Ohm, STE 2/19
2	Resistor 100 Ohm, STE 2/19
1	Resistor 1 kOhm, STE 2/19
1	Resistor 10 kOhm, STE 2/19

Count	Name
1	Variable resistor 47 kOhm, STE 2/19
1	Photoresistor LDR 05, STE 2/19
1	NTC resistor 2.2 kOhm, STE 2/19
1	PTC resistor 100 Ohm, STE 2/19
2	Lamp holder E10, lateral, STE 2/19
1	Toggle switch STE 2/19
2	Plug-in holder STE
1	Contact strip
2	Change-over switch STE 4/50
1	Flat trough/electrolysis cell
2	Plate electrode copper 76 x 40 mm
1	Plate electrode zinc 76 x 40 mm
1	Plate electrode iron 76 x 40 mm
1	Tray, high
1	Grindstone

207 133S	Science Lab Electrics EL3 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

OVERVIEW OF ADVANTAGES

- The plug-in system enables even larger circuits to be mounted on the plug-in boards
- Variable plug-in board with safety sockets for 4 mm plugs
- Set up experiments in L- or T-shape with the plug-in board
- Easily expandable for more complex circuits by plugging several boards together
- Wrapping plate for wires allows easy experimentation on the resistance of wires while using less resources

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per student

Count	Cat.-No.	Name	Description
1	610 010	Laboratory safety goggles, Focomax	

Additionally required per working group

Count	Cat.-No.	Name	Description
1	505 07	Bulbs, 4 V/0,16 W, E10, Set of 10	
1	505 08	Bulbs, 12 V/3 W, E10, Set of 10	
2	505 11	Bulbs, 2.5 V/0,25 W, E10, Set of 10	
1	521 487	AC/DC Power supply PRO 0...12 V/3 A	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
2	531 120	Multimeter LDanalog 20	alternative for analog measurements
2	685 48	Mono cell 1.5 V (IEC R20)	Voltage sources experiments (LP3.3.5)

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 713	LIT: LP3 Science Lab Electrics, digital	
1	550 42	Constantan resistance wire, 0.35 mm diameter, 100 m	Ohmic resistance experiments (LP3.3.3)
1	550 46	Chrome-nickel resistance wire, 0.25 mm diameter, 100 m	Wire's resistance experiments (LP3.3.3)
1	550 47	Chrome-nickel resistance wire, 0.35 mm diameter, 100 m	Wire's resistance experiments (LP3.3.3)
1	550 51	Iron resistance wire, 0.2 mm diameter, 100 m	Wire's resistance experiments (LP3.3.3)
1	672 9650	Copper (II) sulfate solution 1%, 50 ml	Electrochemistry experiments (LP3.3.7)
1	673 5700	Sodium chloride 250 g	Electrochemistry experiments (LP3.3.7)
1	674 7960	Sulfuric acid, diluted, 0.05 mol/l, 2 l	Electrochemistry experiments (LP3.3.7)
1	675 3400	Water, pure, 1 l	Electrochemistry experiments (LP3.3.7)

Detailed information on **Mobile-CASSY 2 WiFi**, **sensors**, **literature packages** and **chemical sets** are available on the following pages.

MOBILE-CASSY 2 WIFI

With the Mobile-CASSY 2 WiFi, voltage *(U)*, current *(I)*, power *(P)* and energy *(E)* can be measured via 4 mm safety sockets.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP3.3 Electrical basic circuits and electrochemistry

printed version available in ring file

Detailed experiment instructions relating to Science Lab Set EL3 (207 133S).
Describes 40 experiments from the field of basic electrical circuits and electrochemistry.

Topics:
Electrical circuits and switches; Electrical measurement methods; Ohmic resistance; Special resistors; Voltage sources; Electrical application circuits; Electrochemistry

520 7133EN	LIT: LP3.3 Electrical basic circuits and electrochemistry	

SUBJECT AREA

LIT: LP3 Science Lab Electricity, digital

includes only ONE subject area

Comprehensive physics experiment instructions in the field of electricity for the Science Lab.
Contains 154 experiments on electrostatics, magnetism, basic electrical circuits and electrochemistry, electromagnetism and induction, motors and generators and electronics.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 713	LIT: LP3 Science Lab Electricity, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

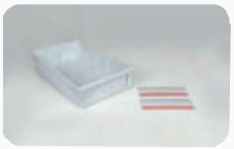
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES

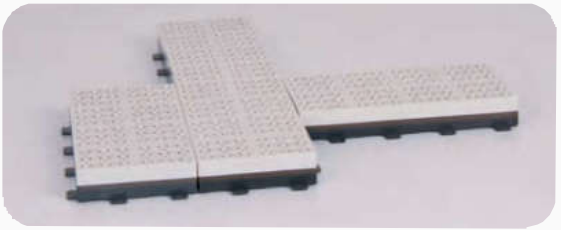


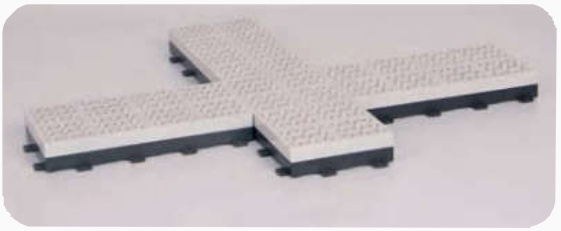


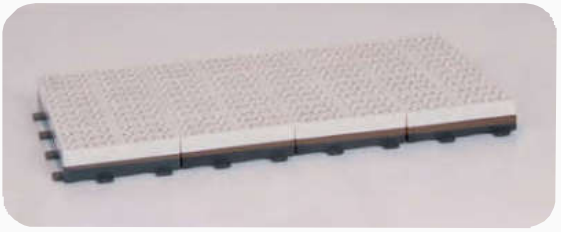
You can find detailed information on additional storage accessories from page 228.

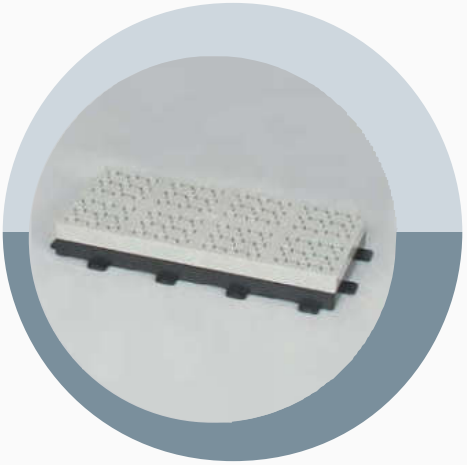
INTRODUCING THE TOPIC

The possibilities of the plug-in board - changeable and adaptable





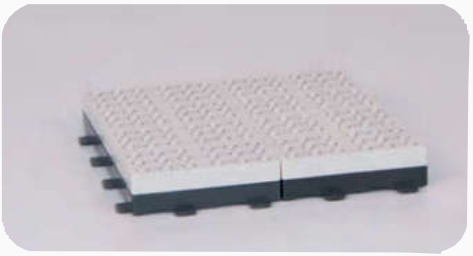




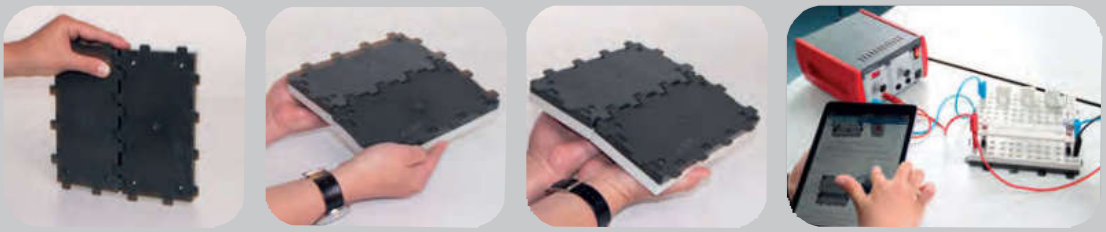
FLEXIBLE AND MODULAR

- Facilitates the use of safety wires in experiments
- Experiment set-up in T and L shapes
- Sturdy
- Minimal space required

FOR SIMPLE ELECTRICAL EXPERIMENTS TO COMPLEX ELECTRONICS CIRCUITS



EASY TO SET UP AND DISASSEMBLE



The sturdy plug-in boards can be clicked together easily.

ELECTRICS – EL4

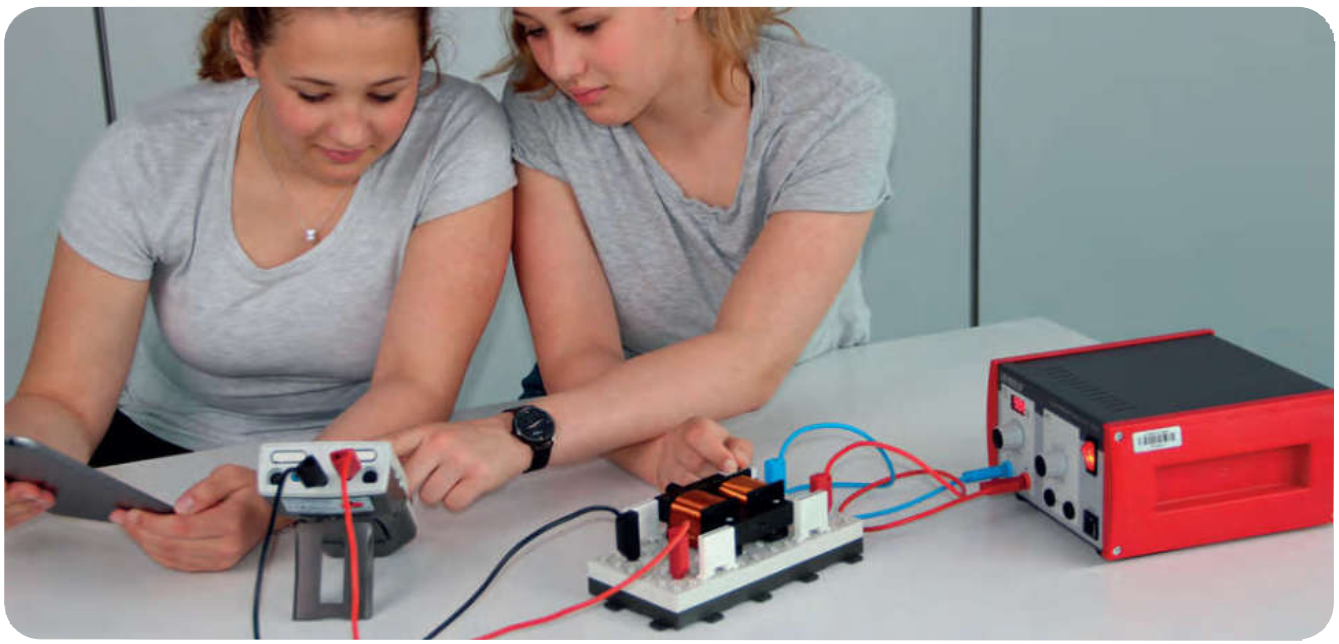
OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors		
	LP3.4	**ELECTROMAGNETISM AND INDUCTION**
	LP3.4.1	Electromagnetism
	LP3.4.1.1	Magnetic effect of electric current
	LP3.4.1.2	Current-carrying conductor in a magnetic field
	LP3.4.1.3	Magnetic field of a coil
●	LP3.4.1.3C	Magnetic field of a coil (with Mobile-CASSY 2 WiFi) DIGITAL
	LP3.4.2	Electromagnetic applications
	LP3.4.2.1	Electromagnet
	LP3.4.2.2	Electromagnetic relays
	LP3.4.2.3	The electric bell
	LP3.4.3	Induction
	LP3.4.3.1	Electromagnetic induction with bar magnet and a coil
	LP3.4.3.1C	Electromagnetic induction with bar magnet and a coil (with Mobile-CASSY 2 WiFi) DIGITAL
	LP3.4.3.2	Electromagnetic induction with two coils
	LP3.4.3.2C	Electromagnetic induction with two coils (with Mobile-CASSY 2 WiFi) DIGITAL
	LP3.4.4	Transformers
	LP3.4.4.1	Voltage transformation
●	LP3.4.4.1C	Voltage transformation (with Mobile-CASSY 2 WiFi) DIGITAL
	LP3.4.4.2	Current transformation
	LP3.4.4.2C	Current transformation (with Mobile-CASSY 2 WiFi) DIGITAL
	LP3.4.5	Applications of induction
	LP3.4.5.1	Self-induction of a coil (model of an induction coil)
	LP3.4.5.2	Model of an alternating current generator
	LP3.4.5.2C	Model of an alternating current generator (with Mobile-CASSY 2 WiFi) DIGITAL
	LP3.4.6	Coils in direct and alternating current circuits
	LP3.4.6.1	DC and AC resistance of a coil I (observation experiment)
	LP3.4.6.2	DC and AC resistance of a coil II (measuring experiment)
	LP3.4.6.2C	DC and AC resistance of a coil II (measuring experiment) (with Mobile-CASSY 2 WiFi) DIGITAL

21 EXPERIMENTS

For experiments marked with „C“, the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

● Voltage sensor M, ±30 V ● Magnetic field sensor M, ±100 mT



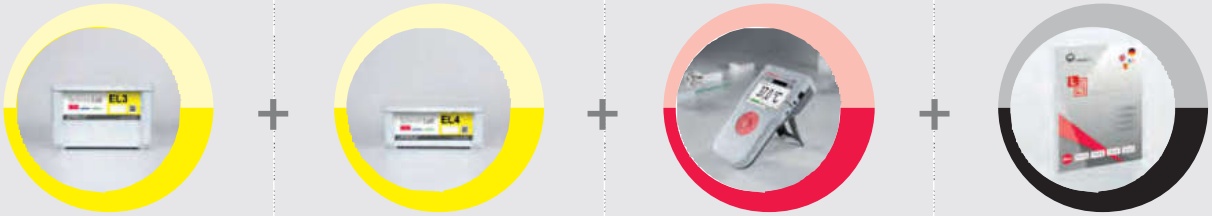
LP3.4.3.2C Electromagnetic induction with two coils

LP3.4.3.1C Electromagnetic induction with bar magnet and a coil

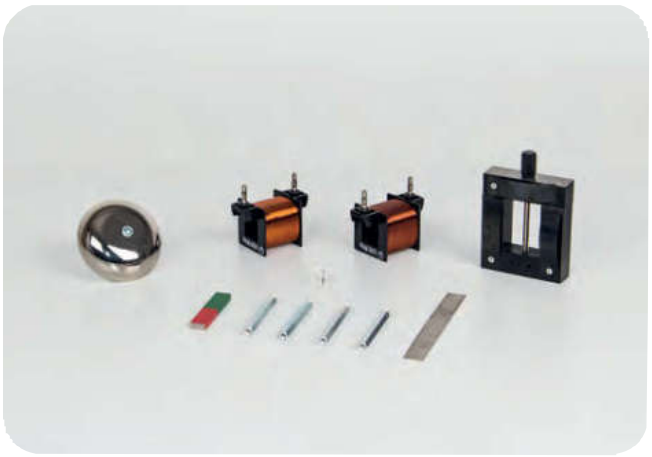
OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP3.4 ELECTROMAGNETISM AND INDUCTION

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Electrics EL3	Electrics EL4	Mobile-CASSY 2 WiFi	Science Lab Electricity digital



Detailed information on the above listed and **additionally required equipment** is available on the following pages.



Science Lab Electrics EL4 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray.
With the equipment set EL4, together with the Science Lab Electrics EL3 (207 133S), 21 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topic electromagnetism. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Bar magnet
1	Plotting compass
1	Magnetizable rods, set of 4
1	Bell dome
1	Leaf spring

Count	Name
1	Coil 500 turns STE 2/50
1	Coil 1000 turns STE 2/50
1	Transformer core, demountable
1	Tray, low
207 134S	Science Lab Electrics EL4 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 133S	Science Lab Electrics EL3 (Set)	
1	521 487	AC/DC Power supply PRO 0...12 V/3 A	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	524 436	Magnetic field sensor M, ±100 mT	
1	524 438	Voltage sensor M, ±30 V	
1	500 622	Safety connecting lead 50 cm, blue	Transformation experiment (LP3.4.4)
2	531 120	Multimeter LDanalog 20	alternative for analog measurements

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 713	LIT: LP3 Science Lab Electricity, digital	

OVERVIEW OF ADVANTAGES

- With EL 4, students understand the link between electricity and magnetism - for example through induction experiments
- The demountable transformer core is easy to use so the transformation of voltages can be worked on quickly and comprehensibly
- Acquired skills: Understanding the connections between magnetic and electrical phenomena

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

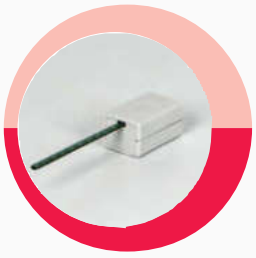
Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS



Magnetic field sensor M, ±100 mT ●

For measuring the tangential or axial magnetic flux density up to ±100 mT with Mobile-CASSY 2 WiFi (524 005W).

524 436	Magnetic field sensor M, ±100 mT	

Voltage sensor M, ±30 V ●

For measuring the electrical voltage up to ±30 V with Mobile-CASSY 2 (524 005W). In connection with the integrated voltage input, Mobile-CASSY 2 WiFi (524 005W) can become a two channel storage oscilloscope.

524 438	Voltage sensor M, ±30 V	

You can find detailed information on these and other sensors from page 229.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP3.4 Electromagnetism and Induction

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set EL4 (207 134S) in conjunction with Science Lab Set EL3 (207 133S). Describes 21 experiments from the fields of electromagnetism and induction.

Topics:
Electromagnetism; Electromagnetic applications; Induction; Transformers; Applications of induction; Coils in direct and alternating current circuits

520 7134EN	LIT: LP3.4 Electromagnetism and Induction	

SUBJECT AREA

LIT: LP3 Science Lab Electricity, digital

Includes only ONE subject area

Comprehensive physics experiment instructions in the field of electricity for the Science Lab.
Contains more than 154 experiments on electrostatics, magnetism, basic electrical circuits and electrochemistry, electromagnetism and induction, motors and generators and electronics.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 713	LIT: LP3 Science Lab Electricity, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

Includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains about 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

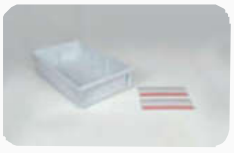
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





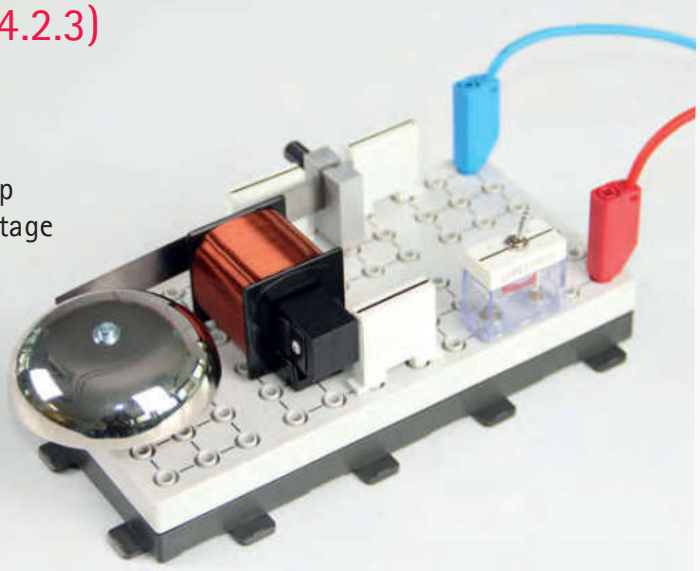
You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

Generate sounds with electromagnetism

THE ELECTRIC BELL (LP3.4.2.3)

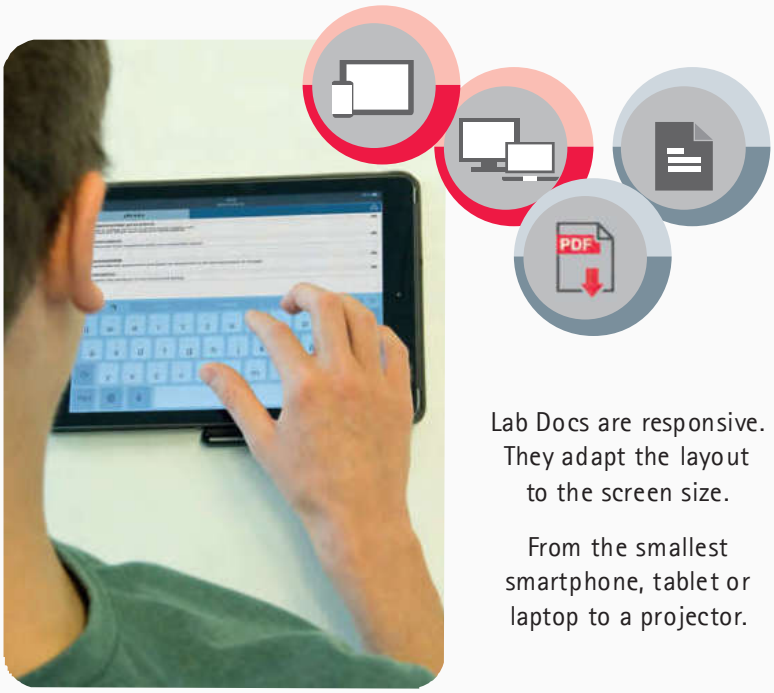
- Investigating the function of an electric bell
- The materials can be used to set up a bell that is operated with AC voltage



EVERYDAY EXPERIENCE – What happens if I press a bell button?
+ GAIN KNOWLEDGE ABOUT MAGNETISM
+ UNDERSTAND ELECTRICAL PHENOMENA

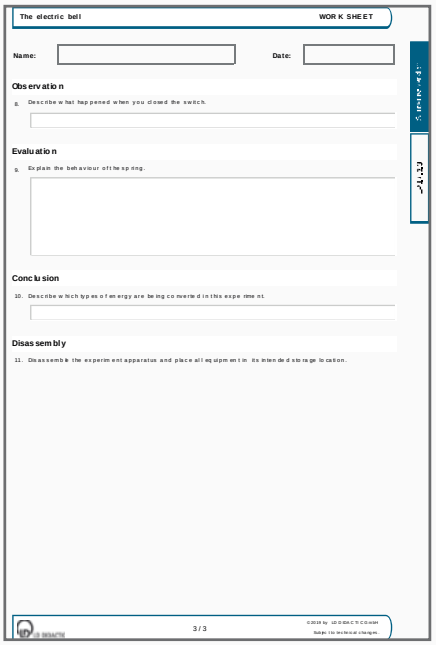
INTERESTING AND EASY-TO-UNDERSTAND EXPERIMENT INSTRUCTIONS

DIGITAL OR IN HARD COPY



Lab Docs are responsive. They adapt the layout to the screen size.

From the smallest smartphone, tablet or laptop to a projector.



The electric bell WORK SHEET

Name: Date:

Observation

8. Describe what happened when you closed the switch.

Evaluation

9. Explain the behaviour of the spring.

Conclusion

10. Describe which types of energy are being converted in this experiment.

Disassembly

11. Disassemble the experiment apparatus and place all equipment in its intended storage location.

3 / 3

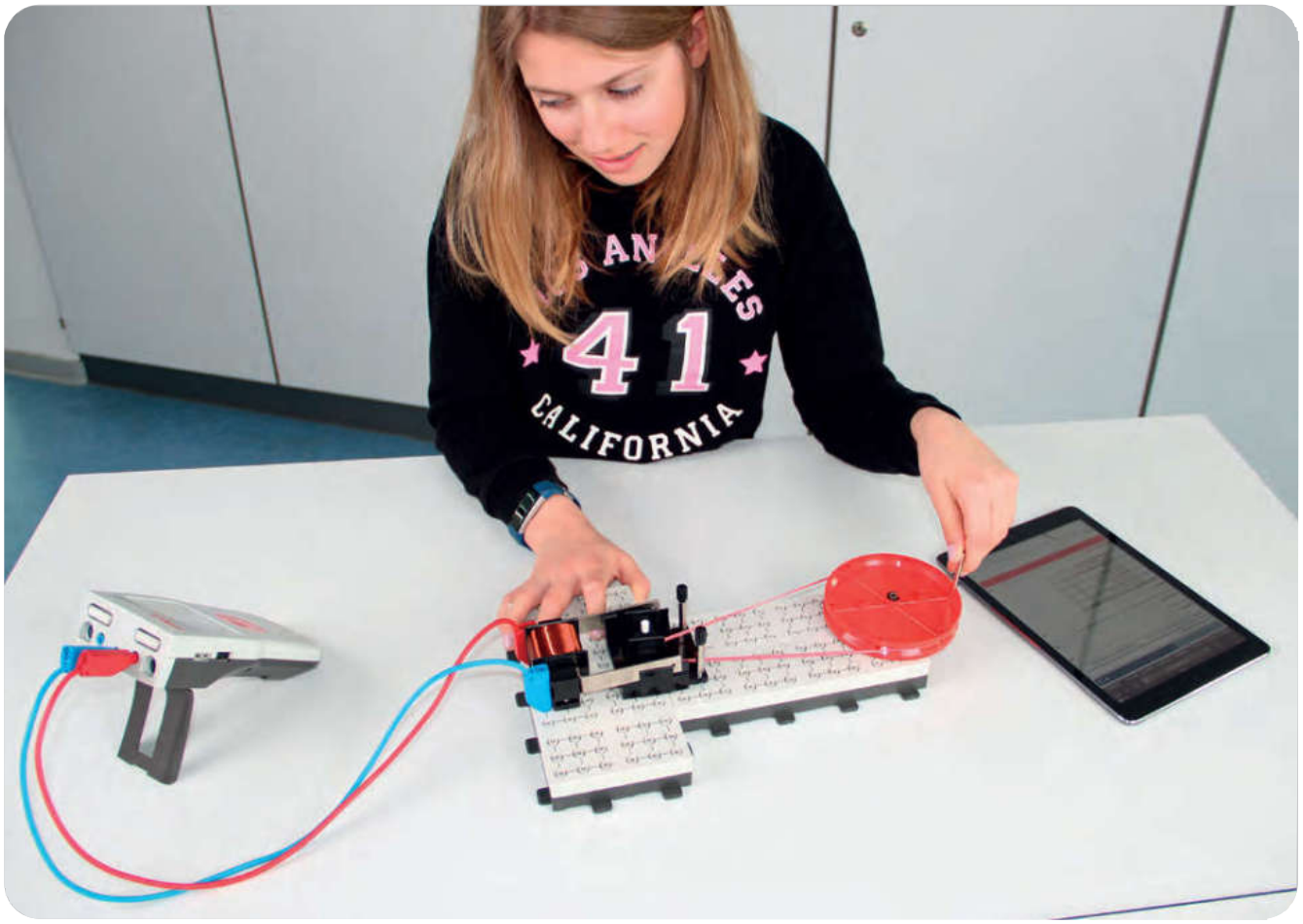
ELECTRICS – EL5

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

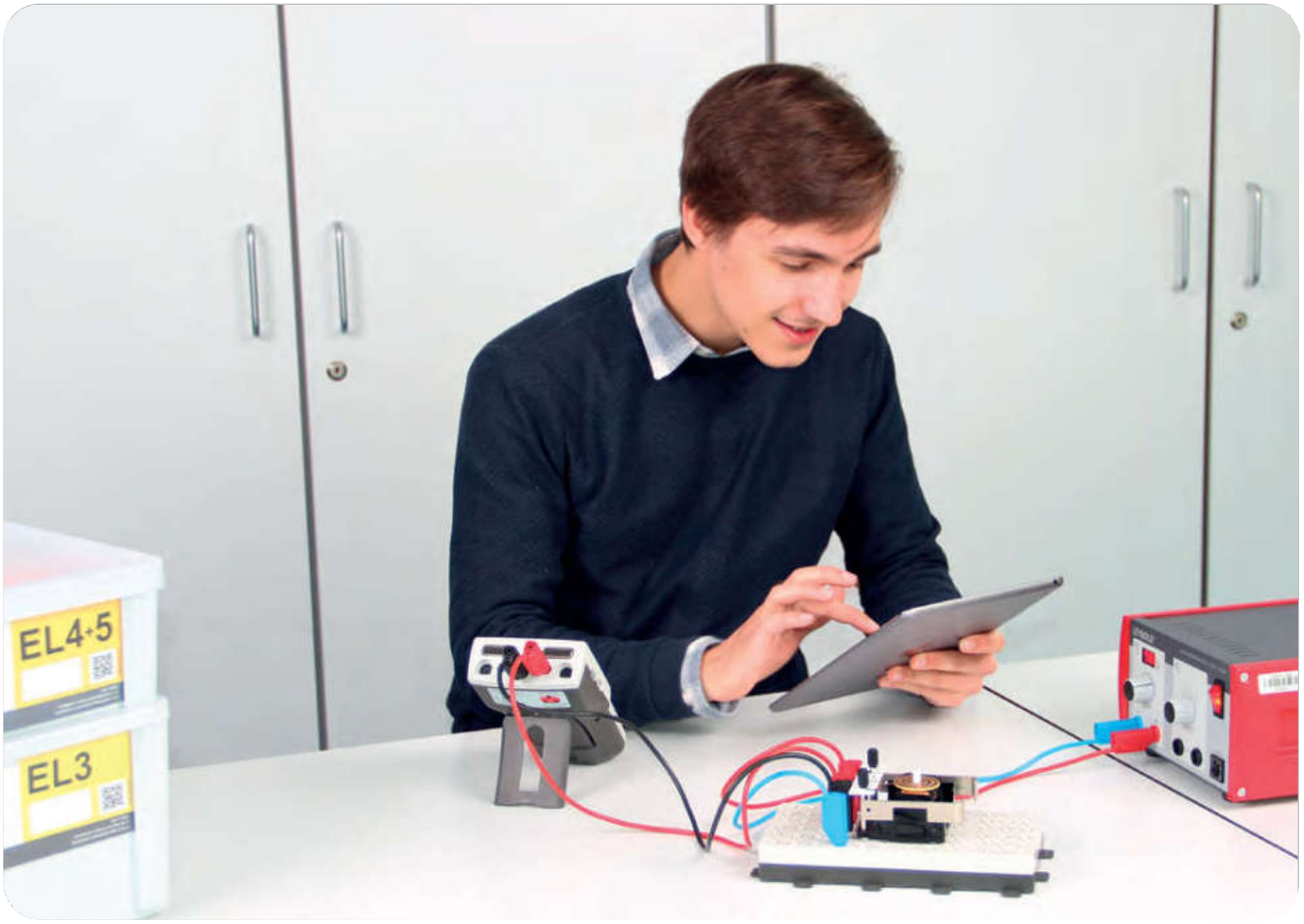
LP3.5	MOTORS AND GENERATORS	
LP3.5.1	Generators	
LP3.5.1.1	Dynamo	
LP3.5.1.1C	Dynamo (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.5.1.2	Universal generator - functional principle	
LP3.5.1.2C	Universal generator - functional principle (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.5.1.3	Power plant generator	
LP3.5.1.3C	Power plant generator (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.5.1.4	AC/DC generator with electromagnetic stator	
LP3.5.1.4C	AC/DC generator with electromagnetic stator (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.5.2	Electric motors	
LP3.5.2.1	DC motor - functional principle	
LP3.5.2.1C	DC motor - functional principle (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.5.2.2	Universal shunt-wound motor	
LP3.5.2.2C	Universal shunt-wound motor (with Mobile-CASSY 2 WiFi)	DIGITAL
LP3.5.2.3	Universal series-wound motor - functional principle	
LP3.5.2.3C	Universal series-wound motor - functional principle (with Mobile-CASSY 2 WiFi)	DIGITAL

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

14 EXPERIMENTS



LP3.5.1.1C Dynamo



LP3.5.2.1C DC motor – functional principle

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP3.5 MOTORS AND GENERATORS

BASIC SET	TOPIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Electrics EL3	Electrics EL4	Electrics EL5	Mobile-CASSY 2 WiFi	Science Lab Electricity digital

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Electrics EL5 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group. The equipment is stored in Science Lab Electrics EL4 (207 134S). With the supplementary equipment set EL5, together with the Science Lab Electrics EL3 (207 133S) and EL4 (207 134S), 14 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics motors and generators. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Plug-in axle
1	Rubber rings, set of 8
1	Pulley Ø 100 mm, plug-in
1	Stator STE 4/50

Count	Name
1	Coil rotor STE
1	Brush yoke STE
1	Magneto inductor STE
207 135S	Science Lab Electrics EL5 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 133S	Science Lab Electrics EL3 (Set)	
1	207 134S	Science Lab Electrics EL4 (Set)	
1	521 487	AC/DC Power supply PRO 0...12 V/3 A	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
2	531 120	Multimeter LDanalog 20	alternative for analog measurements

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 713	LIT: LP3 Science Lab Electricity, digital	

OVERVIEW OF ADVANTAGES

- Everyday relevance: Further insights into electromagnetism through experiments with simple motors and generators
- Engine and generator models are quickly assembled and functionally reliable
- Acquired skills: understanding different drive technologies (relevant for the debate on electromobility)

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

MOBILE-CASSY 2 WIFI

With the Mobile-CASSY 2 WiFi, voltage *(U)*, current *(I)*, power *(P)* and energy *(E)* can be measured via 4 mm safety sockets.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP3.5 Motors and Generators

Printed version available in ring file.

Detailed experiment instructions relating to Science Lab Set EL5 (207 135S) in conjunction with Science Lab Set EL3 (207 133S) and EL4 (207 134S). Describes 14 experiments from the field of motors and generators.

Topics:
Generators; Electric motors

520 7135EN	LIT: LP3.5 Motors and Generators	

SUBJECT AREA

LIT: LP3 Science Lab Electricity, digital

Includes only ONE subject area

Comprehensive physics experiment instructions in the field of electricity for the Science Lab.
Contains 154 experiments on electrostatics, magnetism, basic electrical circuits and electrochemistry, electromagnetism and induction, motors and generators and electronics.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 713	LIT: LP3 Science Lab Electricity, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

Includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

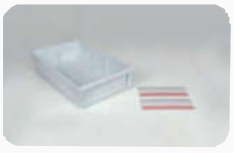
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES

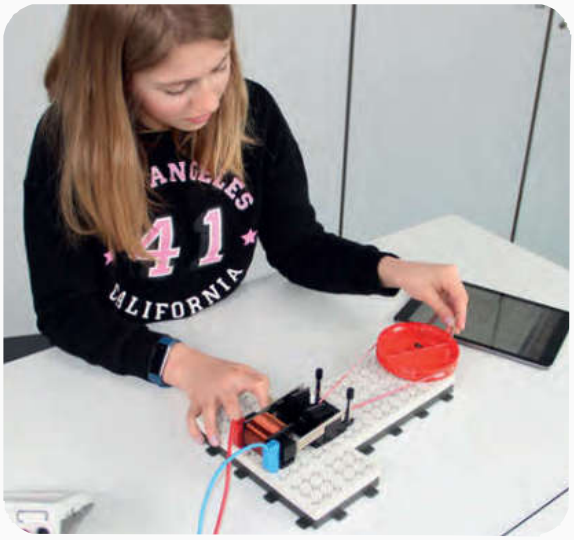




You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

Electromobility - the e-bike trend

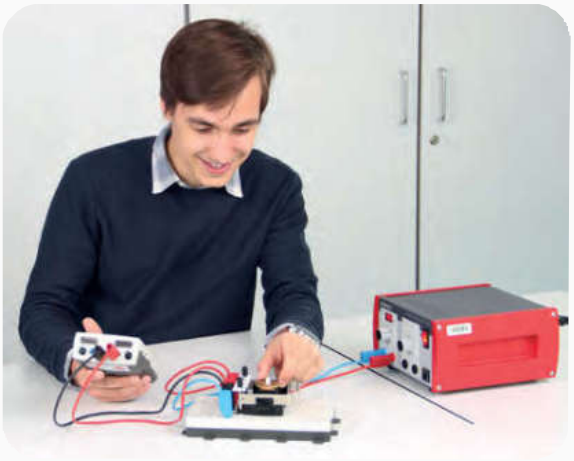


CLASSIC: BICYCLE LIGHT WITH DYNAMO

- As with every trend, it's all about gaining basic knowledge
- By spinning the drive roller, the voltage can be measured or visualised using a light bulb
- General understanding of generators
- Transferable to wind energy

INNOVATIVE: ELECTRIC DRIVES

- The DC motor is comparable with an e-bike motor
- By assembling and operating different motors, the students gain knowledge of the respective functions
- Through this investigation and further experiments with electric motors, students get their first insight into the topic of electromobility



ELECTRONICS – EL6

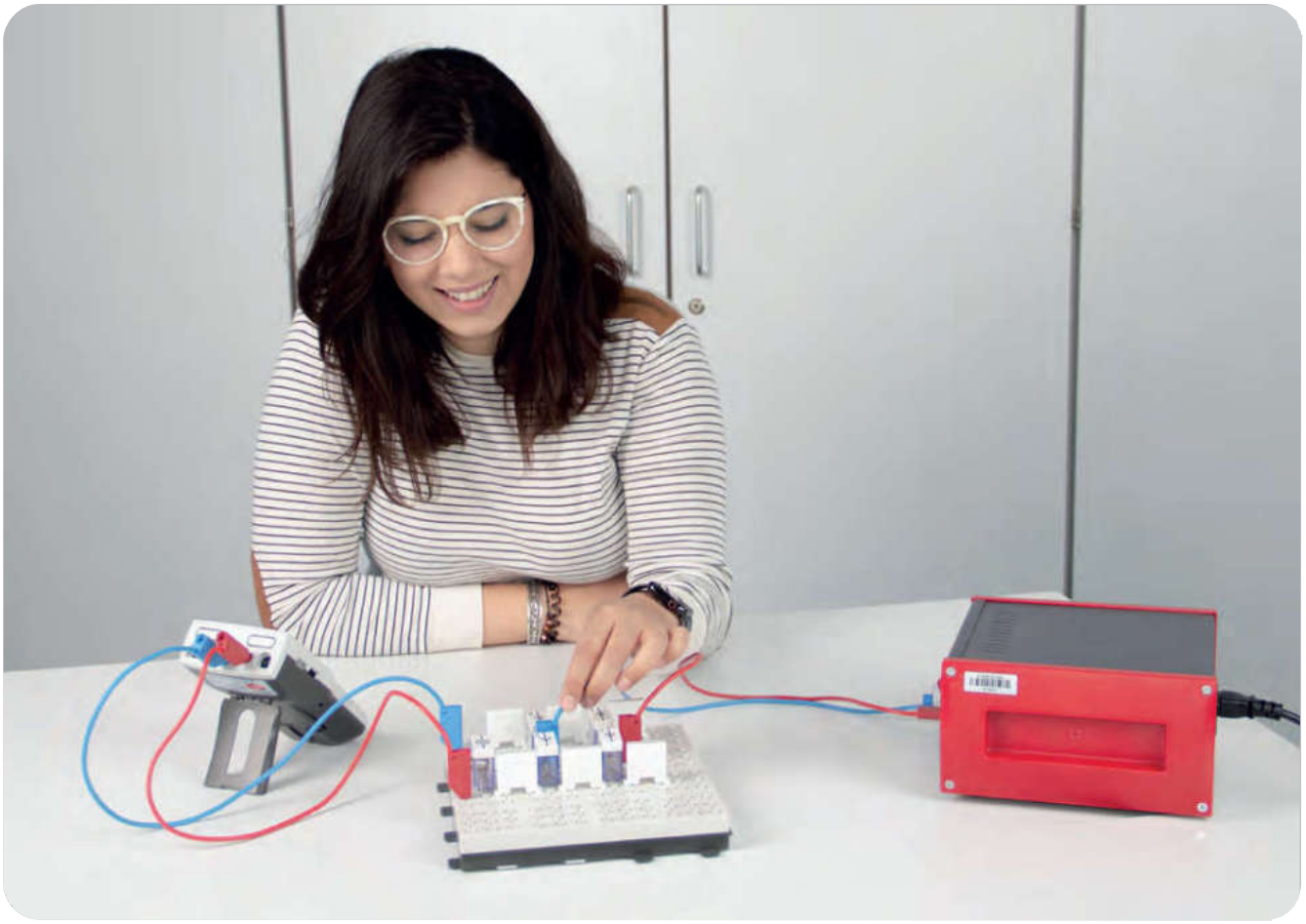
OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors		
	LP4.1	**BASIC ELECTRONIC CIRCUITS**
	LP4.1.1	Capacitors
	LP4.1.1.1	Capacitors in a DC circuit
	LP4.1.1.1C	Capacitors in a DC circuit (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.1.2	Capacitors in an AC circuit
	LP4.1.1.2C	Capacitors in an AC circuit (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.2	Relay circuits
	LP4.1.2.1	Light-controlled relays
	LP4.1.2.1C	Light-controlled relays (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.3	Diodes
	LP4.1.3.1	Characteristic curve of a diode
	LP4.1.3.1C	Characteristic curve of a diode (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.3.2	Half-wave rectification
	LP4.1.3.2C	Half-wave rectification (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.3.3	Full-wave rectification
	LP4.1.3.3C	Full-wave rectification (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.3.4	Light-emitting diodes
	LP4.1.3.4C	Light-emitting diodes (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.3.5	Polarity tester with diodes
	LP4.1.3.5C	Polarity tester with diodes (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.3.6	Characteristic curve of a Z diode
	LP4.1.3.6C	Characteristic curve of a Z diode (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.3.7	Overvoltage protection using a Z diode
●	LP4.1.3.7C	Overvoltage protection using a Z diode (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.4	Transistors
	LP4.1.4.1	Diode junctions on transistors, test circuit with light-emitting diodes
	LP4.1.4.2	Transfer characteristic of a transistor
	LP4.1.4.2C	Transfer characteristic of a transistor (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.4.3	Transistor circuit I, voltage control
	LP4.1.4.3C	Transistor circuit I, voltage control (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.4.4	Light-controlled transistor I, light barrier
	LP4.1.4.5	Delay switch
	LP4.1.4.5C	Delay switch (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.5	Diode circuits
	LP4.1.5.1	Overvoltage and reverse polarity protection using diodes
	LP4.1.5.1C	Overvoltage and reverse polarity protection using diodes (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.5.2	Smoothing pulsating DC voltages with capacitors
	LP4.1.5.2C	Smoothing pulsating DC voltages with capacitors (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.6	Flip-flops
	LP4.1.6.1	Basic experiments with flip-flops
	LP4.1.6.1C	Basic experiments with flip-flops (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.7	Amplifier circuits
	LP4.1.7.2	Touch-sensitive switches, humidity and fill level indicators
	LP4.1.7.2C	Touch-sensitive switches, humidity and fill level indicators (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.8	Solar cells
	LP4.1.8.1	Forward and reverse direction of a solar cell
	LP4.1.8.1C	Forward and reverse direction of a solar cell (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.8.2	Output and power characteristics of a solar cell
	LP4.1.8.2C	Output and power characteristics of a solar cell (with Mobile-CASSY 2 WiFi) DIGITAL
	LP4.1.8.3	No-load voltage of a solar cell
	LP4.1.8.3C	No-load voltage of a solar cell (with Mobile-CASSY 2 WiFi) DIGITAL

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

● Voltage sensor M, ±30 V

42 EXPERIMENTS

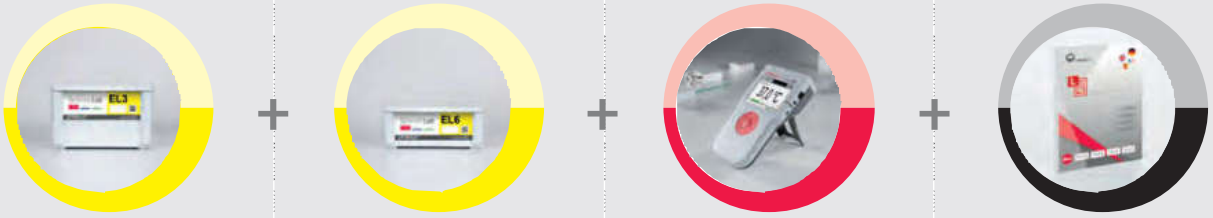


LP4.1.3.3C Full-wave rectification

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP4.1 BASIC ELECTRONIC CIRCUITS

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Electrics EL3	Electrics EL6	Mobile-CASSY 2 WiFi	Science Lab Electricity digital



Detailed information on the above listed and **additionally required equipment** is available on the following pages.

Science Lab Electrics EL6 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray.
With the equipment set EL6, together with the Science Lab Electrics EL3 (207 133S), 42 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics basic electronic circuits and transistor electronics. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Plug-in board safety socket, 20/10
1	Resistor 470 Ohm, STE 2/19
1	Resistor 4.7 kOhm, STE 2/19
1	Potentiometer 220 Ohm, STE 4/50
1	Capacitor, 1 µF, STE 2/19
1	Capacitor (electrolytic) 100 µF, STE 2/19
1	Capacitor (electrolytic) 470 µF, STE 2/19
1	Light emitting diode red, STE 2/19
4	Diode 1N 4007, STE 2/19
1	Zener diode 6.2, STE 2/19

Count	Name
1	Light emitting diode green, STE 2/19
1	Photodiode, lateral
1	Solar cell, STE 2/19
1	Transistor BD 137, NPN, e.b., STE 4/50
1	Transistor BD 138, PNP, e.b., STE 4/50
1	Relay with change-over switch STE 4/50
1	Earphone
1	Tray, low

207 136S	Science Lab Electrics EL6 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 133S	Science Lab Electrics EL3 (Set)	
1	521 487	AC/DC Power supply PRO 0...12 V/3 A	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	524 438	Voltage sensor M, ±30 V	
1	500 622	Safety connecting lead 50 cm, blue	Overvoltage protection experiment (LP4.1.3)
2	531 120	Multimeter LDanalog 20	alternative for analog measurements

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 713	LIT: LP3 Science Lab Electricity, digital	

OVERVIEW OF ADVANTAGES

- Students learn to understand more complex structures, such as diode and transistor circuits, through the structured experiment instructions
- Similarities to the use of printed circuit boards in electronic components become visible
- Acquired skills: understanding the functions of electronic components in modern technical devices

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

Voltage sensor M, ±30 V

For measuring the electrical voltage up to ±30 V with Mobile-CASSY 2 WiFi (524 005W). In connection with the integrated voltage input, Mobile-CASSY 2 WiFi (524 005W) can become a 2 channel storage oscilloscope.

524 438	Voltage sensor M, ±30 V	

You can find detailed information on this and other sensors from page 229.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP4.1 Electronics

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set EL6 (207 136S) in conjunction with Science Lab Set EL3 (207 133S). Describes 42 experiments from the field of electronics.

Topics:
Capacitors; Relay circuits; Diodes; Transistors; Diode circuits; Flip-flops; Amplifier circuits; Solar cells

520 7136EN	LIT: LP4.1 Electronics	

SUBJECT AREA

LIT: LP3 Science Lab Electricity, digital

Includes only ONE subject area

Comprehensive physics experiment instructions in the field of electricity for the Science Lab.
Contains 154 experiments on electrostatics, magnetism, basic electrical circuits and electrochemistry, electromagnetism and induction, motors and generators and electronics.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 713	LIT: LP3 Science Lab Electricity, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

Includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

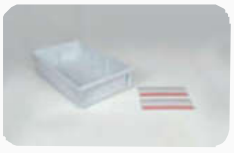
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES

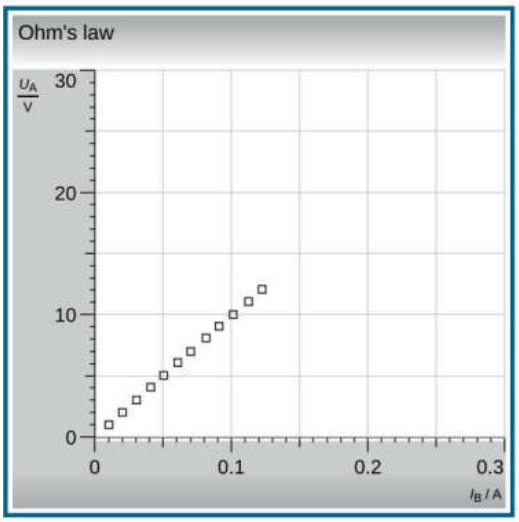




You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

Ohm's Law as a diagram with the Mobile-CASSY 2 WiFi



Current and voltage measurement on a resistor

MEASURE SEVERAL PHYSICAL VARIABLES AT THE SAME TIME

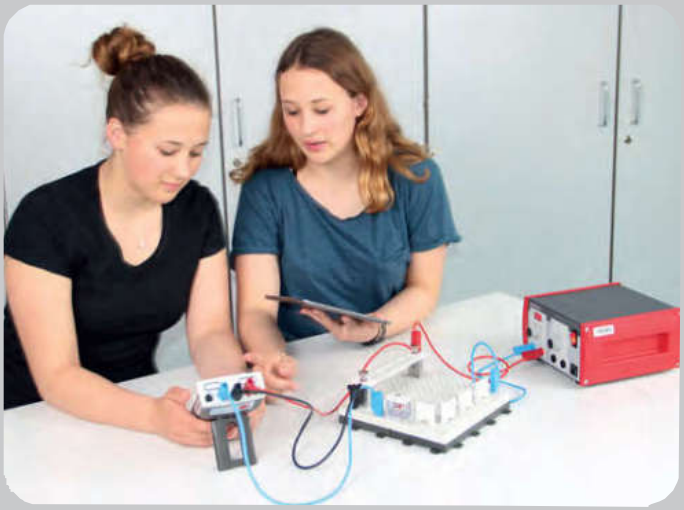
- With the Mobile-CASSY 2 WiFi, two or more measuring quantities can be measured against each other and simultaneously recorded, such as:
  - Current and voltage
  - Temperature and voltage
- Dependencies between measuring quantities can be illustrated exceptionally well in diagrams
- This allows students to gain a deeper understanding of the basic principles of electronics
- Simple measuring of characteristic curves is only possible with digital measuring technology

DIRECT DISPLAY OF CHARACTERISTIC CURVES IN THE DIAGRAMS IN THE DIGITAL EXPERIMENT LITERATURE

With interactivity between the Mobile-CASSY 2 WiFi and Lab Docs, the measured values are transferred in real time and the characteristic curves are displayed directly in the diagrams.

The Lab Doc with the recorded characteristic curve can also be saved as a digital protocol and then shared with the teacher.

With the Lab Docs Editor, the diagrams (among other features) can be adjusted.



OPTICS

Optics can be useful to introduce students to the methodology of investigating phenomena at a very early stage with simple experiments. Due to the flexible use of the LED lamp, light beams can be observed and described using various objects in simple experiment set-ups on the table. Additionally, more complex content, such as interference and diffraction phenomena, can be compiled in a comprehensible framework in advanced classes/lectures.

Two Optics Sets provide *four* topic areas with 72 experiments. Measured values can either be recorded in the classic way or, in some experiments, with the help of the Mobile-CASSY 2 WiFi and the lux sensor M.

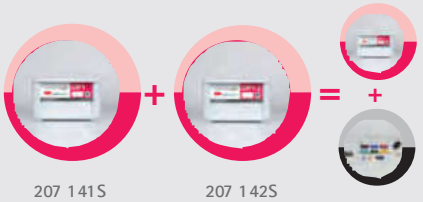
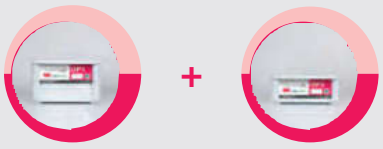
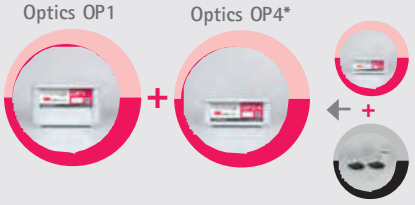
HIGHLIGHT

LP5.3.2.2 Complementary crossed gratings (Babinet's principle)

Students will learn that complementary screens produce the same diffraction images. In comparison with the gap and web experiment, the crossed gratings represent a much more complex structure.

For this experiment you will need the sets **Science Lab Optics OP1 (207 141S)** and **Science Lab Optics OP3 (207 143S)**.

Overview of topics and sets

EXPERIMENT TOPICS		REQUIRED SETS	NO. EXPERIMENTS	DETAILS
LP5.1	**RAY OPTICS AND GEOMETRICAL OPTICS**			
LP5.1.1	PROPAGATION OF LIGHT AND SHADOW FORMATION	Optics OP1  207 141S	46	PAGE 110
LP5.1.2	LIGHT AND SHADOW IN NATURE			
LP5.1.3	REFLECTION IN MIRRORS			
LP5.1.4	LIGHT REFRACTION			
LP5.1.5	DISPERSING LIGHT AND RECOMBINATION OF THE SPECTRUM			
LP5.1.6	LENSES AND LENS ABERRATIONS			
LP5.1.7	OPTICAL INSTRUMENTS FOR ANGULAR MAGNIFICATION			
LP5.1.8	OPTICAL INSTRUMENTS AND THE EYE			
LP5.2	**CHROMATICS**			
LP5.2.1	EXAMINATION OF THE LIGHT PATHS THROUGH A PRISM	Optics OP1 Optics OP2  207 141S 207 142S	11	PAGE 116
LP5.2.2	SPECTRAL COLOURS			
LP5.2.3	COLOUR MIXING			
LP5.3	**WAVE OPTICS**			
LP5.3.1	DIFFRACTION ON DIFFRACTION OBJECTS	Optics OP1 Optics OP3  207 141S 207 143S	7	PAGE 122
LP5.3.2	DIFFRACTION ON COMPLEMENTARY APERTURES			
LP5.4	**POLARISATION**			
LP5.4.1	POLARISATION FILTERS	Optics OP1 Optics OP4*  207 141S 207 144S	8	PAGE 128
LP5.4.2	PHOTOELASTIC DOUBLE REFRACTION			
LP5.4.3	POLARISATION DUE TO REFLECTION AND DIFFRACTION			
LP5.4.4	POLARISATION DUE TO SCATTERING			
LP5.4.5	OPTICAL ACTIVITY			

*Optic Set OP3 is not required.

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

OPTICS – OP1

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors	LP5.1	RAY OPTICS AND GEOMETRICAL OPTICS
	LP5.1.1	Propagation of light and shadow formation
	LP5.1.1.1	Propagation of light
	LP5.1.1.2	Can light pass through all matter?
	LP5.1.1.3	Shadows
	LP5.1.1.4	Illuminance
●	LP5.1.1.4C	Illuminance (with Mobile-CASSY 2 WiFi) DIGITAL
	LP5.1.2	Light and shadow in nature
	LP5.1.2.1	Day and night
	LP5.1.2.2	The seasons
	LP5.1.2.3	The phases of the moon
	LP5.1.2.4	Lunar and solar eclipses
	LP5.1.3	Reflection in mirrors
	LP5.1.3.1	Reflection in a plane mirror
	LP5.1.3.2	Mirror image in a plane mirror
	LP5.1.3.3	Optical paths in a concave mirror
	LP5.1.3.4	Focal length of the convex mirror
	LP5.1.3.5	Focal length of the concave mirror
	LP5.1.3.6	Images in a concave mirror
	LP5.1.3.7	Images in a convex mirror
	LP5.1.4	Light refraction
	LP5.1.4.1	Light refraction on a semicircular body
	LP5.1.4.2	Refraction on a plane-parallel plate
	LP5.1.4.3	Total internal reflection
	LP5.1.4.4	Retroreflector prisms and dove prisms
	LP5.1.4.5	Refraction in various media on a semicircular trough and semicircular body
	LP5.1.5	Dispersing light and recombination of the spectrum
	LP5.1.5.1	Dispersion of white light with a prism
	LP5.1.5.2	Recombination of the spectrum
	LP5.1.6	Lenses and lens aberrations
	LP5.1.6.1	Optical path of a plano-convex lens
	LP5.1.6.2	Optical path of a bi-convex lens
	LP5.1.6.3	Images of convex lenses
	LP5.1.6.4	Spherical aberration of lenses
	LP5.1.6.5	Focal length determination of a convex lens via autocollimation
	LP5.1.6.6	Optical path of a plano-concave lens
	LP5.1.6.7	Optical path of a bi-concave lens
	LP5.1.6.8	The image formula
	LP5.1.6.9	Pincushion and barrel distortion
	LP5.1.6.10	Optical path of lens combinations
	LP5.1.6.11	Optical path of a lens system
	LP5.1.7	Optical instruments for angular magnification
	LP5.1.7.1	Magnification with a magnifying glass
	LP5.1.7.2	The microscope
	LP5.1.7.3	Changing the magnification of a microscope
	LP5.1.7.4	Telescope models
	LP5.1.7.5	Magnification in a Galilean telescope
	LP5.1.7.6	Magnification in a Keplerian telescope
	LP5.1.8	Optical instruments and the eye
	LP5.1.8.1	The camera
	LP5.1.8.2	Depth of field of a camera
	LP5.1.8.3	The slide projector
	LP5.1.8.4	The human eye
	LP5.1.8.5	Refractive errors and vision correction
	LP5.1.8.6	Optical illusions

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi. ● Lux sensor M

46 EXPERIMENTS

LP5.1.1.4C Illuminance

In this experiment, students will discover that the illuminance E of a "point source" decreases with $1/r^2$ and thus is subject to the law of distance. For this experiment you will need the set **Science Lab Optics OP1 (207 141S)**.

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP5.1 RAY OPTICS AND GEOMETRICAL OPTICS

TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Optics OP1	Mobile-CASSY 2 WiFi	Science Lab Optics digital
 +	 +	

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Optics OP1 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray. With the equipment set OP1, 46 experiments at school, college and university level for worldwide curriculums can be performed. The students deal with the topics ray path optics and geometrical optics. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Tape measure 2 m / 1 mm
1	Rubber rings, set of 8
1	Light box housing, LED
1	LED lamp
1	Plug-in power supply USB 5 V DC (A socket)
1	Cable USB (USB Type A - Mini-USB)
1	Translucent screen on rod
1	Plate holder on rod
1	Diaphragm and slide holder on rod
1	Plane mirror 7.5 cm x 5 cm
1	Earth-moon model on rod
1	Combined mirror model
1	Trapezoidal body 60/45 x 30 mm
1	Semicircular body r = 30 mm
1	Right-angled prism h = 30 mm
1	Plano-convex lens

Count	Name
1	Plano-concave lens
1	Semi-circular cell r = 30 mm
1	Lens on rod f = +50 mm
1	Lens on rod f = +100 mm
1	Lens on rod f = +300 mm
1	Lens on rod f = -100 mm
1	Convex-concave mirror on rod
1	Precision metal rail, 50 cm
5	Clamp rider
1	Set of 2 slit diaphragms
1	Set of 4 different diaphragms
1	Set of 4 aperture diaphragms
1	Objects for investigating images, pair
1	Transparencies, optical illusions, set of 6
1	Tray, high
207 141S	Science Lab Optics OP1 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	524 444	Lux sensor M	

Additionally recommended per working group

Count	Cat.-No.	Name	Description
1	459 40	Disc with angular Scale	Mirror reflection & light refraction experiments (LP5.1.3, LP5.1.4)

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 714	LIT: LP5 Science Lab Optics, digital	

OVERVIEW OF ADVANTAGES

- Includes basic optical devices and all other devices for ray optics and geometrical optics
- The LED lamp can be used both for experiments on the work bench (light box) and on the precision metal rail
- Easy-to-use 50 cm precision metal rail, e.g. for mounting a telescope or as an optical bench (can also be used in mechanics)
- Digital measurement of light intensity with the Mobile-CASSY 2 WiFi and the lux sensor M
- LED lamp can be connected to Mobile-CASSY 2 WiFi or power bank – no power supply needed

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

Lux sensor M

For measuring the illuminance of visible light with Mobile-CASSY 2 WiFi (524 005W). The lux sensor has a flat design so that it can, for example, be inserted directly into the holder for diaphragms and slides (459 33). With the lux sensor, measurements can be performed along and orthogonal to the optical axis. A printed millimetre scale is used to position the sensor on the optical axis and also enables the recording of intensity distributions of different diffraction objects (e.g. 469 731) without additional equipment.

524 444	Lux sensor M	

You can find detailed information on this and other sensors from page 229.

EXTERNAL POWER SUPPLY

USB power bank 2200 mAh

Power bank with 2200 mAh suitable for LED lamp (459 094), triple LED lamp (459 098) and laser class 1, red (459 097). The 5V DC USB plug-in power supply unit (459 095) can be used to charge the power bank.

459 099	USB power bank 2200 mAh	

You can find detailed information on the USB power bank on page 232.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP5.1 Ray optics and geometrical optics

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set OP1 (207 141S).
Describes 46 experiments from the fields of ray path optics and geometrical optics.

Topics:
Propagation of light and shadow formation; Light and shadow in nature; Reflection in mirrors; Light refraction; Dispersing light and recombination of the spectrum; Lenses and lens aberrations; Optical instruments for angular magnification; Optical instruments and the eye

520 7141EN	LIT: LP5.1 Ray optics and geometrical optics	

SUBJECT AREA

LIT: LP5 Science Lab Optics, digital

includes only ONE subject area

Comprehensive physics experiment instructions in the field of optics for the Science Lab.
Contains 72 experiments on ray optics and geometrical optics, chromatics, wave optics and polarisation.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 714	LIT: LP5 Science Lab Optics, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

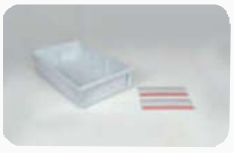
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES

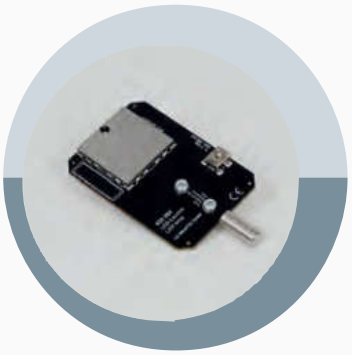




You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

Just one light source! For experiments with the light box on the table and on the precision metal rail



LED lamp

FOR EXPERIMENTS IN RAY OPTICS WITH THE LIGHT BOX ON THE TABLE

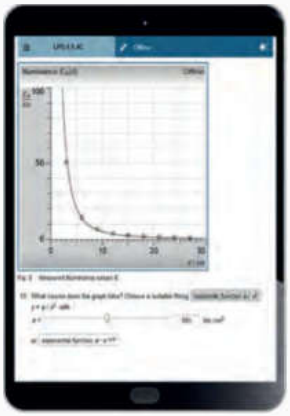
LP5.1.3.1 Reflection in a plane mirror

FOR EXPERIMENTS IN GEOMETRICAL OPTICS ON THE PRECISION METAL RAIL

LP5.1.1.4C Illuminance

EXPERIMENT SAFELY

- Our LED lamp is classified according to DIN EN 62471 in risk group 1
- No risk of danger to students' eyes when performing the experiments
- Minimal heat generated compared to halogen lamps
- Sturdy housing and easy operation



Lab Doc for the experiment of the illuminance

OPTICS - OP2

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

LP5.2	CHROMATICS
LP5.2.1	Examination of the light paths through a prism
LP5.2.1.1	Light paths through a prism
LP5.2.1.2	Deflections in a prism
LP5.2.2	Spectral colours
LP5.2.2.1	Dispersion of white light
LP5.2.2.2	Colour defects in illustrations
LP5.2.2.3	Examination of spectral colours
LP5.2.2.4	Spectra of different slits
LP5.2.3	Colour mixing
LP5.2.3.1	Recombination of the spectrum
LP5.2.3.2	Light and body colours
LP5.2.3.3	Additive mixing of two light colours
LP5.2.3.4	Additive mixing of three light colours
LP5.2.3.5	Subtractive mixing

11 EXPERIMENTS

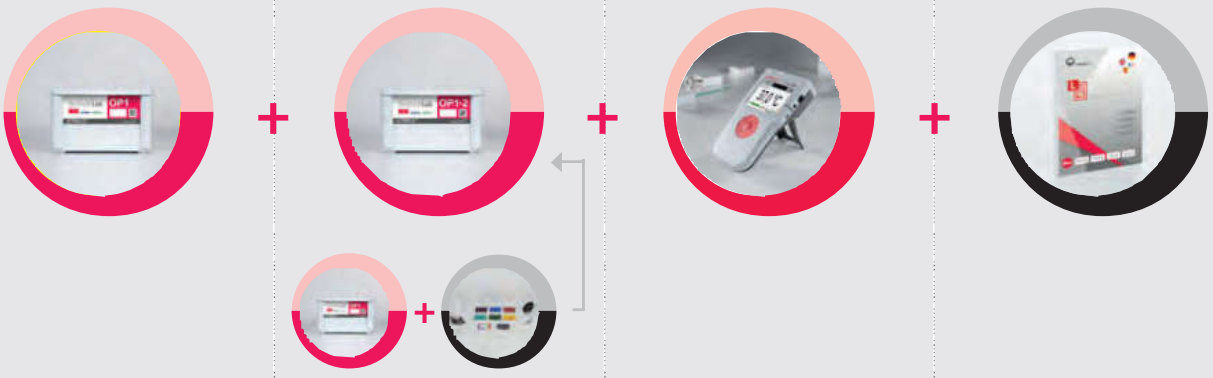
LP5.2.2.1 Dispersion of white light

LP5.2.3.4 Additive mixing of three light colours

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP5.2 CHROMATICS

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Optics OP1	Optics OP2	Mobile-CASSY 2 WiFi	Science Lab Optics digital



Detailed information on the above listed and **additionally required equipment** is available on the following pages.

Science Lab Optics OP2 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group.
The equipment is stored in Science Lab Optics OP1 (207 141S). With the supplementary equipment set OP2, together with the Science Lab Optics OP1, 11 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics chromatics. While working out the curriculum required topics, they are also trained in communication and assessment skills.

Scope of delivery:

Count	Name
1	Triple LED lamp
1	Candle holder
1	Prism, plastic
1	Colour filter set, primary
1	Colour filter set, secondary

Count	Name
1	Triple colour filter
1	Diffraction grating 500/mm
1	Extension pin

207 142S	Science Lab Optics OP2 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 141S	Science Lab Optics OP1 (Set)	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 714	LIT: LP5 Science Lab Optics, digital	

OVERVIEW OF ADVANTAGES

- Experiments from colour mixing to basics of diffraction
- Ingenious and easy-to-use triple LED lamp can be used to mix three or two colours by simply switching one of the built-in LED chips on and off
- With the included diffraction grating, students start discussing their first thoughts on diffraction as well as colour decomposition

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

MOBILE-CASSY 2 WIFI

With the Mobile-CASSY 2 WiFi, voltage *(U)*, current *(I)*, power *(P)* and energy *(E)* can be measured via 4 mm safety sockets.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP5.2 Chromatics

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set OP2 (207 142S) in conjunction with Science Lab Set OP1 (207 141S). Describes 11 experiments from the fields of chromatics.

Topics:
Examination of the light paths through a prism; Spectral colours; Colour mixing

520 7142EN	LIT: LP5.2 Chromatics	

SUBJECT AREA

LIT: LP5 Science Lab Optics, digital

includes only ONE subject area

Comprehensive physics experiment instructions in the field of optics for the Science Lab.
Contains 72 experiments on ray optics and geometrical optics, chromatics, wave optics and polarisation.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 714	LIT: LP5 Science Lab Optics, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES

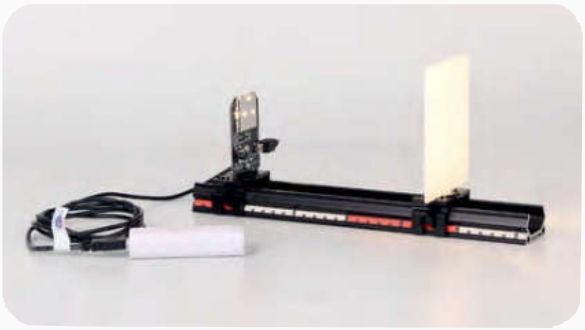




You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

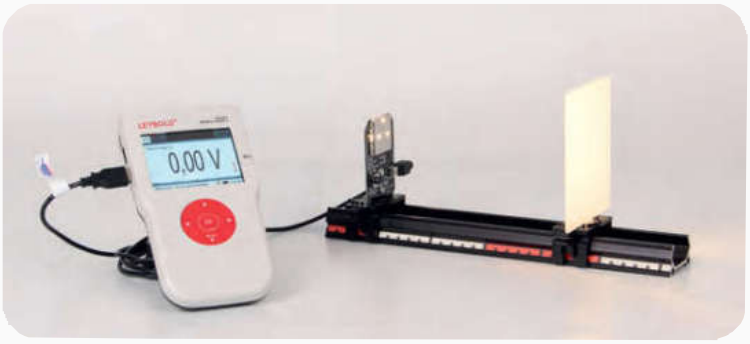
Triple LED lamp
Well thought out features for practical experience



Operation using a power bank

FLEXIBLE POWER SUPPLY

- The triple LED lamp can be operated via the USB output on the Mobile-CASSY 2 WiFi, via a power bank or the USB AC adapter
- All experiments can be performed with the triple LED lamp without a power supply with the Mobile-CASSY 2 WiFi or a power bank



Operation using the Mobile-CASSY 2 WiFi

Operation using an AC adapter

COLOUR MIXING

If the triple LED lamp is switched from two to three light sources, colour mixing experiments can be performed with either two or three colours.

OPTICS – OP3

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors	LP5.3	WAVE OPTICS	
	LP5.3.1	Diffraction on diffraction objects	
	LP5.3.1.1	Diffraction at a slit	
●	LP5.3.1.1C	Diffraction at a slit (with Mobile-CASSY 2 WiFi)	DIGITAL
	LP5.3.1.2	Diffraction at a double slit	
	LP5.3.1.3	Diffraction at multiple slits	
	LP5.3.1.4	Diffraction at gratings	
	LP5.3.2	Diffraction on complementary apertures	
	LP5.3.2.1	Slit and bar (Babinet's principle)	
	LP5.3.2.2	Complementary crossed gratings (Babinet's principle)	

7 EXPERIMENTS

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi. ● Lux sensor M

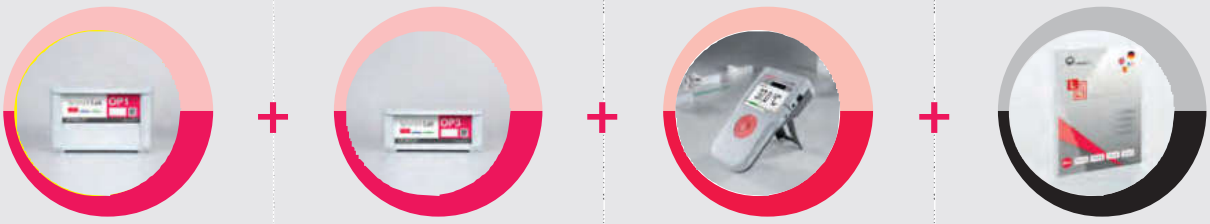
LP5.3.1.1C Diffraction at a slit

LP5.3.2.2 Complementary crossed gratings (Babinet's principle)

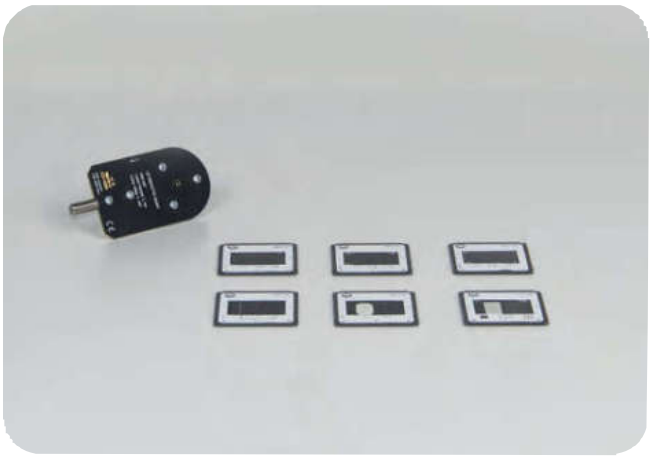
OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP5.3 WAVE OPTICS

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Optics OP1	Optics OP3	Mobile-CASSY 2 WiFi	Science Lab Optics digital



Detailed information on the above listed and **additionally required equipment** is available on the following pages.



Science Lab Optics OP3 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray. With the equipment set OP3, together with the Science Lab Optics OP1 (207 141S), 7 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topic wave optics. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Laser class 1, red
1	Diaphragm with single slits
1	Diaphragm with double slits (b=const.)
1	Diaphragm with double slits (d=const.)
1	Diaphragm with multiple slits

Count	Name
1	Diaphragm with slit and wire
1	Diaphragm with wire-mesh gratings
1	Tray, low
207 143S	Science Lab Optics OP3 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 141S	Science Lab Optics OP1 (Set)	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	524 444	Lux sensor M	
1	459 33	Diaghragm and slide holder on rod	Diffraction experiment (LP5.3.1)

Additionally recommended per working group

Count	Cat.-No.	Name	Description
1	471 09	Fresnel biprism	
1	471 04	Fresnel's mirror, on board	Diffraction experiment (LP5.3.1)
1	471 08	Apparatus for Newton's rings	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 714	LIT: LP5 Science Lab Optics, digital	

OVERVIEW OF ADVANTAGES

- Student-safe laser, class 1
- New, improved diffraction objects
- Diffraction phenomena can be visualised with a simple set-up on the precision metal rail (50 cm)
- The lux sensor M can record intensity distributions for different diffraction objects so the students can develop the topic on a deeper level

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

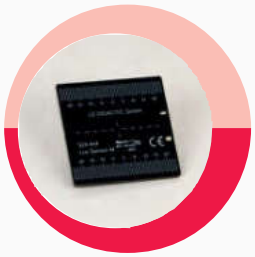
Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS



Lux sensor M

For measuring the illuminance of visible light with Mobile-CASSY 2 WiFi (524 005W). The lux sensor has a flat design so that it can, for example, be inserted directly into the holder for diaphragms and slides (459 33). With the lux sensor, measurements can be performed along and orthogonal to the optical axis. A printed millimetre scale is used to position the sensor on the optical axis and also enables the recording of intensity distributions of different diffraction objects (e.g.469 731) without additional equipment.

524 444	Lux sensor M	

You can find detailed information on this and other sensors from page 229.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP5.3 Wave optics

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set OP3 (207 143S) in conjunction with Science Lab Set OP1 (207 141S). Describes 7 experiments from the fields of wave optics.

Topics:
Diffraction on diffraction objects; Diffraction on complementary apertures

520 7143EN	LIT: LP5.3 Wave optics	

SUBJECT AREA

LIT: LP5 Science Lab Optics, digital

includes only ONE subject area

Comprehensive physics experiment instructions in the field of optics for the Science Lab.
Contains 72 experiments on ray optics and geometrical optics, chromatics, wave optics and polarisation.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 714	LIT: LP5 Science Lab Optics, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

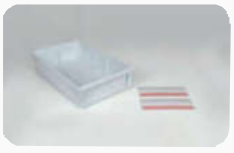
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

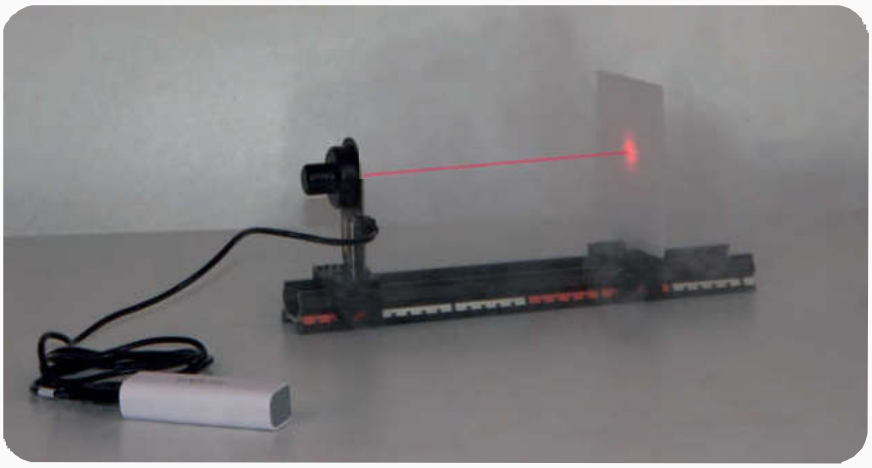
INTRODUCING THE TOPIC

Our laser - Your safety

SAFE

- Laser complies with safety regulations (class 1 in accordance with DIN EN 60825-1:2015-07)
- In comparison, most commercially available laser pointers are categorised in class 2 and their suitability for student experiments is limited

DIFFRACTION AND INTERFERENCE - EXCITING TOPICS



OBSERVE, UNDERSTAND & MEASURE DIGITALLY

- Simple performance of diffraction experiments in a confined space
  - By providing suitable diffraction objects
  - No additional or complicated observation lenses needed
  - Only a few devices are needed
- With the lux sensor M, intensity distributions can also be recorded quantitatively
- Flexible power supply to the laser using a
  - Power bank
  - Mobile-CASSY 2 WiFi USB output
  - USB AC adapter

OPTICS – OP4

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors	LP5.4	POLARISATION	
	LP5.4.1	Polarisation filters	
	LP5.4.1.1	Applying polarisation filters	
●	LP5.4.1.2C	Malus's law (with Mobile-CASSY 2 WiFi)	DIGITAL
	LP5.4.2	Photoelastric double refraction	
	LP5.4.2.1	Chromatic polarisation	
	LP5.4.3	Polarisation due to reflection an diffraction	
	LP5.4.3.1	Polarisation due to reflection	
	LP5.4.3.2	Brewster's law	
	LP5.4.4	Polarisation due to scattering	
	LP5.4.4.1	Tyndall effect on an emulsion	
	LP5.4.5	Optical activity	
	LP5.4.5.1	Polarimetry (saccharimetry)	
●	LP5.4.5.1C	Polarimetry (saccharimetry) (with Mobile-CASSY 2 WiFi)	DIGITAL

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

● Lux sensor M

8 EXPERIMENTS

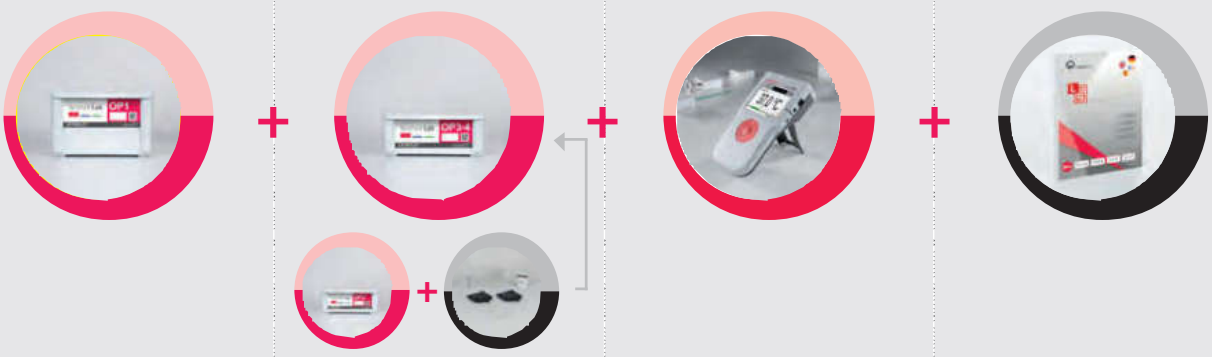
LP5.4.1.2C Malus's law

LP5.4.5.1 Polarimetry (Saccharimetry)

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP5.4 POLARISATION

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Optics OP1	Optics OP4*	Mobile-CASSY 2 WiFi	Science Lab Optics digital



Detailed information on the above listed and **additionally required equipment** is available on the following pages.

*Optic Set OP3 is not required, but OP4 can be stored in the tray of OP3 or OP4 can be ordered separately.

Science Lab Optics OP4 (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group. The equipment can be stored in Science Lab Optics OP3 (207 143S). With the equipment set OP4, together with the Science Lab Optics OP1 (207 141S), 8 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topic polarisation. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Acrylic glass screen on rod
2	Polarisation filter on rod
1	Glas box (cuvette), 100 x 50 x 93 mm

Count	Name
1	Microscope slides 76 mm x 26 mm x 1 mm, set of 50
1	Beaker, PP, 250 ml, squat
207 144S	Science Lab Optics OP4 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 141S	Science Lab Optics OP1 (Set)	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	524 444	Lux sensor M	Malus's law and polarimetry experiments (LP5.4.1, LP5.4.5)

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 714	LIT: LP5 Science Lab Optics, digital	

Additionally required for storage per working group

Count	Cat.-No.	Name	Description
1	647 001	Tray, low	for storage of Science Lab OP4, if set OP3 is not available
0	207 143S	Science Lab Optics OP3 (Set)	if Science Lab OP3 (set) already exists, OP4 can be stored in the tray

OVERVIEW OF ADVANTAGES

- Experiments about the polarisation of light
- Malus's law can be easily and vividly demonstrated with the Mobile-CASSY 2 WiFi and the lux sensor M

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

Lux sensor M

For measuring the illuminance of visible light with Mobile-CASSY 2 WiFi (524 005W). The lux sensor has a flat design so that it can, for example, be inserted directly into the holder for diaphragms and slides (459 33). With the lux sensor, measurements can be performed along and orthogonal to the optical axis. A printed millimetre scale is used to position the sensor on the optical axis and also enables the recording of intensity distributions of different diffraction objects (e.g. 469 731) without additional equipment.

524 444	Lux sensor M	

You can find detailed information on this and other sensors from page 229.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP5.4 Polarisation

Printed version available in ring file

Detailed experiment instructions relating to Science Lab Set OP4 (207 141S) in conjunction with Science Lab Set OP1 (207 141S). Describes 8 experiments from the fields of polarisation.

Topics:
Polarisers; Photoelastic double refraction; Polarisation due to reflection and refraction; Polarisation due to scattering; Optical activity

520 7144EN	LIT: LP5.4 Polarisation	

SUBJECT AREA

LIT: LP5 Science Lab Optics, digital

includes only ONE subject area

Comprehensive physics experiment instructions in the field of optics for the Science Lab.
Contains 72 experiments on ray optics and geometrical optics, chromatics, wave optics and polarisation.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 714	LIT: LP5 Science Lab Optics, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

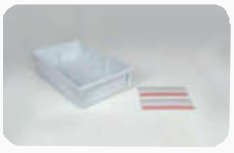
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES



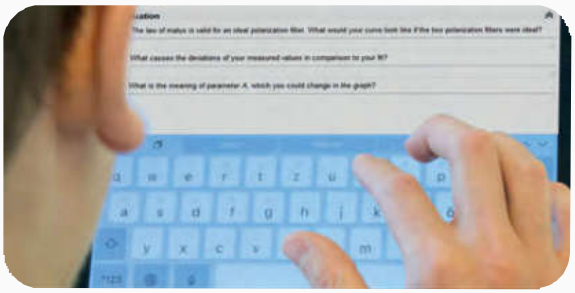


You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

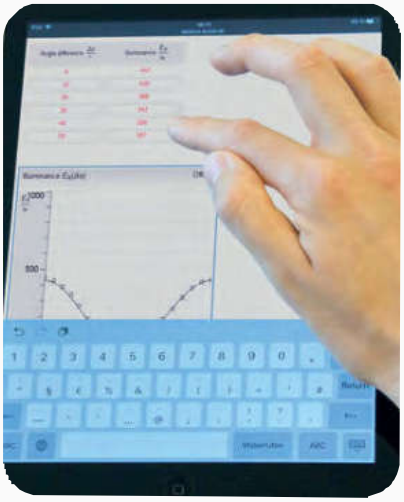
Digital media makes experiences more intense

MALUS'S LAW (LP5.4.1.2C)



LAB DOC - ANSWER QUESTIONS

Students answer questions in their own Lab Doc.



LAB DOC - ENTER MEASURED VALUES

- When not connected to the Mobile-CASSY 2 WiFi, the measured values read can be entered manually
- The diagram is then automatically completed

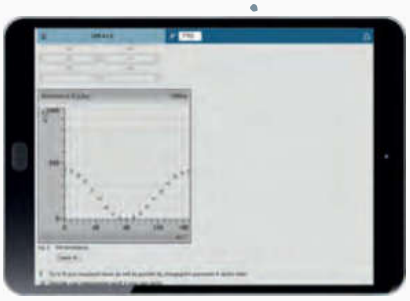
The student is currently entering the sixth measuring value for illuminance

MOBILE-CASSY 2 WIFI

LUX SENSOR M

- Lux sensor M, is automatically recognised by the Mobile-CASSY 2 WiFi
- Interactivity between measuring device and Lab Doc
- Illuminance is measured directly by using the lux sensor M

LAB DOC



PERFORMING THE EXPERIMENT

ATOMIC AND NUCLEAR PHYSICS

Radioactivity has mostly negative associations such as nuclear reactor accidents. But radioactivity is also, in fact, completely natural. For example, the air that we breathe contains decay products of radon. These can be detected with a comprehensible experiment.

Different concentrations can also be measured in tap and rain water depending on the region. The human body has adjusted to this environmental radioactivity and copes with it well. This is known as background radiation.

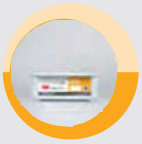
In the Science Lab Set *Atomic and Nuclear Physics*, students investigate this environmental radioactivity.

HIGHLIGHT

LP6.2.3.1C Detecting decay products in the air

Students will investigate the decay products of radon.
For this experiment you will need the set **Science Lab Radioactivity RA (207 152S)**.

Overview of topics and sets

EXPERIMENT TOPICS		REQUIRED SETS	NO. EXPERIMENTS	DETAILS
LP6.2	ENVIRONMENTAL RADIOACTIVITY			
LP6.2.1	INTRODUCTION TO RADIOACTIVITY	Environmental Radioactivity RA  207 152S	42	PAGE 136
LP6.2.2	INVESTIGATING THE INFLUENCE OF SAMPLE PROPERTIES AND THE SIZE OF THE MEASUREMENT WINDOW			
LP6.2.3	ENVIRONMENTAL RADIOACTIVITY			
LP6.2.4	STATISTICS OF RADIOACTIVE DECAY			
LP6.2.5	RADIATION SHIELDING			
LP6.2.6	DISTANCE			
LP6.2.7	INVESTIGATING THE RADIATION IN A MAGNETIC FIELD			
LP6.2.8	HALF-LIFE			

LP6.2.7.1C The influence of a magnet on beta radiation

Students will investigate how a magnetic field can deflect beta radiation.
For this experiment you will need the set **Science Lab Radioactivity RA (207 152S)**.

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

ATOMIC AND NUCLEAR PHYSICS – RA

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors		
	LP6.2	**ENVIRONMENTAL RADIOACTIVITY**
	LP6.2.1	Introduction to radioactivity
	LP6.2.1.1	Detecting radioactive radiation in the environment
●	LP6.2.1.1C	Detecting radioactive radiation in the environment (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.1.2	Detecting radioactive radiation in the surrounding air (underground)
●	LP6.2.1.2C	Detecting radioactive radiation in the surrounding air (underground) (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.1.3	Detecting radioactive radiation in a button shaped source
●	LP6.2.1.3C	Detecting radioactive radiation in a button shaped source (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.1.4	Safety rules when working with radioactive materials
●	LP6.2.1.4C	Safety rules when working with radioactive materials (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.1.5	Number of N pulses and R counting rate
●	LP6.2.1.5C	Number of N pulses and R counting rate (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.2	Investigating the influence of sample properties and the size of the measurement window
	LP6.2.2.1	Potassium chloride in different layer thicknesses
●	LP6.2.2.1C	Potassium chloride in different layer thicknesses (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.2.2	Potassium chloride as normal
●	LP6.2.2.2C	Potassium chloride as normal (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.2.3	Counting rate when screening the entrance window
●	LP6.2.2.3C	Counting rate when screening the entrance window (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.3	Environmental radioactivity
	LP6.2.3.1	Detecting decay products in the air
●	LP6.2.3.1C	Detecting decay products in the air (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.3.2	Detecting decay products in fresh tap water
●	LP6.2.3.2C	Detecting decay products in fresh tap water (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.3.3	Detecting decay products in rain water
●	LP6.2.3.3C	Detecting decay products in rain water (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.3.4	Detecting decay products in freshly fallen snow
●	LP6.2.3.4C	Detecting decay products in freshly fallen snow (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.4	Statistics of radioactive decay
	LP6.2.4.1	Investigating the fluctuations when measuring the pulse count
●	LP6.2.4.1C	Investigating the fluctuations when measuring the pulse count (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.4.2	Statistical examination of the radiation of the button shaped source
●	LP6.2.4.2C	Statistical examination of the radiation of the button shaped source DIGITAL
	LP6.2.4.3	Statistical examination of the radiation of the potassium chloride
●	LP6.2.4.3C	Statistical examination of the radiation of the potassium chloride DIGITAL
	LP6.2.5	Radiation shielding
	LP6.2.5.1	Radiation shielding from the button shaped source using different materials
●	LP6.2.5.1C	Radiation shielding from the button shaped source using different materials (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.5.2	Radiation shielding from the button shaped source using different material thicknesses
●	LP6.2.5.2C	Radiation shielding from the button shaped source using different material thicknesses (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.6	Distance
	LP6.2.6.1	Dependence of the counting rate on the distance between button shaped source & counter tube
●	LP6.2.6.1C	Dependence of the counting rate on the distance between button shaped source & counter tube (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.7	Investigating the radiation in a magnetic field
	LP6.2.7.1	The influence of a magnet on beta radiation
●	LP6.2.7.1C	The influence of a magnet on beta radiation (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.7.2	Use of the influence of a magnet on beta radiation
●	LP6.2.7.2C	Use of the influence of a magnet on beta radiation (with Mobile-CASSY 2 WiFi) DIGITAL
	LP6.2.8	Half-life
	LP6.2.8.1	Evaluation of a test series with radon water
●	LP6.2.8.1C	Evaluation of a test series with radon water (with Mobile-CASSY 2 WiFi) DIGITAL

42 EXPERIMENTS

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

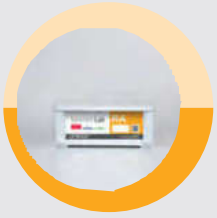
● GM adapter M

LP6.2.1.3C Detecting radioactive radiation in a button shaped source

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LP6.2 ENVIRONMENTAL RADIOACTIVITY

TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Radioactivity RA	Mobile-CASSY 2 WiFi	Science Lab Atomic and nuclear physics digital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Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Radioactivity RA (Set)

Student experiment set of the student experiment system Science Lab in the field of physics. Set-up material for one working group in pre-formed tray. With the equipment set RA, in combination with the Mobile-CASSY 2 WiFi (524 005W) and the GM adapter M (524 440) or with the counter S (575 471), 42 experiments at school, college and university level for worldwide curriculums can be performed. The students deal with the topic radioactivity and in particular with the environmental radioactivity. While working out the curriculum required topics, they are also trained in communication and assessment skills. The additional possibility of using the Mobile-CASSY 2 WiFi (524 005W) enables the students the access of digital learning.

Scope of delivery:

Count	Name
1	Plate holder on rod
1	Precision metal rail, 25 cm
4	Clamp rider
1	Horseshoe magnet, small
1	Buffer and Plastic Plate
1	Pancake GM counter tube
1	Holder for Pancake GM counter
1	Holder for radiation emitter and magnet

Count	Name
1	Tray, low
25 out of	Round filter fiber glass, 55 mm Ø, Set of 100
1	Petri dish 60 mm
1	Büchner funnel porcelain, for filters with 55 mm Ø
2 out of	Plastic clamps, span 1.2 cm, set of 3
1	Potassium Chloride 50 g
1	Frame and Set of Aluminium slides
207 152S	Science Lab Radioactivity RA (Set)

ADDITIONALLY REQUIRED EQUIPMENT

Additionally required per working group

Count	Cat.-No.	Name	Description
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	524 440	GM adapter M	
1	559 460	Button-shaped source	
1	575 471	Counter S	alternative for analog measurements
1	LDS00001	Stopwatch, digital	alternative for analog measurements

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 715	LIT: LP6 Science Lab Atomic and nuclear physics, digital	
1	666 767	Hotplate, 1500 W, 180 mm Ø	
1	ADACB501	Compact scale 500 g: 0.1 g	

OVERVIEW OF ADVANTAGES

- Proof of all relevant phenomena of environmental radioactivity
- Includes a large area (Pancake) GM counter tube with a stable protection net for the measurement of low decay rates
- The additionally required button-shaped source is below the exemption limits in Germany and many other countries
- Devices and detailed instructions were developed in cooperation with Prof. Dr. phil. Henning von Philipsborn (University of Regensburg)
- Acquired skills: Communication and evaluation

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

GM adapter M

For measuring radioactive radiation with a Geiger-Mueller counter tube (559 01 or 559 012) with Mobile-CASSY 2 WiFi (524 005W).

524 440	GM adapter M	

You can find detailed information on this and other sensors from page 229.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC

LIT: LP6.2 Environmental radioactivity

Printed version available in one file

Detailed experiment instructions relating to Science Lab Set RA (207 152S).
Describes 42 experiments from the fields of environmental radioactivity.

Topics:
Introduction to radioactivity; Investigating the influence of sample properties and the size of the measurement window; Environmental radioactivity; Statistics of radioactive decay; Radiation shielding; Distance; Investigating the radiation in a magnetic field; Half-life

520 7151EN	LIT: LP6.2 Environmental radioactivity	

SUBJECT AREA

LIT: LP6 Science Lab Atomic and nuclear physics, digital

includes only ONE subject area

Comprehensive physics experiment instructions in the field of atomic and nuclear physics for the Science Lab.
Contains 42 experiments on environmental radioactivity.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 715	LIT: LP6 Science Lab Atomic and nuclear physics, digital	

SUBJECT

LIT: LP Science Lab Physics, digital

includes ALL subject areas

Comprehensive physics experiment instructions for the Science Lab. Contains 450 experiments in the fields of mechanics, energy, electricity and electronics, optics, atomic and nuclear physics.

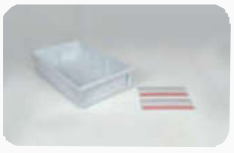
Includes all interactive experiment instructions (Lab Docs) as html file.

520 71	LIT: LP Science Lab Physics, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

INTRODUCING THE TOPIC

Learning about and investigating natural radioactivity

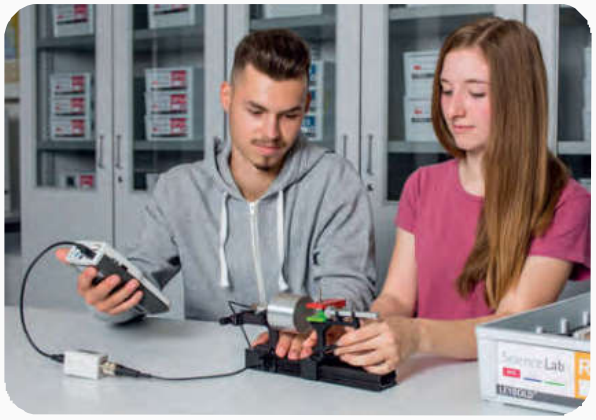
The term "radioactivity" makes most people feel uneasy or anxious because it immediately makes them think of nuclear disasters. Therefore, it is important that students see a different picture and learn that natural radioactivity exists in our everyday lives that we cannot avoid and what this means. With the RA set, for example, radioactive radon can be collected from the ambient air, concentrated and detected from the air around us.

QUANTITATIVE EXPERIMENTS ON THE PROPERTIES OF IONISING RADIATION

- The button-shaped source allows you to conduct reproducible and quantitative experiments on the basic properties of radioactive radiation
- With the large area (Pancake) Geiger-Mueller counter tube from the set RA, all experiments are possible despite weak activity levels
- Quick and easy experimental procedure

THE BUTTON-SHAPED SOURCE

- A "button" of uranium-coloured green glass
- Inserted into a holder
- Supplied with a certificate that confirms:
  - Maximum activity of 250 Bq U-238
  - No activity of thorium or radium
- Activity does not spread into the environment as the uranium is embedded into the glass
- Easy to use in the classroom
- Protected against theft

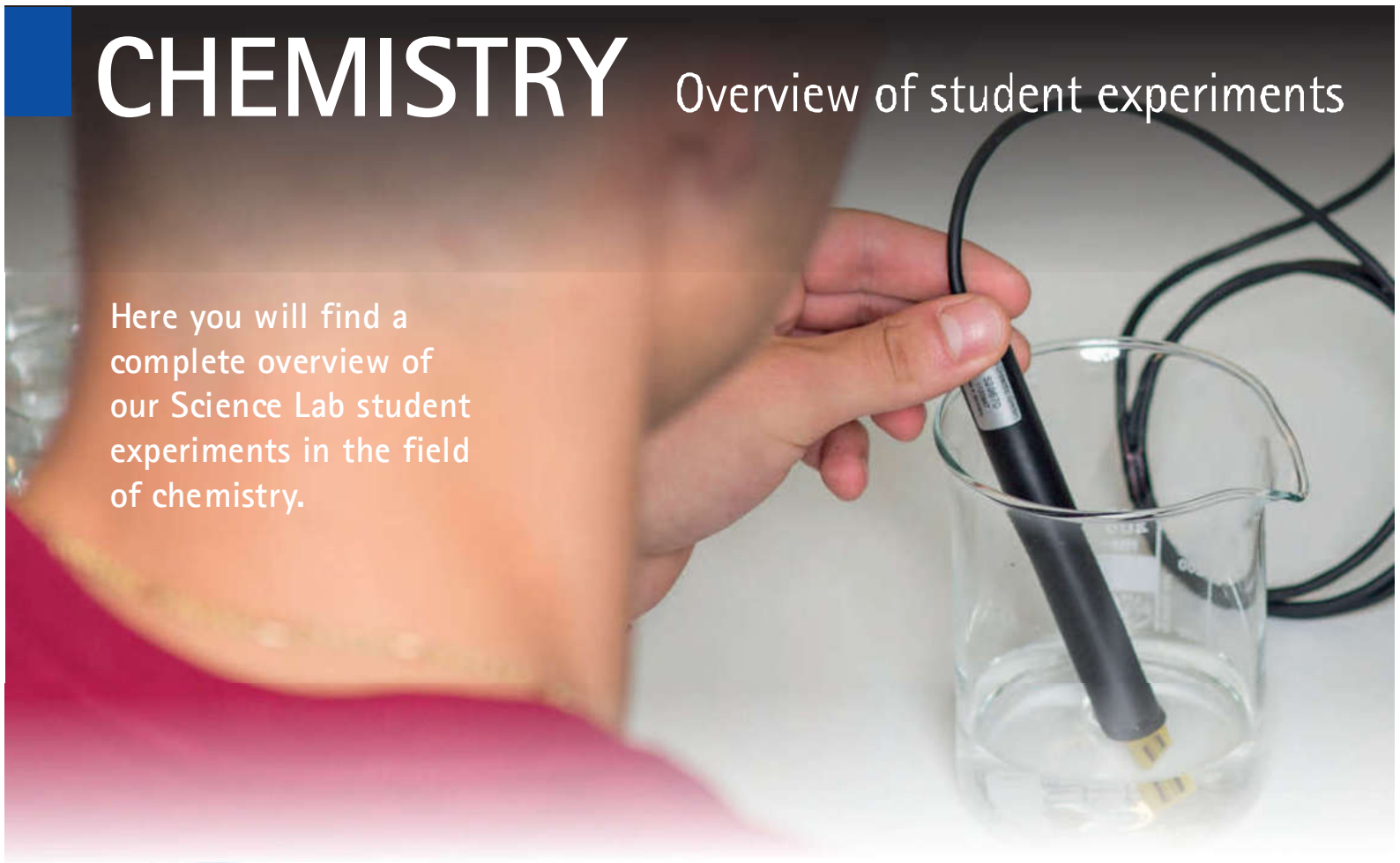


EASY-TO-USE IN STUDENT EXPERIMENTS

- The button-shaped source is far below the exemption limit (2.5 %)
- The sources may be used in the classroom without any particular advanced training as per German radiation protection law*
- Due to the low activity of the radioactive substances, there is no danger when being handled by untrained persons

*Always observe the regulations that apply to your country.

CHEMISTRY Overview of student experiments



Here you will find a complete overview of our Science Lab student experiments in the field of chemistry.

INORGANIC AND GENERAL CHEMISTRY

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIMENTS	DETAILS FROM
LC1.1	GENERAL METHODS & SEPARATION METHODS	Properties of substances; Mixtures of substances; Separation of substances	93	PAGE 148
LC1.2	WATER	Water as a solvent; Analysis, synthesis and detection of water; Water treatment		
LC1.3	AIR, GASES AND THEIR PROPERTIES	Gases - synthesis, detection and properties; Air and combustion		
LC1.4	ACIDIC AND ALKALINE SOLUTIONS	Acidic and alkaline; Acids, Alkaline solutions; Protolysis equilibrium; Titrations; Neutralisation and salification		
LC1.5	SALTS	Ion detection; Utilising salts		
LC1.6	METALS	Properties of metals; Use of metals; Complex chemistry		
LC1.7	REDOX REACTIONS	Oxidation; Redox titration		
LC1.8	CHEMICAL REACTIONS	Characteristics of a chemical reaction; Chemical laws		
LC1.9	NEW FIELDS IN CHEMISTRY	Nanochemistry		

ORGANIC CHEMISTRY

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIMENTS	DETAILS FROM
LC2.1	ORGANIC SUBSTANCES	Characteristics of organic substances; Elements in organic substances	53	PAGE 156
LC2.2	HYDROCARBONS	Saturated hydrocarbons; Unsaturated hydrocarbons; Petrochemistry		
LC2.3	ALCOHOLS, ALDEHYDES AND KETONES	Production of alcohols; Detection of alcohols; Properties and uses of alcohols; Aldehydes; Ketones		
LC2.4	CARBOXYLIC ACIDS AND ESTERS	Production of carboxylic acids; Properties and uses of carboxylit acids; Production and properties of esters		
LC2.5	REACTIONS IN ORGANIC CHEMISTRY	Addition reactions; Substitution reactions		
LC2.6	METHODS OF ORGANIC CHEMISTRY	Distillations		

more than 250 EXPERIMENTS IN TOTAL

PHYSICAL CHEMISTRY

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIMENTS	DETAILS FROM
LC3.1	ELECTROCHEMISTRY	Electrial conductivity; Electrochemical potentials; Galvanic elements; Applied electrochemistry; Electrolysis	55	PAGE 164
LC3.2	PHYSICAL PROCESSES	Particle movement		
LC3.3	ENERGY IN CHEMICAL REACTIONS	Calorimetry; Reaction heat		
LC3.4	RATE OF REACTION	Course of a reaction; Influencing the rate of reaction		
LC3.5	CHEMICAL EQUILIBRIUM	Chemical equilibrium; Le Chatelier's priniciple; The law of mass action and its applications		

TECHNICAL CHEMISTRY

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIMENTS	DETAILS FROM
LC4.1	BUILDING MATERIALS	Limestone and gypsum	24	PAGE 172
LC4.2	GLASS	Glass		
LC4.3	METALS	Extraction of metals; Alloys		
LC4.4	CHEMICAL APPLICATIONS	Fertilisers; Photography		
LC4.5	PRODUCTS OF THE ORGANIC INDUSTRY	Pigment and Dyestuffs; Plastics; Soaps		

BIOCHEMISTRY

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIMENTS	DETAILS FROM
LC5.1	FATS	Properties of fats; Fatty foods; Analysing Fats	32	PAGE 172
LC5.2	CARBOHYDRATES	Properties of carbohydrates; Extraction of sugars; Detection of sugars; Starch and cellulose		
LC5.3	AMINO ACIDS AND PROTEINS	Properties of proteins; Detection of proteins		
LC5.4	FOOD	Preservatives; Additives		

Science Lab

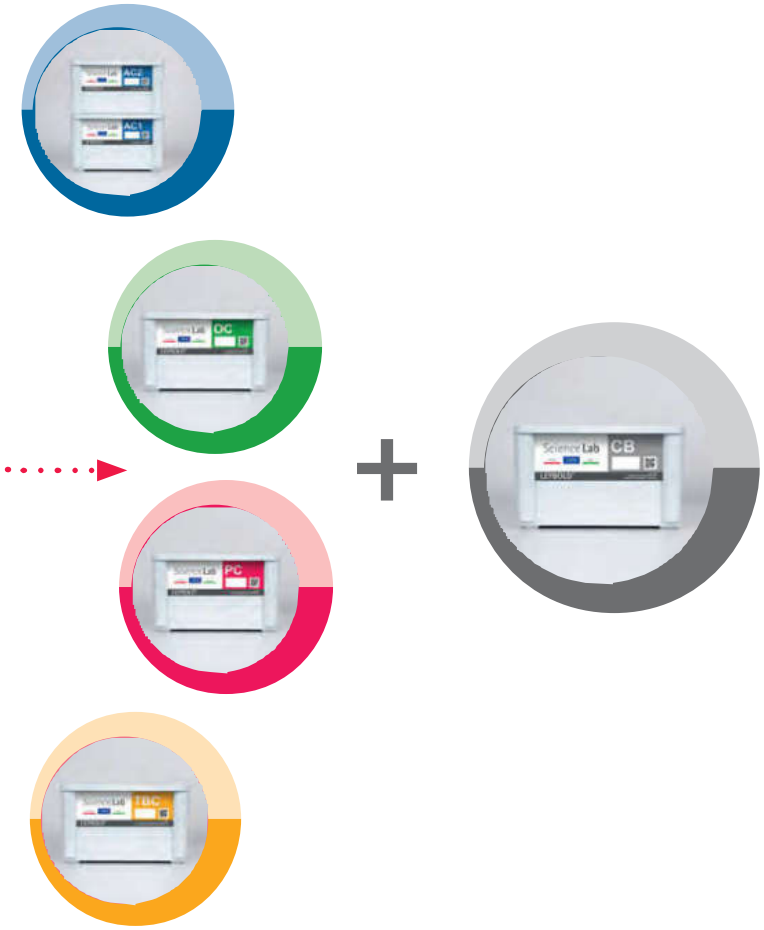
Chemistry Basic CB (207 200S)

BASIC SET FOR OUR INNOVATIVE STUDENT EXPERIMENT SYSTEM FOR CHEMISTRY

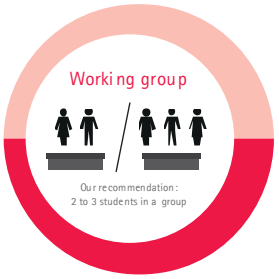
- This Basic Set contains **the basic devices** which are regularly needed for student experiments in chemistry.
- Each device has its own specified space in the pre-formed storage tray.
- With four **different thematic sets** more than **250** student experiments can be performed in chemistry.
- One Basic Set for all fields of chemistry and a maximum of two trays on the student workstation.

ADVANTAGES

- The Basic Set contains the material required for **one work group** - consisting of 2-3 students.
- Experiments from the Science Lab Chemistry can then be carried out with only one additional set, depending on the topic.
- Same devices = always the same handling: no need to re-learn devices for every topic.



Science Lab Chemistry Basic CB (Set)



Student experiment set of the student experiment system Science Lab in the field of chemistry. Basic equipment for experiments in inorganic and general chemistry, organic chemistry, physical chemistry, technical and biochemistry.
Set-up material for one working group in pre-formed tray. The individual trays are stackable and can optionally be closed with a lid (647 003).
The equipment set Science Lab Chemistry Basic CB, in combination with at least one of the following chemistry sets, enables the performance of experiments at school, college and university level for worldwide curriculums:

- Experiment set Science Lab Inorganic Chemistry AC (207 211S)
- Experiment set Science Lab Organic Chemistry OC (207 221S)
- Experiment set Science Lab Physical Chemistry PC (207 231S)
- Experiment set Science Lab Technical and Biochemistry TBC (207 241S)

Scope of delivery:

Count	Name
2	Bosshead S
2	Stand base MF
1	Stand feet, pair
3	Stand rod 40 cm, 10 mm Ø
1	Universal pencil
1	Thermometer, -10...+150 °C/1 K
1	Powder spatula, steel, 185 mm
1	Tray, high
1	Round filter, Type 595, 125 mm Ø, Set of 100
1	Boiling stones 100 g
5	Watch glass dish 80 mm Ø
3	Glass stirring rod 200 x 8 mm Ø
1	Measuring cylinder 100 ml, with plastic base
5	Dropping pipette 150 mm x 7 mm Ø
5	Rubber bulb
2	Graduated pipette 10 ml
1	Pipetting ball (Peleus ball)
2	Universal clamp 0...80 mm
1	Test tube brush with head bundle 20 mm Ø
1	Scissors 125 mm, round-ended
1	Laboratory knife
1	Tweezers, blunt, 130 mm
1	Test tube holder 20 mm Ø
1	Crucible tongs 200 mm
1	Test tube rack metal 20 mm Ø
1	Universal indicator paper pH 1...14, roll
207 200S	Science Lab Chemistry Basic CB (Set)

Additionally required:

Count	Cat.-No.	Name
1	207 211S	Science Lab Inorganic Chemistry AC (Set)
1	207 221S*	Science Lab Organic Chemistry OC (Set)
1	207 231S*	Science Lab Physical Chemistry PC (Set)
1	207 241S*	Science Lab Technical and Biochemistry TBC (Set)

* alternative

Additionally recommended:

Count	Cat.-No.	Name
1	647 003	Lid for tray

INORGANIC AND GENERAL CHEMISTRY

The Inorganic and General Chemistry experiment collection effortlessly arouses fascination towards chemistry: The Science Lab Set *Inorganic Chemistry* consists of *two* trays AC1 and AC2 and includes devices for both basic and advanced experiments, important for chemistry classes/lectures at school, college and university level.

Your students will use this set to carry out perceivable experiments, such as "Red cabbage as an indicator", as well as complex experiments such as conductivity titrations or redox titrations.

HIGHLIGHT

LC1.1.1.2C Boiling point

In this experiment, the boiling temperatures of water and methylated spirits are determined. For this purpose, the temperature of the respective liquid is measured at constant time intervals during the heating process with the help of the Mobile-CASSY 2 WiFi. The value pairs are then plotted on a graph to determine the boiling temperature from the curve. For this experiment you will need the sets **Science Lab Chemistry Basic CB (207 200S)** and **Science Lab Inorganic Chemistry AC (207 211S)**.

Overview of topics and sets

EXPERIMENT TOPICS		REQUIRED SETS	NO. EXPERIMENTS	DETAILS
LC1.1	GENERAL METHODS & SEPARATION METHODS	Chemisty Basic CB + Inorganic Chemistry AC	93	PAGE 148
LC1.2	WATER			
LC1.3	AIR, GASES AND THEIR PROPERTIES			
LC1.4	ACIDIC AND ALKALINE SOLUTIONS			
LC1.5	SALTS			
LC1.6	METALS			
LC1.7	REDOX REACTIONS			
LC1.8	CHEMICAL REACTIONS			
LC1.9	NEW FIELDS IN CHEMISTRY			

207 200S + 207 211S

LC1.4.1.5C pH paper versus pH electrode

In this experiment, students will learn how to determine the pH values of solutions with pH paper and how to measure these with the Mobile-CASSY 2 WiFi and a pH probe. For this experiment you will need the sets **Science Lab Chemistry Basic CB (207 200S)** and **Science Lab Inorganic Chemistry AC (207 211S)**.

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

INORGANIC AND GENERAL CHEMISTRY – AC

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

LC1.1 GENERAL METHODS & SEPARATION METHODS

LC1.1.1 Properties of substances

LC1.1.1.1	Density, solubility, magnetisability and colour	
LC1.1.1.2	Boiling point	
LC1.1.1.2C	Boiling point (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.1.1.3	Sublimation	

LC1.1.2 Mixtures of substances

LC1.1.2.1	Heterogeneous mixtures	
LC1.1.2.2	Homogeneous mixtures	
LC1.1.2.3	Comparison of different solvents	
LC1.1.2.4	Solutions, colloids and suspensions	

LC1.1.3 Separation of substances

LC1.1.3.1	Evaporation	
LC1.1.3.2	Elutriation and decanting	
LC1.1.3.3	Separation by melting and by magnets	
LC1.1.3.4	Purification of rock salt	
LC1.1.3.5	Separation of immiscible liquids	
LC1.1.3.6	Extraction	
LC1.1.3.7	Separation of substances by solvent extraction	
LC1.1.3.8	Chromatography	

LC1.2 WATER

LC1.2.1 Water as a solvent

LC1.2.1.1	Detector of dissolved solid substances in different water samples	
LC1.2.1.2	Detection of dissolved gases in drinking water	
LC1.2.1.3	Total hardness of water	
LC1.2.1.4C	Saturated solutions (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.2.1.5	Influencing the process of dissolution	

LC1.2.2 Analysis, synthesis and detection of water

LC1.2.2.1	Water splitting and water synthesis	
LC1.2.2.2	Chemical testing for water	

LC1.2.3 Water treatment

LC1.2.3.1	Filtering with gravel and activated charcoal filters	
LC1.2.3.2C	Oxygen content of water (with Mobile-CASSY 2 WiFi)	DIGITAL

LC1.3 AIR, GASES AND THEIR PROPERTIES

LC1.3.2 Gases - synthesis, detection and properties

LC1.3.2.1	Oxygen - synthesis, detection and properties	
LC1.3.2.2	Carbon dioxide - synthesis, detection and properties	
LC1.3.2.3	The carbon dioxide fire extinguisher	
LC1.3.2.4	Hydrogen - synthesis and properties	

LC1.3.3 Air and combustion

LC1.3.3.1	Functionality of the burner	
LC1.3.3.2	Importance of air for combustion processes	
LC1.3.3.3	Oxygen content of air	
LC1.3.3.4	Production of charcoal	

LC1.4 ACIDIC AND ALKALINE SOLUTIONS

LC1.4.1 Acidic and alkaline

LC1.4.1.1	Preparing an indicator from red cabbage	
LC1.4.1.2	Effects of acids on indicators	
LC1.4.1.3	Effects of alkaline solutions on indicators	
LC1.4.1.4	The pH scale	
LC1.4.1.4C	The pH scale (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.4.1.5C	pH paper versus pH electrode (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.4.1.6	The pH value of everyday chemicals	
LC1.4.1.6C	The pH value of everyday chemicals (with Mobile-CASSY 2 WiFi)	DIGITAL

LC1.4.2 Acids

LC1.4.2.1C	Conductivity of strong and weak acids (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.4.2.2	Sulphuric acid and its properties	
LC1.4.2.2C	Sulphuric acid and its properties (with Mobile-CASSY 2 WiFi)	DIGITAL

LC1.4.3 Alkaline solutions

LC1.4.3.1	Using alkaline solutions in everyday life	
LC1.4.3.2	Reaction of hydroxides with water	
LC1.4.3.2C	Reaction of hydroxides with water (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.4.3.3	Reaction of alkali metals and alkaline earth metals with water	
LC1.4.3.4	Reaction of metal oxides with water	
LC1.4.3.5	Ammonia as an alkaline solution	

LC1.4.4 Protolysis equilibrium

LC1.4.4.1C	Multi-step protolysis of phosphoric acid (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.4.4.2	Buffer solutions	
LC1.4.4.2C	Buffer solutions (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.4.4.3C	From the pH value to the pKa value (with Mobile-CASSY 2 WiFi)	DIGITAL

LC1.4.5 Titrations

LC1.4.5.1	Titration of hydrochloric acid with sodium hydroxide solution	
LC1.4.5.2	Determining the acetic acid content in vinegar	
LC1.4.5.3	Recording a titration curve	
LC1.4.5.3C	Recording a titration curve (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.4.5.4	Selecting an indicator for titration	
LC1.4.5.4C	Selecting an indicator for titration (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.4.5.5C	Amino acids as dipolar ions (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.4.5.6C	Conductometric titration (with Mobile-CASSY 2 WiFi)	DIGITAL

LC1.4.6 Neutralisation and salification

LC1.4.6.1	Neutralisation	
LC1.4.6.2	Reaction of metals with acids	
LC1.4.6.3	Reaction of metal oxides with acids	

LC1.5 SALTS

LC1.5.2 Ion detection

LC1.5.2.1	Detection of carbonate ions	
LC1.5.2.2	Detection of chloride ions	
LC1.5.2.3	Detection of sulphate ions	
LC1.5.2.4	Detection of iron ions	
LC1.5.2.5	Detection of copper ions	

LC1.5.3 Utilising salts

LC1.5.3.1	Growing crystals	
LC1.5.3.1C	Growing crystals (with Mobile-CASSY 2 WiFi)	DIGITAL
LC1.5.3.2	Cold and heat mixtures	
LC1.5.3.2C	Cold and heat mixtures (with Mobile-CASSY 2 WiFi)	DIGITAL

LC1.6 METALS

LC1.6.1 Properties of metals

LC1.6.1.1	Heating metals	
LC1.6.1.2	The copper envelope	
LC1.6.1.3	Combustion of metals	
LC1.6.1.4	The rusting process	
LC1.6.1.5	Flame colouration	

LC1.6.2 Use of metals

LC1.6.2.1	Rust protection by tin plating and galvanising	
LC1.6.2.2	Heat treatment of steel	
LC1.6.2.3	Silver mirror	

LC1.6.3 Complex chemistry

LC1.6.3.1	Ligand exchange with copper complexes	

	LC1.7	REDOX REACTIONS
	LC1.7.1	Oxidation
	LC1.7.1.1	Reaction of metals with air
	LC1.7.1.2	The reason for oxidation
	LC1.7.1.3	Combustion of metals
	LC1.7.2	Redox titration
	LC1.7.2.1	Redox titration

	LC1.8	CHEMICAL REACTIONS
	LC1.8.1	Characteristics of a chemical reaction
	LC1.8.1.1	Physical process or chemical reaction?
	LC1.8.1.2	The reaction of copper and iron with sulphur
	LC1.8.2	Chemical laws
	LC1.8.2.1	The law of conservation of mass
	LC1.8.2.2	The law of definite proportions

	LC1.9	NEW FIELDS IN CHEMISTRY
	LC1.9.1	Nanochemistry
	LC1.9.1.1	Solutions, colloids and suspensions
	LC1.9.1.2	Nanochemistry of carbon

93 EXPERIMENTS

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

- Conductivity sensor
- Conductivity adapter S
- pH sensor, BNC
- pH adapter S

LC1.6.1.1 Heating metals

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LC1.1 TO LC1.9 INORGANIC AND GENERAL CHEMISTRY

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE	CHEMICALS
Chemistry Basic CB	Inorganic Chemistry AC	Mobile-CASSY 2 WiFi	Science Lab Chemistry digital	Chemical Set AC

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Inorganic Chemistry AC (Set)

Student experiment set of the student experiment system Science Lab in the field of chemistry. Set-up material for one working group in pre-formed tray. With the equipment set AC, together with the Science Lab Chemistry Basic CB (207 200S), 93 experiments at school, college and university level for worldwide curriculums can be performed. The Science Lab Inorganic Chemistry AC contains two trays. The individual devices are assigned in such a way that the students have a maximum of 2 trays on the table for the experiments. The students deal with the topics general and inorganic chemistry. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Bar magnet
8	Beaker Boro 3.3, 100 ml, squat
2	Tray, high
1	Microscope slides 76 mm x 26 mm x 1 mm, set of 50
1	Crucible porcelain 20 ml
16	Test tube Fiolax 16 mm x 160 mm
1	Test tube Supremax 20 mm x 180 mm
2	Beaker Boro 3.3, 400 ml, squat
1	Pneumatic Tank, Plastic
1	Erlenmeyer flask 250 ml, narrow neck, SB 29
1	Evaporating dish 60 mm Ø
2	Funnel PP 75 mm Ø
1	Dropper funnel, 75 ml, ST 29
1	Gas delivery tube, angled, 8 mm Ø
1	Angled tube 90°, 50/50 mm, 8 mm Ø
1	Angled tube 90°, 300/50 mm, 8 mm Ø

Count	Name
1	Glass nozzle 90°, 80 mm x 80 mm, 8 mm Ø
1	Burette filling funnel plastic, 35 mm Ø
1	Burette clear glass, 10 ml, side stopcock
1	Stand ring with stem 100 mm Ø
1	Wire gauze 160 mm x 160 mm
1	Wire triangle with clay sleeves 60 mm
1	Pestle 88 mm
1	Mortar porcelain 70 mm Ø
1	Rubber tubing 7 mm Ø, 1 m
14	Rubber stopper solid, 14...18 mm Ø
1	Rubber stopper solid, 25...31 mm Ø
1	Rubber stopper two 7 mm holes, 25...31 mm Ø
1	Silicone stopper, one 7 mm hole, 16...21 mm Ø
1	Stopwatch, digital
207 211S	Science Lab Inorganic Chemistry AC (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

OVERVIEW OF ADVANTAGES

- Easy introduction to digital measurements and evaluation
- Includes the chemicals for at least 10 repetitions of all experiments
- Covers all requirement levels

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per student

Count	Cat.-No.	Name	Description
1	610 010	Laboratory safety goggles, Focomax	

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 200S	Science Lab Chemistry Basic CB (Set)	
1	661 243	Wash bottle PE 500 ml	
1	656 017	Teclu burner, universal	
1	607 020	Safety gas hose with clamp 0.5 m	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	529 670	Conductivity sensor	
1	524 0671	Conductivity adapter S	
1	529 672	pH sensor, BNC	
1	524 0672	pH adapter S	
1	666 194	Protective sleeves for temperature probe, set of 5	
1	ADACB501	Compact scale 500 g : 0.1 g	
1	667 609	Safety gloves, nitrile rubber, size 8	
1	607 105	Magnetic stirrer mini	
1	666 851	Stirring magnet 25 mm x 6 mm Ø, circular	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 72	LIT: LC Science Lab Chemistry, digital	
1	679 210	Chemicals Science Lab Inorganic Chemistry	
1	675 3410	Water, pure, 5 l	
1	MA91201	Test sticks total water hardness	
1	674 4640	Buffer solution pH 4.00, 250 ml	pH measurement experiments (LC1.4)
1	674 4670	Buffer solution pH 7.00, 250 ml	pH measurement experiments (LC1.4)
1	ADAHCB123	Compact Balance 120 g : 0.001 g	Titration experiment (LC1.4.5)

Detailed information on **Mobile-CASSY 2 WiFi**, **sensors**, **literature packages** and **chemical sets** are available on the following pages.

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

INCLUDED IN SCOPE OF DELIVERY

Temperature probe NiCr-Ni, type K

Included with the purchase of the Mobile-CASSY 2 WiFi (524 005W).

SENSORS

Conductivity sensor ●

Conductivity sensor using four-wire technology with integrated Pt temperature sensor for use with chemistry box (524 067), conductivity adapter S (524 0671) and CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Open design for rapid response to changes in conductivity. When conducting measurements a minimum distance of 1 cm from the side of the, as well as a minimum immersion depth of 2 cm are to be maintained.

529 670	Conductivity sensor	

Conductivity adapter S ●

Used in conjunction with the conductivity sensor (529 670), this adapter enables conductivity and temperature to be measured with CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836).

524 0671	Conductivity adapter S	

pH sensor, BNC ●

pH glass electrode in plastic shaft and BNC plug for use with the chemistry box (524 067), pH adapter S (524 0672) and CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Low-maintenance pH electrode with solid electrolyte made of a conductive gel-like polymer.

529 672	pH sensor, BNC	

For storage 3 M Potassium chloride sol. is recommended (672 5250).

pH adapter S ●

Enables a pH electrode to be connected to CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Moreover, the voltage at the BNC socket can be measured at a very high resistance, e.g. for measuring electrochemical potentials.

524 0672	pH adapter S	

You can find detailed information on these and other sensors from page 229.

CHEMICALS

Chemicals Science Lab Inorganic Chemistry

Chemicals for carrying out student experiments in Science Lab Inorganic Chemistry. The chemical set contains 87 different chemicals which can be used to perform every experiment at least 10 times.

679 210	Chemicals Science Lab Inorganic Chemistry	

The individual chemicals from this set can be found in the chemicals overview which starts from page 220. There you will also find the relevant hazard symbols and classes as well as hazard warnings and safety instructions.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC
SUBJECT AREA

LIT: LC1 Inorganic and general chemistry

Printed version available in ring file of ONE subject area

Detailed experiment instructions relating to Science Lab Set AC (207 211S) and Science Lab Set Chemistry Basic CB (207 200S). Describes 93 experiments from the field of general and inorganic chemistry.

Topics:
General methods & separation methods; Water; Air, gases and their properties; Acidic and alkaline solutions; Salts; Metals; Redox reactions; Chemical reactions, New fields of chemistry

520 7211EN	LIT: LC1 Inorganic and general chemistry

SUBJECT

LIT: LC Science Lab Chemistry, digital

Includes ALL subject areas

Comprehensive chemistry experiment instructions for the Science Lab.
Contains 257 experiments in the fields of inorganic chemistry, organic chemistry, physical chemistry, technical chemistry and biochemistry.

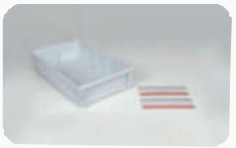
Includes all interactive experiment instructions (Lab Docs) as html file.

520 72	LIT: LC Science Lab Chemistry, digital

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

ORGANIC CHEMISTRY

The Science Lab Set *Organic Chemistry* is the optimal collection of devices for teaching all topics relevant to organic chemistry.

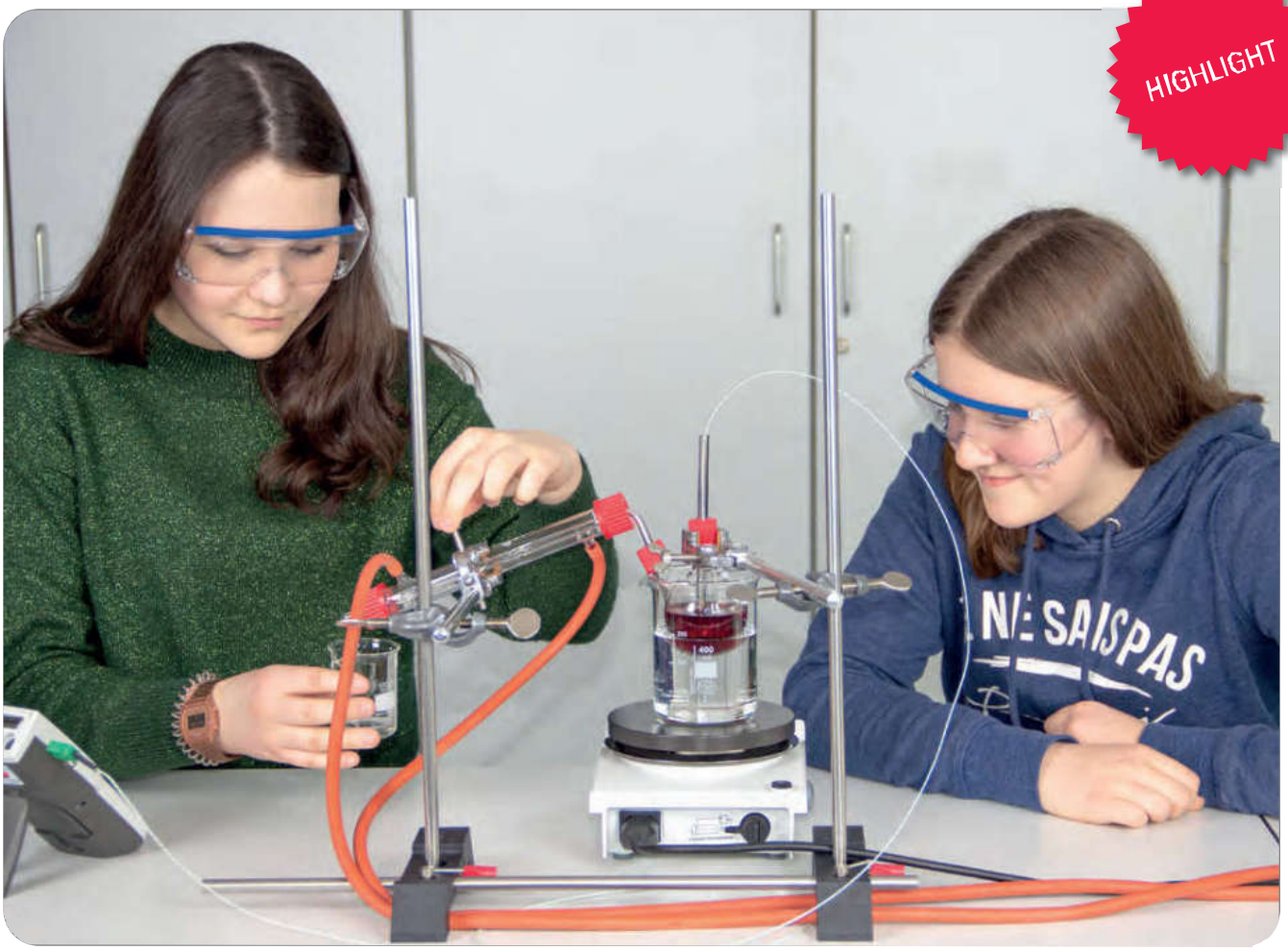
Take advantage of the intelligent set-up system: Instead of using ground joint instruments, your students can implement complex set-ups themselves simply with GL screw joints. Thereby you can successfully conduct the experiment in just one class/lecture. This provides a large variety, from basic experiments on the properties of organic substances to insights into the petrochemical industry.

LC2.1.2.1 Detection of hydrogen and carbon

In this experiment, students will prove that organic matter consists of carbon and hydrogen. To do this, urea is heated together with copper oxide as an example of an organic substance. In doing so, the copper oxide reacts to the copper. The escaping gases are detected in a calcium hydroxide solution as CO_2. For this experiment you will need the sets **Science Lab Chemistry Basic CB (207 200S)** and **Science Lab Organic Chemistry OC (207 221S)**.

Overview of topics and sets

EXPERIMENT TOPICS		REQUIRED SETS		NO. EXPERIMENTS	DETAILS
LC2.1	ORGANIC SUBSTANCES	Chemistry Basic CB	Organic Chemistry OC	53	PAGE 156
LC2.2	HYDROCARBONS				
LC2.3	ALCOHOLS, ALDEHYDES AND KETONES				
LC2.4	CARBOXYLIC ACIDS AND ESTERS				
LC2.5	REACTIONS IN ORGANIC CHEMISTRY				
LC2.6	METHODS OF ORGANIC CHEMISTRY	207 200S	207 221S		



LC2.3.1.3C Distillation of wine

Distillation is a classic chemical process. In this experiment, pure alcohol is isolated from wine through distillation. For this experiment you will need the sets **Science Lab Chemistry Basic CB (207 200S)** and **Science Lab Organic Chemistry OC (207 221S)**.

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

ORGANIC CHEMISTRY – OC

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

	LC2.1	ORGANIC SUBSTANCES
	LC2.1.1	Characteristics of organic substances
	LC2.1.1.1	Characteristics of organic substances
	LC2.1.1.2	Combustion gas of organic substances
	LC2.1.2	Elements in organic substances
	LC2.1.2.1	Detection of hydrogen and carbon
	LC2.1.2.2	Detection of oxygen

	LC2.2	HYDROCARBONS
	LC2.2.1	Saturated hydrocarbons
	LC2.2.1.1	Dry distillation of coal
	LC2.2.1.2	Properties of propane
	LC2.2.1.3	Properties of some alkanes
	LC2.2.1.4	The melting point of paraffin
	LC2.2.2	Unsaturated hydrocarbons
	LC2.2.2.1	Detection of multiple bonds
	LC2.2.2.2	Properties of ethyne
	LC2.2.3	Petrochemistry
	LC2.2.3.1	Properties of some crude oil fractions
	LC2.2.3.2	Petrol as a solvent
	LC2.2.3.3	Catalytic cracking
	LC2.2.3.4	Analysis of crack products
	LC2.2.3.5	Production of biodiesel
	LC2.2.3.5C	Production of biodiesel (with Mobile-CASSY 2 WiFi) DIGITAL

	LC2.3	ALCOHOLS, ALDEHYDES AND KETONES
	LC2.3.1	Production of alcohols
	LC2.3.1.1	Production of "wood alcohol"
	LC2.3.1.2	Alcoholic fermentation
	LC2.3.1.3	Distillation of wine
	LC2.3.1.3C	Distillation of wine (with Mobile-CASSY 2 WiFi) DIGITAL
	LC2.3.2	Detection of alcohols
	LC2.3.2.1	Differentiation of methanol and ethanol
	LC2.3.2.2	Iodoform test
	LC2.3.2.3	Detection of multivalent alkanols
	LC2.3.3	Properties and uses of alcohols
	LC2.3.3.1	Ethanol as a solvent
	LC2.3.3.2	Flammability of an ethanol-water mixture
	LC2.3.3.3	Water-solubility of different alkanols
	LC2.3.3.4	Isomeric alkanols and their boiling points
	LC2.3.3.4C	Isomeric alkanols and their boiling points (with Mobile-CASSY 2 WiFi) DIGITAL
	LC2.3.3.5	Oxidation of alcohols
	LC2.3.4	Aldehydes
	LC2.3.4.1	The Tollens reaction
	LC2.3.4.2	Synthesis and detection of ethanal
	LC2.3.5	Ketones
	LC2.3.5.1	Synthesis of alkanons
	LC2.3.5.2	Properties and uses of acetone

	LC2.4	CARBOXYLIC ACIDS AND ESTERS
	LC2.4.1	Production of carboxylic acids
	LC2.4.1.1	Synthesis of acetic acid by oxidation
	LC2.4.1.2	Synthesis of wine vinegar
	LC2.4.2	Properties & uses of carboxylic acids
	LC2.4.2.1	Formic acid as a preservative
	LC2.4.2.2	Properties of formic acid and acetic acid
	LC2.4.2.3	Properties and uses of wine vinegar
	LC2.4.3	Production and properties of esters
	LC2.4.3.1	Esters of acetic acid
	LC2.4.3.2	Esters of propane acid
	LC2.4.3.3	Esters of benzoic acid
	LC2.4.3.4	Ester synthesis as an equilibrium reaction
	LC2.4.3.5	Alkaline ester hydrolysis
●●	LC2.4.3.5C	Alkaline ester hydrolysis (with Mobile-CASSY 2 WiFi) DIGITAL

	LC2.5	REACTIONS IN ORGANIC CHEMISTRY
	LC2.5.1	Addition reactions
	LC2.5.1.1	Electrophilic addition reaction
	LC2.5.1.2	Nucleophilic addition to the carbonyl group
	LC2.5.2	Substitution reactions
	LC2.5.2.1	Nucleophilic substitution reaction
	LC2.5.2.2	Radical substitution reaction
●●	LC2.5.2.2C	Radical substitution reaction (with Mobile-CASSY 2 WiFi) DIGITAL

	LC2.6	METHODS OF ORGANIC CHEMISTRY
	LC2.6.1	Distillations
	LC2.6.1.1	Distillation of cola
	LC2.6.1.1C	Distillation of cola (with Mobile-CASSY 2 WiFi) DIGITAL
	LC2.6.1.2	Steam distillation for the extraction of fragrances
	LC2.6.1.2C	Steam distillation for the extraction of fragrances (with Mobile-CASSY 2 WiFi) DIGITAL

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

- Conductivity sensor
- Conductivity adapter S
- pH sensor, BNC
- pH adapter S

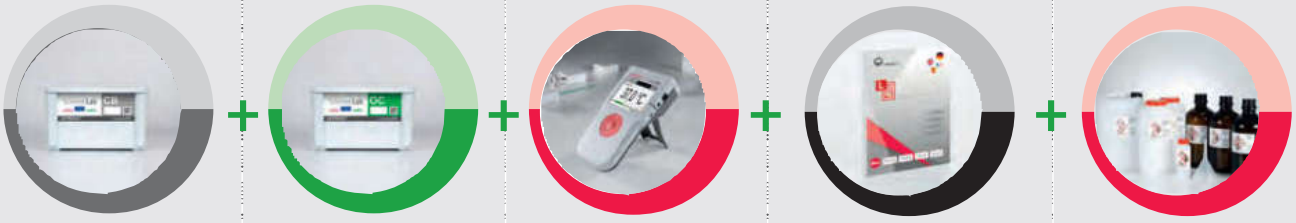
53 EXPERIMENTS

LC2.2.1.4 The melting point of paraffin

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LC2.1 TO LC2.6 ORGANIC CHEMISTRY

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE	CHEMICALS
Chemistry Basic CB	Organic Chemistry OC	Mobile-CASSY 2 WiFi	Science Lab Chemistry digital	Chemical Set OC



Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Organic Chemistry OC (Set)

Student experiment set of the student experiment system Science Lab in the field of chemistry. Set-up material for one working group in pre-formed tray.
With the equipment set OC, together with the Science Lab Chemistry Basic CB (207 200S), 53 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics organic chemistry. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
2	Beaker Boro 3.3, 100 ml, squat
1	Syringe 50 ml
1	Luer Combi Stopper red
1	Two-neck round bottom flask Boro 3.3, 100 ml, GL 18
1	Cooling jacket
1	Tray, high
6	Test tube Fiolax 16 mm x 160 mm
1	Test tube Supremax 20 mm x 180 mm
1	Test tube with side arm, Boro 3.3, 20 x 180 mm
1	Copper wire gauze roll 80 x 7.5 mm Ø
2	Beaker Boro 3.3, 400 ml, squat
1	Petri dish, 100 x 20 mm, glass
1	Erlenmeyer flask 250 ml, narrow neck, SB 29
2	Evaporating dish 60 mm Ø

Count	Name
1	Gas delivery tube, angled, 8 mm Ø
1	Angled tube 90°, 300/50 mm, 8 mm Ø
1	Glass nozzle 90°, 80 mm x 80 mm, 8 mm Ø
1	Fermentation tube 200 mm x 8 mm Ø
1	Pestle 88 mm
1	Mortar porcelain 70 mm Ø
2	Rubber tubing 7 mm Ø, 1 m
5	Rubber stopper solid, 14...18 mm Ø
1	Rubber stopper, one 7-mm hole, 14...18 mm Ø
1	Rubber stopper, one 7-mm hole, 16...21 mm Ø
1	Rubber stopper, one 7-mm hole, 25...31 mm Ø
1	Silicone stopper, one 7-mm hole, 16...21 mm Ø
1	Screw cap GL 18, solid

207 221S	Science Lab Organic Chemistry OC (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

OVERVIEW OF ADVANTAGES

- GL screw joints instead of ground joints
- Includes chemicals for at least 10 repetitions of all experiments
- Wide range of experiments: basic and advanced level

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per student

Count	Cat.-No.	Name	Description
1	610 010	Laboratory safety goggles, Focomax	

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 200S	Science Lab Chemistry Basic CB (Set)	
1	661 243	Wash bottle PE 500 ml	
1	656 017	Teclu burner, universal	
1	607 020	Safety gas hose with clamp 0.5 m	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	529 670	Conductivity sensor	
1	524 0671	Conductivity adapter S	
1	529 672	pH sensor, BNC	
1	524 0672	pH adapter S	
1	666 194	Protective sleeves for temperature probe, set of 5	
1	ADACB501	Compact scale 500 g : 0.1 g	
1	667 609	Safety gloves, nitrile rubber, size 8	
1	666 839	Magnetic stirrer with hot plate	for several experiments
1	666 851	Stirring magnet 25 mm x 6 mm Ø, circular	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 72	LIT: LC Science Lab Chemistry, digital	
1	679 220	Chemicals Science Lab Organic Chemistry	
1	675 3410	Water, pure, 5 l	
1	674 4640	Buffer solution pH 4.00, 250 ml	Substitution reaction experiment (LC2.5.2)
1	674 4670	Buffer solution pH 7.00, 250 ml	Substitution reaction experiment (LC2.5.2)
1	674 9340	Anthracite coal, pieces, 100 g	

Detailed information on **Mobile-CASSY 2 WiFi**, **sensors**, **literature packages** and **chemical sets** are available on the following pages.

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

INCLUDED IN SCOPE OF DELIVERY

Temperature probe NiCr-Ni, type K

Included with the purchase of the Mobile-CASSY 2 WiFi (524 005W).

SENSORS

Conductivity sensor

Conductivity sensor using four-wire technology with integrated Pt temperature sensor for use with chemistry box (524 067), conductivity adapter S (524 0671) and CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Open design for rapid response to changes in conductivity.
When conducting measurements a minimum distance of 1 cm from the side of the, as well as a minimum immersion depth of 2 cm are to be maintained.

529 670	Conductivity sensor	

Conductivity adapter S

Used in conjunction with the conductivity sensor (529 670), this adapter enables conductivity and temperature to be measured with CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836).

524 0671	Conductivity adapter S	

pH sensor, BNC

pH glass electrode in plastic shaft and BNC plug for use with the chemistry box (524 067), pH adapter S (524 0672) and CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836).
Low-maintenance pH electrode with solid electrolyte made of a conductive gel-like polymer.

529 672	pH sensor, BNC	

For storage 3 M Potassium chloride sol. is recommended (672 5250).

pH adapter S

Enables a pH electrode to be connected to CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Moreover, the voltage at the BNC socket can be measured at a very high resistance, e.g. for measuring electrochemical potentials.

524 0672	pH adapter S	

You can find detailed information on these and other sensors from page 229.

CHEMICALS

Chemicals Science Lab Organic Chemistry

Chemicals for carrying out student experiments in Science Lab Organic Chemistry. The chemical set contains 68 different chemicals which can be used to perform every experiment at least 10 times.

679 220	Chemicals Science Lab Organic Chemistry	

The individual chemicals from this set can be found in the chemicals overview which starts from page 220. There you will also find the relevant hazard symbols and classes as well as hazard warnings and safety instructions.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC
SUBJECT AREA

LIT: LC2 Organic Chemistry

Printed version available in ring file of ONE subject area

Detailed experiment instructions relating to Science Lab Set OC (207 221S) and Science Lab Set Chemistry Basic CB (207 200S). Describes 53 experiments from the field of organic chemistry.

Topics:
Organic substances; Hydrocarbons; Alcohols, aldehydes and ketones; Carboxylic acids and esters; Reactions in organic chemistry; Methods of organic chemistry

520 7221EN	LIT: LC1 Organic chemistry

SUBJECT

LIT: LC Science Lab Chemistry, digital

Includes ALL subject areas

Comprehensive chemistry experiment instructions for the Science Lab.
Contains 257 experiments in the fields of inorganic chemistry, organic chemistry, physical chemistry, technical chemistry and biochemistry.

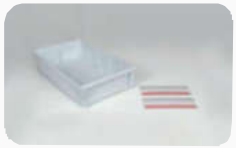
Includes all interactive experiment instructions (Lab Docs) as html file.

520 72	LIT: LC Science Lab Chemistry, digital

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

PHYSICAL CHEMISTRY

With the Science Lab Set *Physical Chemistry*, you will inspire your students with basic, chemistry-related phenomena. With this selection of experiments students do not only gain a deep understanding of electrochemistry, but also of basic concepts such as reaction rate, the energy of chemical reactions or equilibrium concentrations.

Our long established devices, such as our cell batteries for the construction of electrochemical elements, can still be used hereby alongside with our Mobile-CASSY 2 WiFi with its state-of-the-art measuring technology.

HIGHLIGHT

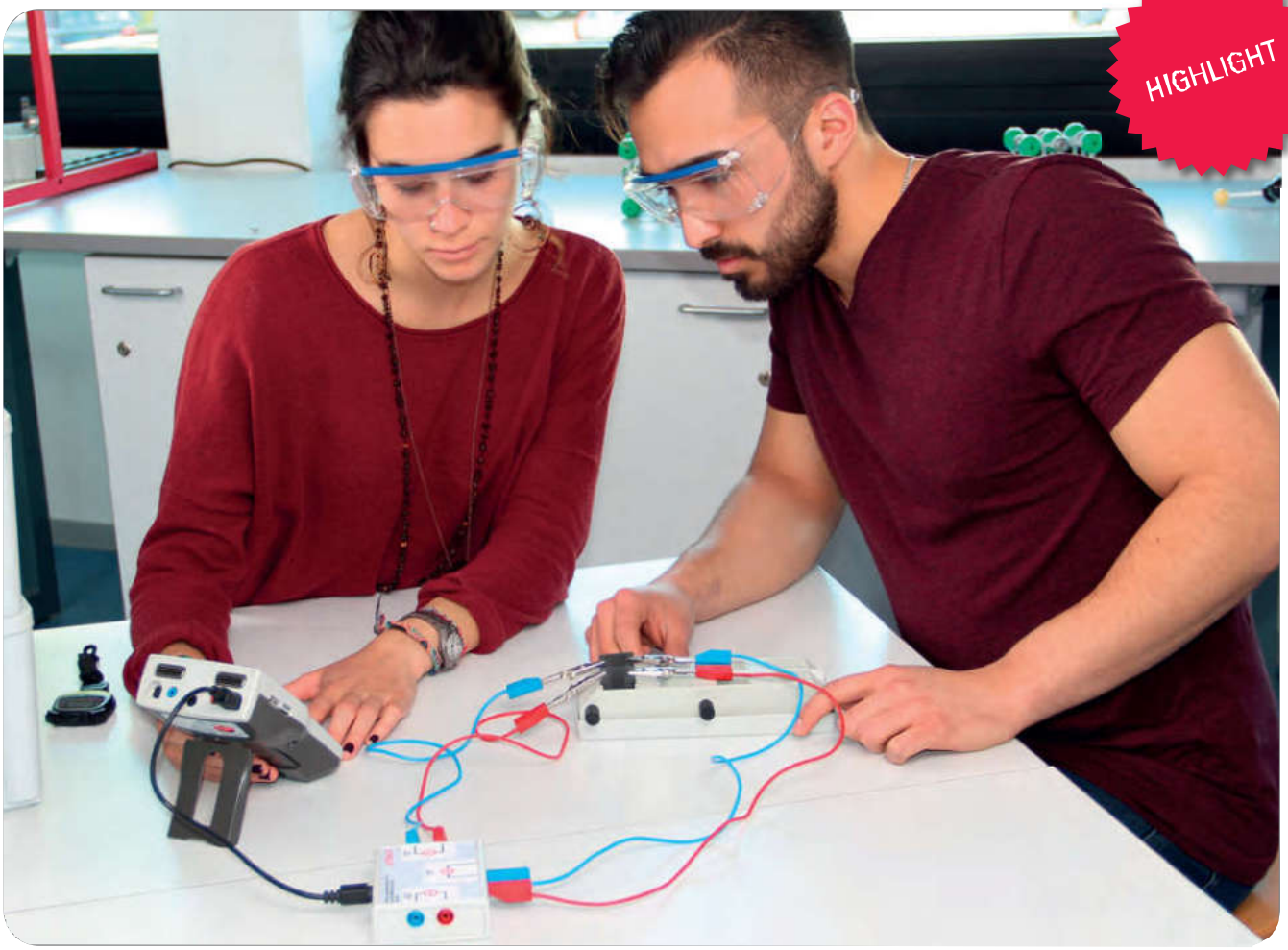
LC3.3.1.1C The water equivalent of a calorimeter

In this experiment, the students will build a simple calorimeter and use a water mixture to calculate the thermal capacity of their calorimeter. This forms a foundation for later calorimetry experiments. For this experiment you will need the sets **Science Lab Chemistry Basic CB (207 200S)** and **Science Lab Physical Chemistry PC (207 231S).**

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

Overview of topics and sets

EXPERIMENT TOPICS		REQUIRED SETS		NO. EXPERIMENTS	DETAILS
LC3.1	ELECTROCHEMISTRY	Chemisty Basic CB	Physical Chemistry PC	55	PAGE 164
LC3.2	PHYSICAL PROCESSES				
LC3.3	ENERGY IN CHEMICAL REACTIONS				
LC3.4	RATE OF REACTION				
LC3.5	CHEMICAL EQUILIBRIUM	207 200S	207 231S		



LC3.1.3.4C The zinc iodide battery

For this experiment, students will construct a zinc iodide battery and charge it using electrolysis in the first part of the experiment. This process is especially easy to observe, as iodine is formed in one half cell and zinc is deposited on the carbon electrode in the other half cell. Then, the battery discharge is examined by measuring the cell voltage and the short-circuit current with the Mobile-CASSY 2 WiFi. For this experiment you will need the sets **Science Lab Chemistry Basic CB (207 200S)** and **Science Lab Physical Chemistry PC (207 231S).**

PHYSICAL CHEMISTRY - PC

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors		
	LC3.1	**ELECTROCHEMISTRY**
	LC3.1.1	**Electrical conductivity**
●	LC3.1.1.1	Conductors and non-conductors
●	LC3.1.1.2	The conductivity of liquids and solutions
●	LC3.1.1.3	Ionic migration
	LC3.1.2	**Electrochemical potentials**
	LC3.1.2.1	The redox series of metals
●	LC3.1.2.2C	Creation of an electrochemical series (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.2.3C	Expansion of an electrochemical series (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.2.4C	The standard potentials of metals (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.2.5C	The standard potentials of non-metals (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.2.6C	The NERNST equation part I - Fundamentals (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.2.7C	The NERNST equation part II - Structure (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.2.8C	Influences on the voltage of concentration cells (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.1.3	**Galvanic elements**
●	LC3.1.3.1C	The Voltaic element (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.3.2C	The DANIELL element (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.3.3C	The DANIELL element (series connection) (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.3.4C	The zinc iodide battery (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.3.5C	The functionality of a fuel cell (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.1.4	**Applied electrochemistry**
	LC3.1.4.1	The corrosion of iron
	LC3.1.4.2	Corrosion protection of iron
●	LC3.1.4.3C	Galvanisation (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.4.4	Electrolytic refining of copper
●	LC3.1.4.5	Anodic oxidation
●	LC3.1.4.6C	The solubility product (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.4.7C	The dissociation constant (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.4.8C	The silver/silver chloride electrode (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.1.5	**Electrolysis**
●	LC3.1.5.1	Electrolysis of water
●	LC3.1.5.2	Electrolysis of metal halide solutions
●	LC3.1.5.3C	Faraday's first law with the electrolyser (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.5.4C	Faraday's second law with the electrolyser (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.1.5.5C	Determination of the Faraday efficiency of an electrolyser (with Mobile-CASSY 2 WiFi) DIGITAL

	LC3.2	**PHYSICAL PROCESSES**
	LC3.2.1	**Particle movement**
	LC3.2.1.1	Diffusion

	LC3.3	**ENERGY IN CHEMICAL REACTIONS**
	LC3.3.1	**Calorimetry**
	LC3.3.1.1C	The water equivalent of a calorimeter (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.3.1.2C	Neutralisation enthalpy (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.3.1.3C	Solution enthalpy of salts (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.3.1.4C	Reaction enthalpy of a redox reaction (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.3.2	**Reaction heat**
	LC3.3.2.1C	The exothermic reaction (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.3.2.2C	The endothermic reaction (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.3.2.3C	Hess's law (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.3.2.4C	A spontaneous endothermic reaction (with Mobile-CASSY 2 WiFi) DIGITAL

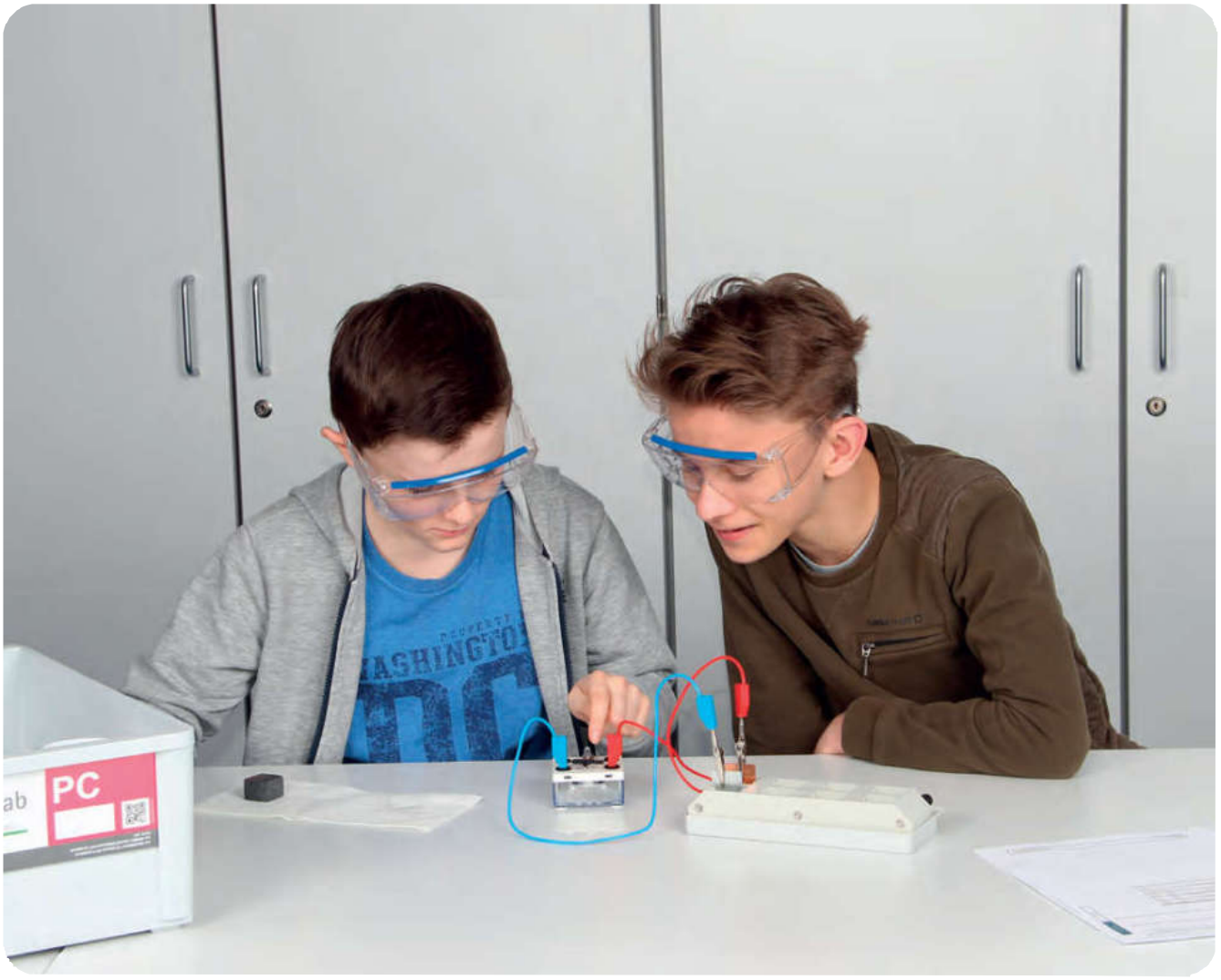
	LC3.4	**RATE OF REACTION**
	LC3.4.1	**Course of a reaction**
● ●	LC3.4.1.1C	Hydrolysis of esters (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.4.1.2	Activation energy
	LC3.4.2	**Influencing the rate of reaction**
	LC3.4.2.1	Temperature dependence
	LC3.4.2.2	Concentration dependence
	LC3.4.2.3	Degree of fragmentation
	LC3.4.2.4	A catalytic reaction
	LC3.4.2.5	Inorganic and organic catalysts
	LC3.4.2.6	Analysis of enzyme activity

	LC3.5	**CHEMICAL EQUILIBRIUM**
	LC3.5.1	**Chemical equilibrium**
	LC3.5.1.1	Chemical equilibrium
	LC3.5.1.2	Ligand exchange with copper complexes
	LC3.5.2	**Le Chatelier's principle**
● ●	LC3.5.2.1C	Influence of a change in temperature (with Mobile-CASSY 2 WiFi) DIGITAL
	LC3.5.2.2	Influence of a change in concentration
	LC3.5.2.3	Influence of a change in pressure
	LC3.5.3	**The law of mass action and its applications**
	LC3.5.3.1	Law of mass action
● ●	LC3.5.3.2C	Determination of the equilibrium constant (with Mobile-CASSY 2 WiFi) DIGITAL
●	LC3.5.3.3	The solubility product
●	LC3.5.3.4C	The dissociation constant (with Mobile-CASSY 2 WiFi) DIGITAL

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

- Conductivity sensor
- Conductivity adapter S
- pH sensor, BNC
- pH adapter S
- Electrochemistry box M

55 EXPERIMENTS



LC3.1.3.2C The DANIELL element

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LC3.1 TO LC3.5 PHYSICAL CHEMISTRY

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE	CHEMICALS
Chemistry Basic CB	Physical Chemistry PC	Mobile-CASSY 2 WiFi	Science Lab Chemistry digital	Chemical Set PC

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Physical Chemistry PC (Set)

Student experiment set of the student experiment system Science Lab in the field of chemistry. Set-up material for one working group in pre-formed tray. With the equipment set PC, together with the Science Lab Chemistry Basic CB (207 200S), 55 experiments at school, college and university level for worldwide curriculums can be performed. The students deal with the topics physical chemistry and electrochemistry. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
2	Connecting lead 19 A, 50 cm, red/blue, pair
6	Crocodile clip, polished
4	Beaker Boro 3.3, 100 ml, squat
1	Syringe 50 ml
1	Luer Combi Stopper red
4	Plastic cup
1	Tray, high
5	Test tube Fiolax 16 mm x 160 mm
2	Beaker Boro 3.3, 400 ml, squat
2	Petri dish, 100 x 20 mm, glass
1	Plastic plate for magnesium electrode
4	Plate electrode copper 43 x 28 mm
2	Plate electrode zinc 43 x 28 mm

Count	Name
2	Plate electrode iron 43 x 28 mm
3	Plate electrode carbon 43 x 28 mm
2	Plate electrode silver 43 x 28 mm
1	Mesh electrode platinum 43 x 28 mm
1	Grindstone
1	Spare Diaphragms, 100 sheets
1	Angled tube 90°, 250/50 mm, 8 mm Ø
1	Electrical loads Electrochemistry
1	Cell batteries, pair
1	Stopwatch, digital
207 231S	Science Lab Physical Chemistry PC (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

OVERVIEW OF ADVANTAGES

- Electrochemistry with the reliable cell battery: low amounts of chemicals needed and simultaneous measurements in the separate compartments possible
- Digital measurements (temperature, voltage, current, conductivity)
- Experiments with the multifunctional electrochemistry box M, no separate power supply required
- Quantitative experiments for advanced chemistry lessons/classes
- Includes enough chemicals for at least 10 repetitions of all experiments

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per student

Count	Cat.-No.	Name	Description
1	610 010	Laboratory safety goggles, Focomax	

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 200S	Science Lab Chemistry Basic CB (Set)	
1	661 243	Wash bottle PE 500 ml	
1	656 017	Teclu burner, universal	
1	607 020	Safety gas hose with clamp 0.5 m	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	529 670	Conductivity sensor	
1	524 0671	Conductivity adapter S	
1	529 672	pH sensor, BNC	
1	524 0672	pH adapter S	
1	524 450	Electrochemistry box M	
1	666 194	Protective sleeves for temperature probe, set of 5	
1	ADACB501	Compact scale 500 g : 0.1 g	
1	667 609	Safety gloves, nitrile rubber, size 8	
1	607 105	Magnetic stirrer mini	
1	666 839	Magnetic stirrer with hot plate	Le Chatelier's principle experiment (LC3.5.2)
1	666 851	Stirring magnet 25 mm x 6 mm Ø, circular	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 72	LIT: LC Science Lab Chemistry, digital	
1	679 230	Chemicals Science Lab Physical Chemistry	
1	675 3410	Water, pure, 5 l	
1	ADAHCB123	Compact Balance 120 g : 0.001 g	
1	674 4640	Buffer solution pH 4.00, 250 ml	Le Chatelier's principle experiment (LC3.5.2)
1	674 4670	Buffer solution pH 7.00, 250 ml	Le Chatelier's principle experiment (LC3.5.2)

Detailed information on **Mobile-CASSY 2 WiFi**, **sensors**, **literature packages** and **chemical sets** are available on the following pages.

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

INCLUDED IN SCOPE OF DELIVERY

Temperature probe NiCr-Ni, type K

Included with the purchase of the Mobile-CASSY 2 WiFi (524 005W).

SENSORS

Conductivity sensor

Conductivity sensor using four-wire technology with integrated Pt temperature sensor for use with chemistry box (524 067), conductivity adapter S (524 0671) and CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Open design for rapid response to changes in conductivity. When conducting measurements a minimum distance of 1 cm from the side of the, as well as a minimum immersion depth of 2 cm are to be maintained.

529 670	Conductivity sensor	

Conductivity adapter S

Used in conjunction with the conductivity sensor (529 670), this adapter enables conductivity and temperature to be measured with CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836).

524 0671	Conductivity adapter S	

pH sensor, BNC

pH glass electrode in plastic shaft and BNC plug for use with the chemistry box (524 067), pH adapter S (524 0672) and CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Low-maintenance pH electrode with solid electrolyte made of a conductive gel-like polymer.

529 672	pH sensor, BNC	

For storage 3 M Potassium chloride sol. is recommended (672 5250).

pH adapter S

Enables a pH electrode to be connected to CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Moreover, the voltage at the BNC socket can be measured at a very high resistance, e.g. for measuring electrochemical potentials.

524 0672	pH adapter S	

You can find detailed information on these and other sensors from page 229.

SENSORS

Electrochemistry box M

Mobile power supply for experiments as well as voltage and current measuring device in conjunction with Mobile-CASSY 2 WiFi (524 005W). For power supply up to 300 mA as well as the intuitive, parallel measurement of voltage up to ±20 V and current up to ±2 A.

524 450	Electrochemistry box M	

You can find detailed information on this and other sensors from page 229.

CHEMICALS

Chemicals Science Lab Physical Chemistry

Chemicals for carrying out student experiments in Science Lab topic Physical Chemistry and Electrochemistry.
The chemical set contains 57 different chemicals which can be used to perform every experiment at least 10 times.

679 230	Chemicals Science Lab Physical Chemistry	

The individual chemicals from this set can be found in the chemicals overview which starts from page 220. There you will also find the relevant hazard symbols and classes as well as hazard warnings and safety instructions.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC
SUBJECT AREA

LIT: LC3 Physical Chemistry

Printed version available in ring file of ONE subject area

Detailed experiment instructions relating to Science Lab Set PC (207 231S) and Science Lab Set Chemistry Basic CB (207 200S). Describes 55 experiments from the field of physical chemistry.

Topics:
Electrochemistry; Physical processes; Energy in chemical reactions; Rate of reaction; Chemical equilibrium

520 7231EN	LIT: LC3 Physical chemistry

SUBJECT

LIT: LC Science Lab Chemistry, digital

includes ALL subject areas

Comprehensive chemistry experiment instructions for the Science Lab.
Contains 257 experiments in the fields of inorganic chemistry, organic chemistry, physical chemistry, technical chemistry and biochemistry.

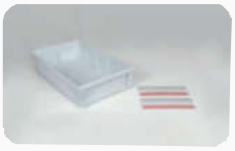
Includes all interactive experiment instructions (Lab Docs) as html file.

520 72	LIT: LC Science Lab Chemistry, digital

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

TECHNICAL CHEMISTRY AND BIOCHEMISTRY

With the experiments from the Science Lab Set Technical Chemistry, your students can apply their basic knowledge to their everyday lives. For example, they can apply the principles of chemical equilibrium to the topic of lime and gypsum, or they can use the fundamentals of organic chemistry when it comes to dyes. The topics of metals, plastics and soaps also have relevance to everyday life.

Biochemistry, as an interdisciplinary subject between chemistry and biology, is a captivating topic for many students. With the Science Lab Set Technical Chemistry and Biochemistry, you will look at fats, carbohydrates and proteins as well as their properties and applicable chemical detection reactions. Additionally, you can perform experiments on the chemistry of food and therefore practice applying chemical knowledge to everyday topics.

The Technical Chemistry and Biochemistry Set contains experiments in *Technical Chemistry* and *Biochemistry* that can be individually selected.

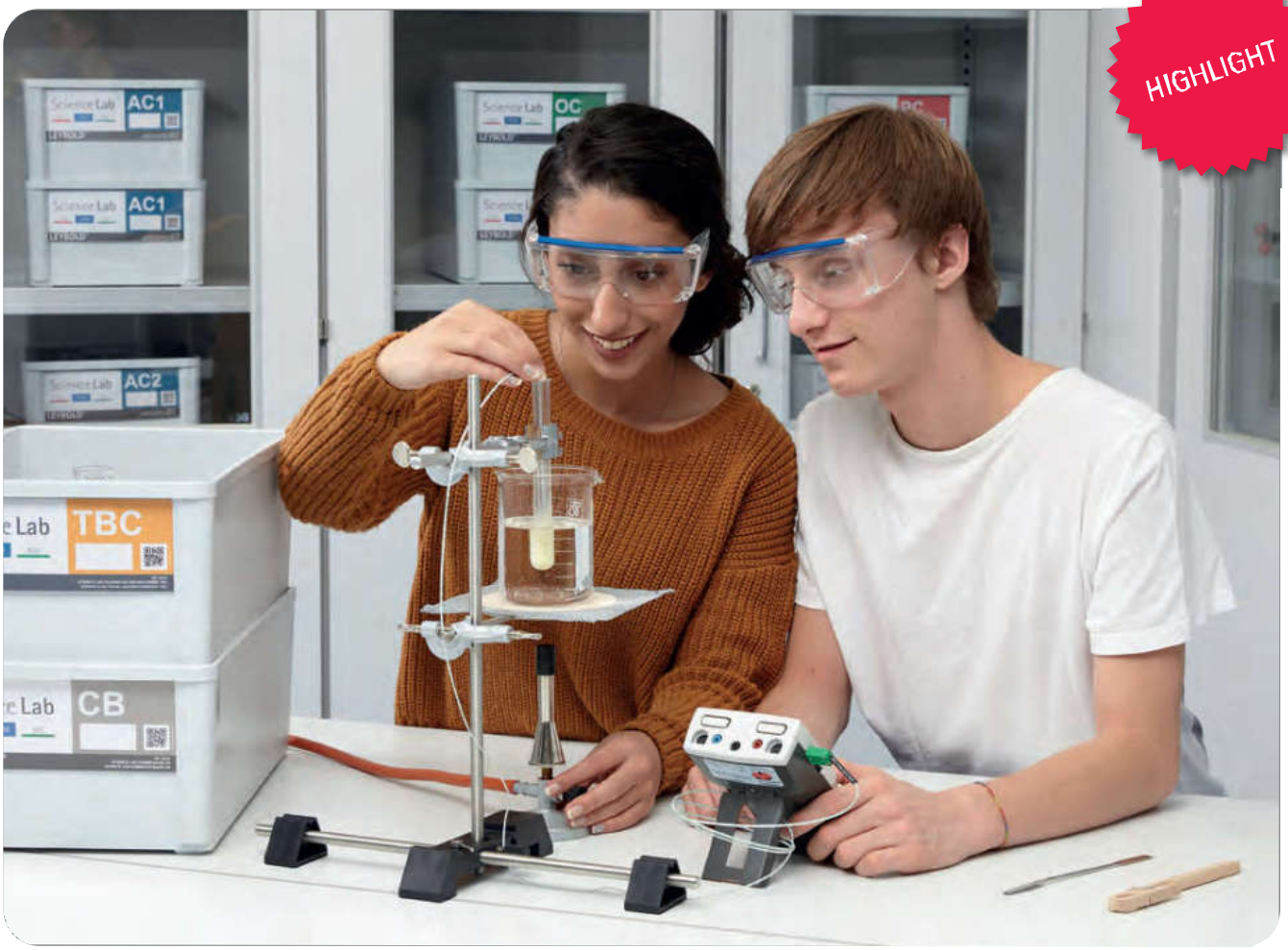
HIGHLIGHT

LC4.5.2.3 Influencing the properties of plastics

Plasticisers can change the properties of a plastic. In this experiment, two sheets of starch are prepared, one with added glycerine as plasticiser. Both sheets are compared with each other. For this experiment you will need the sets **Science Lab Chemistry Basic CB (207 200S)** and **Science Lab Technical Chemistry and Biochemistry TBC (207 241S)**.

Overview of topics and sets

EXPERIMENT TOPICS	TECHNICAL CHEMISTRY	REQUIRED SETS		NO. EXPERIMENTS	DETAILS
LC4.1	BUILDING MATERIALS	Chemistry Basic CB	Technical & Biochemistry TBC	24	PAGE 172
LC4.2	GLASS				
LC4.3	METALS				
LC4.4	CHEMICAL APPLICATIONS				
LC4.5	PRODUCTS OF THE ORGANIC INDUSTRY				
EXPERIMENT TOPICS	BIOCHEMISTRY			NO. EXPERIMENTS	DETAILS
LC5.1	FATS	207 200S	207 241S	32	PAGE 172
LC5.2	CARBOHYDRATES				
LC5.3	AMINO ACIDS AND PROTEINS				
LC5.4	FOOD				



LC5.1.1.2C Melting and solidification point

Fats are always mixtures of several triglycerides. The melting point or melting range gives information about the composition of a fat. For this experiment you will need the sets **Science Lab Chemistry Basic CB (207 200S)** and **Science Lab Technical Chemistry and Biochemistry TBC (207 241S)**.

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

TECHNICAL CHEMISTRY AND BIOCHEMISTRY

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

TECHNICAL CHEMISTRY

LC4.1	BUILDING MATERIAL	
LC4.1.1	Limestone and gypsum	
LC4.1.1.1	Calcination of limestone	
LC4.1.1.2	Slaking of limestone	
LC4.1.1.3	Setting of limestone	
LC4.1.1.4	Setting of gypsum	
LC4.1.1.4C	Setting of gypsum (with Mobile-CASSY 2 WiFi)	DIGITAL

LC4.2	GLASS
LC4.2.1	Glass
LC4.2.1.1	Production of soda-lime glass

LC4.3	METALS
LC4.3.1	Extraction of metals
LC4.3.1.1	The smelting of oxidic ores
LC4.3.2	Alloys
LC4.3.2.1	Production of bronze
LC4.3.2.2	Production of brass

LC4.4	CHEMICAL APPLICATIONS
LC4.4.1	Fertilisers
LC4.4.1.1	Production of ammonium sulphate
LC4.4.2	Photography
LC4.4.2.1	The photochemical reaction

LC4.5	PRODUCTS OF THE ORGANIC INDUSTRY	
LC4.5.1	Pigments and dyestuffs	
LC4.5.1.1	Molecular structure and colour	
LC4.5.1.2	Synthesis of orange II	
LC4.5.1.3	Extraction of food colourings	
LC4.5.1.4	Synthesis of indigo and vat dyeing	
LC4.5.1.5	The phenomenon of fluorescence	
LC4.5.2	Plastics	
LC4.5.2.1	The characteristics of different plastics	
LC4.5.2.2	Polycondensation in the production of plastics	
LC4.5.2.3	Influencing the properties of plastics	
LC4.5.2.4	Recycling via pyrolysis	
LC4.5.2.5	Silicons and carbon fibres as modern materials	
LC4.5.3	Soaps	
LC4.5.3.1	Production via alkaline saponification	
LC4.5.3.2	Production using the carbonate process	
LC4.5.3.3	Soap as an emulsifier	

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

24 EXPERIMENTS

BIOCHEMISTRY

LC5.1	FATS	
LC5.1.1	Properties of fats	
LC5.1.1.1	Solubility	
LC5.1.1.2	Melting and solidification point	
LC5.1.1.2C	Melting and solidification point (with Mobile-CASSY 2 WiFi)	DIGITAL
LC5.1.1.3	Boiling point	
LC5.1.1.3C	Boiling point (with Mobile-CASSY 2 WiFi)	DIGITAL
LC5.1.2	Fatty foods	
LC5.1.2.1	Rendering animal fats	
LC5.1.2.2	Extracting vegetable fats	
LC5.1.2.2C	Extracting vegetable fats (with Mobile-CASSY 2 WiFi)	DIGITAL
LC5.1.3	Analysing fats	
LC5.1.3.1	Detection of fats	
LC5.1.3.2	Detection of unsaturated fatty acids	
LC5.1.3.2C	Detection of unsaturated fatty acids (with Mobile-CASSY 2 WiFi)	DIGITAL

LC5.2	CARBOHYDRATES	
LC5.2.1	Properties of carbohydrates	
LC5.2.1.1	Components of carbohydrates	
LC5.2.1.2	Solubility of carbohydrates	
LC5.2.1.2C	Solubility of carbohydrates (with Mobile-CASSY 2 WiFi)	DIGITAL
LC5.2.2	Extraction of sugars	
LC5.2.2.1	Isolation and detection of lactose	
LC5.2.3	Detection of sugars	
LC5.2.3.1	Detection of glucose and fructose	
LC5.2.3.3	Seliwanoff's test	
LC5.2.3.4	Blue bottle experiment	
LC5.2.3.5	Components of sucrose	
LC5.2.4	Starch and cellulose	
LC5.2.4.1	Components of starch	
LC5.2.4.2	Starch test	
LC5.2.4.3	Cellulose test	

LC5.3	AMINO ACIDS AND PROTEINS
LC5.3.1	Properties of proteins
LC5.3.1.1	Preparing an egg white solution
LC5.3.1.2	Properties of proteins
LC5.3.1.3	The composition of proteins
LC5.3.1.5	The isoelectric point of amino acids
LC5.3.2	Detection of proteins
LC5.3.2.1	The Biuret test
LC5.3.2.2	Detection with test sticks

LC5.4	FOOD
LC5.4.1	Preservatives
LC5.4.1.1	Detection of vitamin C
LC5.4.1.2	Preservation with benzoic acid and sorbic acid
LC5.4.2	Additives
LC5.4.2.1	Extraction of food colourings
LC5.4.2.2	Composition of baking powder

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

32 EXPERIMENTS

LC4.5.1.4 Synthesis of indigo and vat dyeing

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LC4.1 TO LC5.4 TECHNICAL AND BIOCHEMISTRY

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE	CHEMICALS
Chemistry Basic CB	Technical & Biochemistry TBC	Mobile-CASSY 2 WiFi	Science Lab Chemistry digital	Chemical Sets TBC

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Technical and Biochemistry TBC (Set)

Student experiment set of the student experiment system Science Lab in the field of chemistry. Set-up material for one working group in pre-formed tray. With the equipment set TBC, together with the Science Lab Chemistry Basic CB (207 200S), 56 experiments at school, college and university level for worldwide curriculums can be performed. The students deal with the topics technical chemistry and/or biochemistry. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
3	Beaker Boro 3.3, 100 ml, squat
4	Plastic cup
1	Tray, high
1	Crucible porcelain 20 ml
6	Test tube Fiolax 16 mm x 160 mm
1	Test tube Supremax 20 mm x 180 mm
2	Beaker Boro 3.3, 400 ml, squat
2	Petri dish, 100 x 20 mm, glass
1	Erlenmeyer flask 250 ml, narrow neck, SB 29
1	Grindstone
2	Evaporating dish 60 mm Ø

Count	Name
1	Funnel PP 75 mm Ø
1	Angled tube 90°, 300/50 mm, 8 mm Ø
1	Stand ring with stem 100 mm Ø
1	Wire gauze 160 mm x 160 mm
1	Pestle 88 mm
1	Mortar porcelain 70 mm Ø
4	Rubber stopper solid, 14...18 mm Ø
1	Rubber stopper solid, 25...31 mm Ø
1	Silicone stopper, one 7-mm hole, 16...21 mm Ø

207 241S	Science Lab Technical and Biochemistry TBC (Set)

LC5.3.1.3 The composition of proteins

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

OVERVIEW OF ADVANTAGES

- 1 experiment set plus Basic Set provides 24 experiments in technical chemistry and 32 experiments in biochemistry
- Everyday topics also suitable for project work and elective courses
- Includes enough chemicals for at least 10 repetitions of all experiments

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per student

Count	Cat.-No.	Name	Description
1	610 010	Laboratory safety goggles, Focomax	

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 200S	Science Lab Chemistry Basic CB (Set)	
1	656 017	Teclu burner, universal	
1	607 020	Safety gas hose with clamp 0.5 m	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	666 194	Protective sleeves for temperature probe, set of 5	
1	ADACB501	Compact scale 500 g : 0.1 g	
1	667 609	Safety gloves, nitrile rubber, size 8	
1	666 839	Magnetic stirrer with hot plate	Pigments & dyestuffs, plastics, starch & cellulose experiments (LC4.5.1, LC4.5.2, LC5.2.4)
1	666 851	Stirring magnet 25 mm x 6 mm Ø, circular	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 72	LIT: LC Science Lab Chemistry, digital	
1	679 240	Chemicals Science Lab Technical Chemistry	
1	679 250	Chemicals Science Lab Biochemistry	
1	675 3410	Water, pure, 5 l	
1	661 080	Cobalt chloride test paper 2 x 7 cm, 100 strips	
1	670 2230	Albustix test sticks, 50 pcs	
1	670 9430	Lead(II) acetate paper, 1 package	
1	672 1150	Glucose-test stripes, 50 pcs	
1	MA91314	Test sticks Ascorbic acid	
1	665 6351	Analysis lamp (UV)	

Detailed information on **Mobile-CASSY 2 WiFi**, **sensors**, **literature packages** and **chemical sets** are available on the following pages.

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

INCLUDED IN SCOPE OF DELIVERY

Temperature probe NiCr-Ni, type K

Included with the purchase of the Mobile-CASSY 2 WiFi (524 005W).

MOBILE-CASSY 2 WIFI

With the Mobile-CASSY 2 WiFi, voltage *(U)*, current *(I)*, power *(P)* and energy *(E)* can be measured via 4 mm safety sockets.

CHEMICALS

Chemicals Science Lab Technical Chemistry

Chemicals for carrying out student experiments in Science Lab topic Technical Chemistry. The chemical set contains 40 different chemicals which can be used to perform every experiment at least 10 times.

679 240	Chemicals Science Lab Technical Chemistry	

Chemicals Science Lab Biochemistry

Chemicals for carrying out student experiments in Science Lab topic Biochemistry. The chemical set contains 37 different chemicals which can be used to perform every experiment at least 10 times.

679 250	Chemicals Science Lab Biochemistry	

The individual chemicals from this set can be found in the chemicals overview which starts from page 220. There you will also find the relevant hazard symbols and classes as well as hazard warnings and safety instructions.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC
SUBJECT AREA

LIT: LC4 Technical Chemistry

Printed version available in ring file of ONE subject area

Detailed experiment instructions relating to Science Lab Set TBC (207 241S) and Science Lab Set Chemistry Basic CB (207 200S). Describes 24 experiments from the field of technical chemistry.

Topics:
Building material; Glass; Metals; Chemical applications; Products of the organic industry

520 7241EN	LIT: LC4 Technical Chemistry	

LIT: LC5 Biochemistry

Printed version available in ring file of ONE subject area

Detailed experiment instructions relating to Science Lab Set TBC (207 241S) and Science Lab Set Chemistry Basic CB (207 200S). Describes 32 experiments from the field of biochemistry.

Topics:
Fats; Carbohydrates; Amino acids and proteins; Food

520 7251EN	LIT: LC5 Biochemistry	

SUBJECT

LIT: LC Science Lab Chemistry, digital

includes ALL subject areas

Comprehensive chemistry experiment instructions for the Science Lab.
Contains 257 experiments in the fields of inorganic chemistry, organic chemistry, physical chemistry, technical chemistry and biochemistry.

Includes all interactive experiment instructions (Lab Docs) as html file.

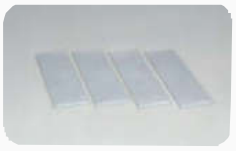
520 72	LIT: LC Science Lab Chemistry, digital

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES




You can find detailed information on additional storage accessories from page 228.

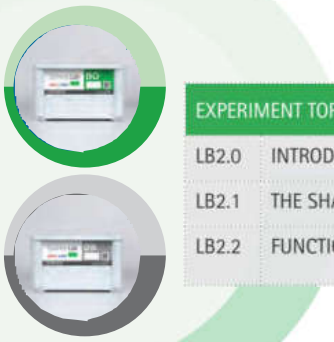
BIOLOGY

Overview of student experiments

Here you will find a complete overview of our Science Lab student experiments in the field of biology.

HUMAN BIOLOGY

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIENCES	DETAILS
LB1.1	OUR SENSES	Tactile sense; Hearing; Sight; Smell	20	PAGE 184
LB1.2	OUR BODY	The cardiovascular system; The nervous system; Digestion; Sensory organs	33	PAGE 190
LB1.3	MAINTAINING A HEALTHY BODY	Nutrition; Hygiene; Food technology		



BOTANY

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIENCES	DETAILS
LB2.0	INTRODUCTION TO METHODS	Microscopy	32	PAGE 198
LB2.1	THE SHAPE OF PLANTS	Leaf; Flower; Plant stem; Roots		
LB2.2	FUNCTION OF PLANTS	Germination and growth; Water balance; Photosynthesis		

ECOLOGY

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIENCES	DETAILS
LB3.0	INTRODUCTION TO METHODS	Microscopy	35	PAGE 206
LB3.1	ECOSYSTEMS	Abiotic factors; Biotic factors; Biodiversity; Population ecology		
LB3.2	ANALYSIS OF ECOSYSTEMS	Analysis of waterbodies on site; Forest and soil analysis		
LB3.3	HUMANS AND THE ENVIRONMENT	Water pollution; Soil pollution; Air pollution		
LB3.4	EVOLUTION	Adaptation to the environment		

CELL BIOLOGY

EXPERIMENT TOPICS		CURRICULUM TOPICS	NO. EXPERIENCES	DETAILS
LB4.0	INTRODUCTION TO METHODS	Microscopy	19	PAGE 214
LB4.1	STRUCTURE OF THE CELL	Single-cell organisms; Multi-cell organisms		
LB4.2	PROCESSES IN THE CELL	The cell membrane; Cell cycle; Enzymes; Transport processes		

Science Lab

Biology Basic BB (207 300S)

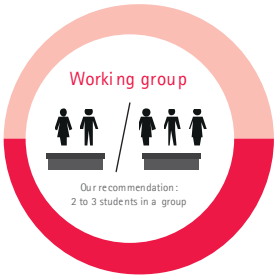
BASIC SET FOR OUR INNOVATIVE STUDENT EXPERIMENT SYSTEM FOR BIOLOGY

- This Basic Set contains **the basic devices** which are regularly needed for student experiments in Biology.
- Each device has its own specified space in the pre-formed storage tray.
- With the **different thematic sets** more than **135** student experiments can be performed in Biology.
- One Basic Set for all fields of biology and a maximum of two trays on the student workstation.

ADVANTAGES

- The Basic Set contains the material required for **one working group** - consisting of 2-3 students.
- Experiments from the Science Lab Biology can then be carried out with only one additional set, depending on the topic.
- Same devices = always the same handling: no need to re-learn devices for every topic.

Science Lab Biology Basic BB (Set)



Student experiment set of the student experiment system Science Lab in the field of biology. Basic equipment for experiments in human biology, botanics, ecology and cellular biology. Set-up material for one working group in pre-formed tray. The individual trays are stackable and can optionally be closed with a lid (647 003).
The equipment set Science Lab Biology Basic BB, in combination with at least one of the following biology sets, enables the performance of experiments at school, college and university level for worldwide curriculums:

- Equipment set Science Lab Human Biology HU2 (207 312S)
- Equipment set Science Lab Botanics BO (207 321S)
- Equipment set Science Lab Ecology ECO (207 331S)
- Equipment set Science Lab Cellular Biology CE (207 341S)

Scope of delivery:

Count	Name
4	Bosshead S
2	Stand base MF
3	Stand rod 40 cm, 10 mm Ø
1	Universal pencil
1	Stirring thermometer -10...+110 °C
1	Powder spatula, steel, 185 mm
1	Tray, high
1	Round filter, Type 595, 125 mm Ø, Set of 100
1	Blades, 5 pieces
1	Cover slips
1	Microscope slides 76 mm x 26 mm x 1 mm, set of 50
3	Watch glass dish 80 mm Ø
3	Petri dish, 100 x 15 mm, glass
1	Glass stirring rod 200 x 8 mm Ø
1	Measuring cylinder 100 ml, with plastic base
4	Dropping pipette 150 mm x 7 mm Ø
4	Rubber bulb
1	Universal clamp 0...80 mm
1	Spoon-ended spatula, PP, 180 mm
1	Scissors 125 mm, round-ended
1	Laboratory knife
1	Crucible tongs 200 mm
1	Test tube rack metal 20 mm Ø
1	Microscopic set, 6 parts in a box
207 300S	Science Lab Biology Basic BB (Set)

Additionally required:

Count	Cat.-No.	Name
1	207 312S	Science Lab Human Biology HU2 (Set)
1	207 321S*	Science Lab Botanics BO (Set)
1	207 331S*	Science Lab Ecology ECO (Set)
1	207 341S*	Science Lab Cellular Biology CE (Set)

* alternative

Additionally recommended:

Count	Cat.-No.	Name
1	647 003	Lid for tray

leybold/207300S

HUMAN BIOLOGY

Human biology is a key topic in biology lessons and, in addition to improving biology skills, also serves as a tool for health education.

The senses can be taught very well using experiments, where students can be the test subjects themselves.

This is the idea the Science Lab Set *IHuman Biology 1 (IIU1)* is based on. Smell, sight, touch or hearing: the students can perform most of the experiments directy on themselves. The selection of experiments is complemented by anatomical experiments, e.g. the dissection of a porcine's eye.

The Science Lab Set *IHuman Biology 2 (IIU2)* deals with the human body and health in general. The students will study the cardiovascular and digestive systems in classic experiments. A particular focus is placed on experiments concerning the nervous system. From reaction tests to memorisation tasks, the students can performed many experiments on their own body. The topic of health focuses on experiments on digestion as well as hygiene, with applicable microbiological experiments.

HIGHLIGHT

LB1.1.3.4 Apparent depth

In this experiment, an image is observed with 3D glasses. Although the surface is flat, the image appears to be three-dimensional.
For this experiment you will need the set **Science Lab Human Biology HU1 (207 311S)**.

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

Overview of topics and sets

EXPERIMENT TOPICS		REQUIRED SETS	NO. EXPERIMENTS	DETAILS
LB1.1	OUR SENSES	Human Biology HU1 207 311S	20	PAGE 184
LB1.2	OUR BODY	Biology Basic BB + Human Biology HU2 207 300S + 207 312S	33	PAGE 190
LB1.3	MAINTAINING A HEALTHY BODY			

LB1.3.2.2 Colony counting in the air

In this experiment, uncovered culture media are placed at different locations. After incubating the culture media, the germ count can be determined by counting the colonies.

For this experiment you will need the sets **Science Lab Biology Basic BB (207 300S)** and **Science Lab Human Biology HU2 (207 312S)**.

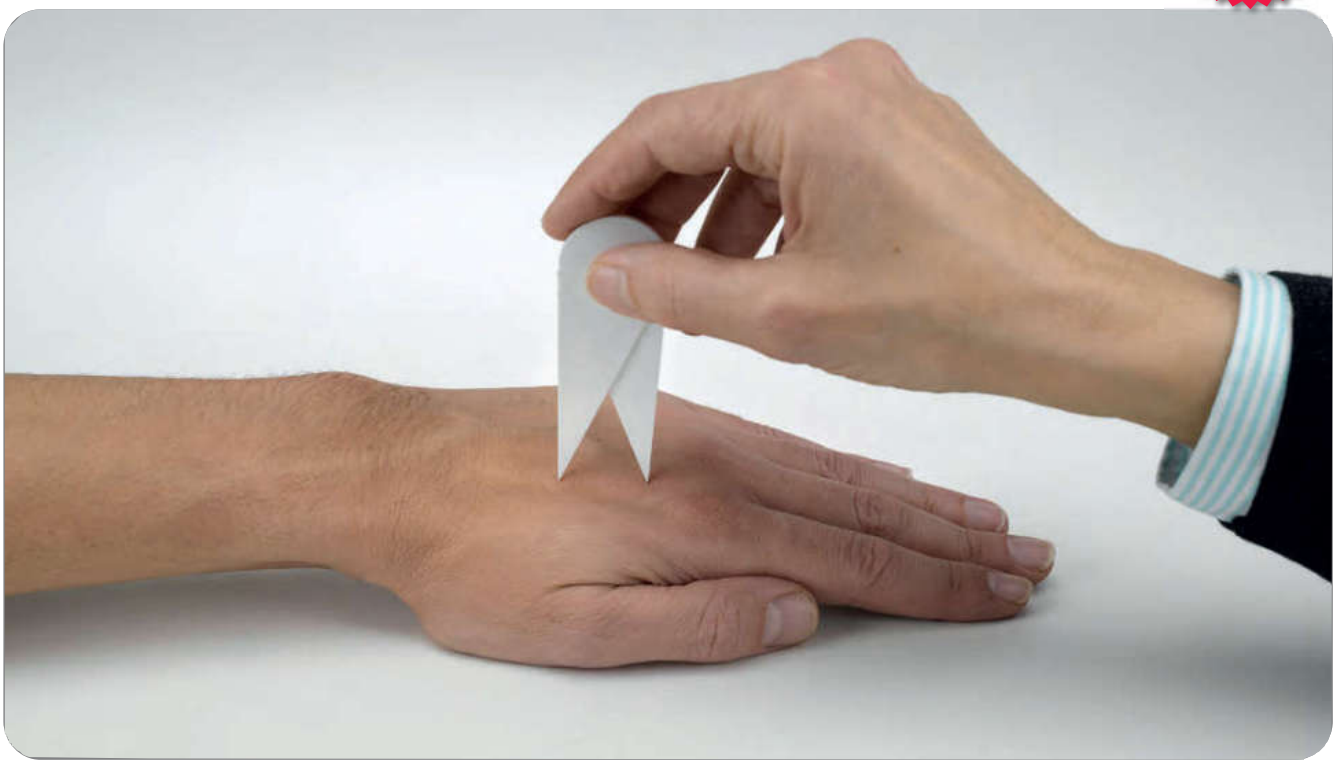
HUMAN BIOLOGY HU1

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

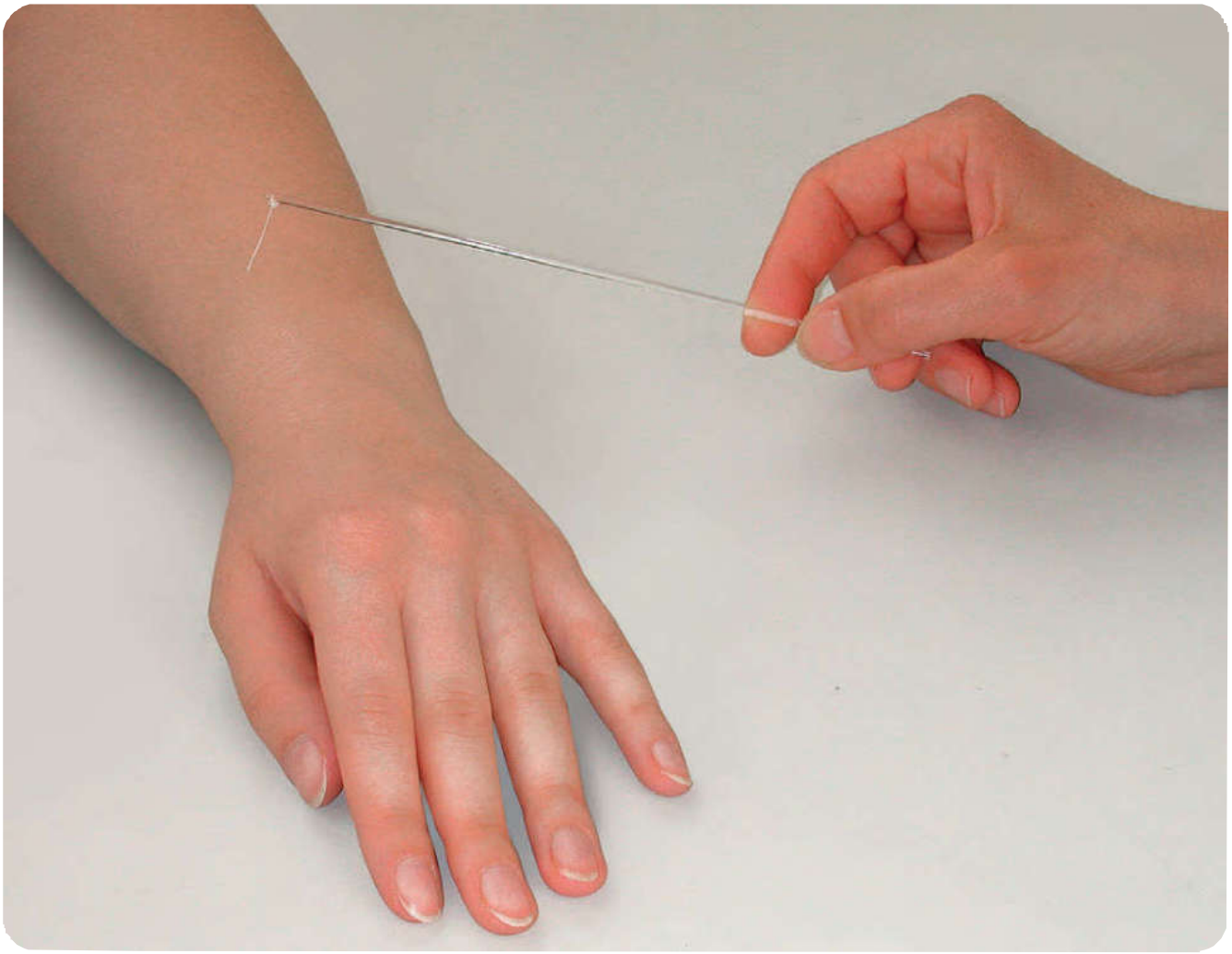
LB1.1	OUR SENSES
LB1.1.1	**Tactile sense**
LB1.1.1.1	Touch
LB1.1.1.2	Distribution of contact points
LB1.1.1.3	Cold points
LB1.1.1.4	Distance perception on the skin
LB1.1.1.5C	Heat discharge from the body (with Mobile-CASSY 2 WiFi) DIGITAL
LB1.1.2	**Hearing**
LB1.1.2.1	Hearing the body's own sounds
LB1.1.2.2	Directional hearing
LB1.1.2.3	Bone-conducted sounds and the perception of vibrations
LB1.1.2.4	Sound radiation through the eardrum
LB1.1.3	**Sight**
LB1.1.3.1	Blind spot
LB1.1.3.2	Optical illusions due to convergence
LB1.1.3.3	Three-dimensional vision requires two eyes
LB1.1.3.4	Apparent depth
LB1.1.3.5	Stimulus rivalry and chromatic adaptation
LB1.1.3.6	Coloured after-images
LB1.1.3.7	Colour contrast
LB1.1.3.8	Visual acuity
LB1.1.4	**Smell**
LB1.1.4.1	Perception of different smells
LB1.1.4.2	Breathing and smell perception
LB1.1.4.3	Adaptation of olfactory cells

20 EXPERIMENTS

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.



LB1.1.1.4 Distance perception on the skin



LB1.1.1.1 Touch

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LB1.1 HUMAN BIOLOGY

TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE
Human biology HU1	Mobile-CASSY 2 WiFi	Science Lab Biology digital
 +	 +	

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Human Biology HU1 (Set)

Student experiment set of the student experiment system Science Lab in the field of biology. Set-up material for one working group in pre-formed tray.
With the equipment set HU1, 20 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topic senses. While working out the curriculum required topics, they are also trained in communication and assessment skills.
In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
1	Tape measure 2 m / 1 mm
1	Red-cyan glasses (3D)
1	Tray, low
1	Booklet of fragrance strips
1	Set of image optical phenomena
1	Cold-feeler
1	Tactile bristle

Count	Name
1	Tactile circle
1	Resonant tubing
1	Instrument for binaural audition
1	Tuning fork 440 Hz 4 x 8 mm
1	Stopwatch, digital

207 311S	Science Lab Human Biology HU1 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per working group

Count	Cat.-No.	Name	Description
1	524 005W	Mobile-CASSY 2 WiFi	for experiment LB1.1.1.5

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 73	LIT: LB Science Lab Biology, digital	
1	610 071	Disposable gloves, latex, medium, 100 pcs	
1	662 460	Essential oils set	

OVERVIEW OF ADVANTAGES

- Students examine their own body functions
- Little preparation time for teachers
- Tactile bristle, cold probe, directional hearing device: extra developed for such experiments

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

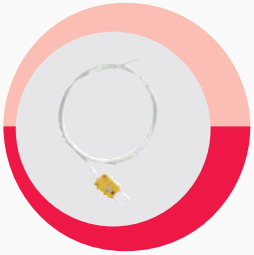
The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

INCLUDED IN SCOPE OF DELIVERY



Temperature probe NiCr-Ni, type K

Included with the purchase of the Mobile-CASSY 2 WiFi (524 005W).

MOBILE-CASSY 2 WIFI

With the Mobile-CASSY 2 WiFi, voltage *(U)*, current *(I)*, power *(P)* and energy *(E)* can be measured via 4 mm safety sockets.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC
SUBJECT AREA

LIT: LB1.1 Human Biology 1 – Senses

Printed version available in ring file or ONE subject area

Detailed experiment instructions for Science Lab Set HU1 (207 311S). Describes 20 experiments from the field of human biology - senses.

Topics:
Tactile sense; Hearing; Sight; Smell

520 7311EN	LIT: LB1.1 Human Biology 1 - Senses	

SUBJECT

LIT: LB Science Lab Biology, digital

includes ALL subject areas

Comprehensive biology experiment instructions for the Science Lab.
Contains 139 experiments in the fields of human biology, botany, ecology and cell biology.

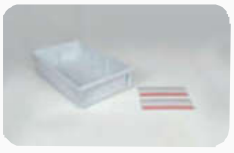
Includes all interactive experiment instructions (Lab Docs) as html file.

520 73	LIT: LB Science Lab Biology, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

Reaction time

Experiment examples
Human Biology HU 2

Blood pressure

Heart rate and pulse

Details from page 190

HUMAN BIOLOGY HU2

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

	LB1.2	**OUR BODY**
	LB1.2.1	The cardiovascular system
●	LB1.2.1.1C	Respiratory volume and breathing rate (with Mobile-CASSY 2 WiFi) DIGITAL
	LB1.2.1.2	Detection of CO_2 in exhaled air
●	LB1.2.1.3C	Heart rate and pulse (with Mobile-CASSY 2 WiFi) DIGITAL
●	LB1.2.1.4C	Blood pressure (with Mobile-CASSY 2 WiFi) DIGITAL
	LB1.2.2	The nervous system
	LB1.2.2.1C	Model experiment: measuring the resting potential (with Mobile-CASSY 2 WiFi) DIGITAL
	LB1.2.2.2	The Ostwald-Lillie iron wire model
●	LB1.2.2.3C	Reaction time test: visual stimulus (with Mobile-CASSY 2 WiFi) DIGITAL
●	LB1.2.2.4C	Reaction time test: acoustic stimulus (with Mobile-CASSY 2 WiFi) DIGITAL
●	LB1.2.2.5C	Reaction time test: distraction (with Mobile-CASSY 2 WiFi) DIGITAL
●	LB1.2.2.6C	Reaction time test: determining the nerve conduction velocity (with Mobile-CASSY 2 WiFi) DIGITAL
	LB1.2.2.7	Finger labyrinth - memorisation with eyes closed
	LB1.2.2.8	Finger labyrinth - memorisation progress
	LB1.2.2.9	Finger labyrinth - memorisation with eyes opened
	LB1.2.3	Digestion
	LB1.2.3.1	Digestion in the mouth
	LB1.2.3.2	Pepsin-regulated digestion of proteins in the stomach
	LB1.2.3.3	Pepsin-regulated digestion of proteins in the stomach - temperature dependence
	LB1.2.3.4C	Fat digestion with pancreatin (with Mobile-CASSY 2 WiFi) DIGITAL
	LB1.2.3.5	Starch digestion with pancreatin
	LB1.2.4	Sensory organs
	LB1.2.4.1	Preparation of a porcine eye
	LB1.3	**MAINTAINING A HEALTHY BODY**
	LB1.3.1	Nutrition
	LB1.3.1.1	Testing foods for glucose
	LB1.3.1.2	Testing foods for starch
	LB1.3.1.3	Testing foods for fats
	LB1.3.1.4	Testing foods for proteins
	LB1.3.1.5	Testing foods for vitamin C
	LB1.3.2	Hygiene
	LB1.3.2.1	Preparation and sterilisation of culture mediums
	LB1.3.2.2	Colony counting in the air
	LB1.3.2.3	Determination of the germ content of banknotes and coins
	LB1.3.2.4	Comparing the germ content of washed and unwashed hands
	LB1.3.2.5	Simulation of an infection chain with baking yeast
	LB1.3.2.6	Bacteriostatic effect of different substances
	LB1.3.2.7	Sterilisation, cleansing or destruction of equipment and breeding grounds
	LB1.3.3	Food technology
	LB1.3.3.1	Detecting fermentation products of yeasts
	LB1.3.3.2	Temperature-dependence of the fermentation process

33 EXPERIMENTS

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

● Reaction test adapter S
● Pulse sensor S
● Blood pressure sensor S
● Spirometer box

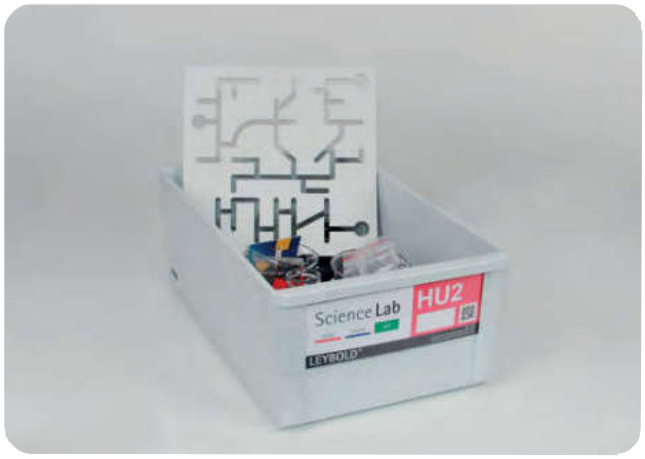
LB1.2.2.7 Finger labyrinth - memorisation with eyes closed

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LB1.2 TO LB1.3 HUMAN BIOLOGY

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE	CHEMICALS
Biology Basic BB	Human biology HU2	Mobile-CASSY 2 WiFi	Science Lab Biology digital	Chemical Set HU2

Detailed information on the above listed and **additionally required products** are available on the following pages.



Science Lab Human Biology HU2 (Set)

Student experiment set of the student experiment system Science Lab in the field of biology. Set-up material for one working group in pre-formed tray.
With the equipment set HU2, together with the Science Lab Biology Basic BB (207 300S), 33 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics body and health. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
2	Connecting lead 19 A, 50 cm, red/blue, pair
4	Crocodile clip, polished
4	Beaker Boro 3.3, 100 ml, squat
1	Tray, high
1	Drigalski spatula, glass
1	Iron nail, set 2
1	Maze for finger
8	Test tube Fiolax 16 mm x 160 mm
2	Beaker Boro 3.3, 400 ml, squat
1	Erlenmeyer flask 250 ml, narrow neck, SB 29
1	Plate electrode zinc 43 x 28 mm

Count	Name
4	Plate electrode carbon 43 x 28 mm
1	Grindstone
1	Fermentation tube 200 mm x 8 mm Ø
3	Graduated pipette 10 ml
1	Pipetting aid
1	Sieve, plastic, 70 mm Ø
1	Rubber balloons, set of 10
3	Rubber stopper solid, 14...18 mm Ø
1	Rubber stopper, one 7-mm hole, 25...31 mm Ø

207 312S	Science Lab Human Biology HU2 (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

OVERVIEW OF ADVANTAGES

- Including the important topics on hygiene and nutrition
- Modern model experiments on resting potential and nerve transmission

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per student

Count	Cat.-No.	Name	Description
1	610 010	Laboratory safety goggles, Focomax	

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 300S	Science Lab Biology Basic BB (Set)	
1	656 017	Teclu burner, universal	
1	607 020	Safety gas hose with clamp 0.5 m	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	524 0461	Reaction test adapter S	
1	524 0471	Pulse sensor S	
1	524 0501	Blood pressure sensor S	
1	524 056	Spirometer box	
1	662 148	Hand-held button	Nervous system experiments (LB1.2.2)
1	662 149	Foot switch	Nervous system experiment (LB1.2.2)
1	ADACB501	Compact scale 500 g : 0.1 g	
1	666 8471	Magnetic stirrer with hot plate	Nervous system and Nutrition experiments (LB1.2.3, LB1.3.1)
1	666 851	Stirring magnet 25 mm x 6 mm Ø, circular	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 73	LIT: LB Science Lab Biology, digital	
1	679 312	Chemicals Science Lab Human Biology HU2	
1	675 3410	Water, pure, 5 l	
1	610 290	Parafilm, 100 mm-w.	
1	661 091	Boiling stones 100 g	
1	670 2230	Albustix test sticks, 50 pcs	
1	MA91314	Test sticks Ascorbic acid	
1	666 8036	Drying oven UNB 30 l	Hygiene experiment (LB1.3.2.7)
1	662 851	Pressure cooker, 6.5 l, 20 cm Ø	Hygiene experiments (LB1.3.2)

Detailed information on **Mobile-CASSY 2 WiFi**, **sensors**, **literature packages** and **chemical sets** are available on the following pages.

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

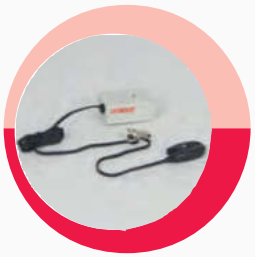
You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

Reaction test adapter S

For measuring reaction times, controlled by a hand or foot button, and for determining nerve conductor speed. Signalling accomplished as selected, either via three-colour LEDs (hand key) or acoustic sign (foot button) or software with CASSY (524 013, 524 006, 524 005W, 524 018).

524 0461	Reaction test adapter S	



Pulse sensor S

For measurement of the pulse frequency with the aid of an infrared sensor which is attached to the ear lobe or finger tip, whereby the sensibility is adjusted automatically. The individual pulse beats are indicated by a LED. The pulse sensor is electrically isolated from CASSY (524 013, 524 006, 524 005W, 524 018).

524 0471	Pulse sensor S	

Blood pressure sensor S

For blood pressure measurements using the oscillometric method with Sensor-CASSY 2 (524 013) or Pocket-CASSY (524 006, 524 018) without stethoscope and microphone. The pressure variations which are caused by the pulse waves are transmitted by the arm collar and measured together with the falling pressure in the arm collar. Alternative for use with the Mobile-CASSY (524 005W) after the auscultatoric method (designed by Korotkov). The characteristic noise phenomena are listened to with a stethoscope (additionally required).

The universal biology measuring instrument (531 837) gives an audible sound for the pressure variations.

524 0501	Blood pressure sensor S	

Spirometer box

For pneumotachographic measurement of various pulmonary volumes, the flow-volume curve and the forced expiratory volume per second with CASSY (524 013, 524 006, 524 005W, 524 018).

524 056	Spirometer box	

You can find detailed information on these and other sensors from page 229.

CHEMICALS

Chemicals Science Lab Human Biology

Chemicals for carrying out student experiments in Science Lab Human Biology HU2. The chemical set contains 20 different chemicals which can be used to perform every experiment at least 10 times.

679 312	Chemicals Science Lab Human Biology	

The individual chemicals from this set can be found in the chemicals overview which starts from page 220. There you will also find the relevant hazard symbols and classes as well as hazard warnings and safety instructions.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC
SUBJECT AREA

LIT: LB1.2+LB1.3 Human Biology 2 – Body and Health

Printed version available in ring file of ONE subject area

Detailed experiment instructions for Science Lab Set HU2 (207 312S). Describes 33 experiments from the field of human biology - body and health.

Topics:
Cardiovascular system; Nervous system ; Digestion; Sensory organs; Nutrition; Hygiene; Food technology

520 7312EN	LIT: LB1.2+LB1.3 Human Biology 2 - Body and health	

SUBJECT

LIT: LB Science Lab Biology, digital

Includes ALL subject areas

Comprehensive biology experiment instructions for the Science Lab.
Contains 139 experiments in the fields of human biology, botany, ecology and cell biology.

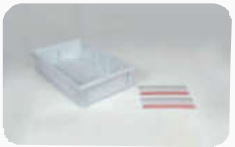
Includes all interactive experiment instructions (Lab Docs) as html file.

520 73	LIT: LB Science Lab Biology, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES



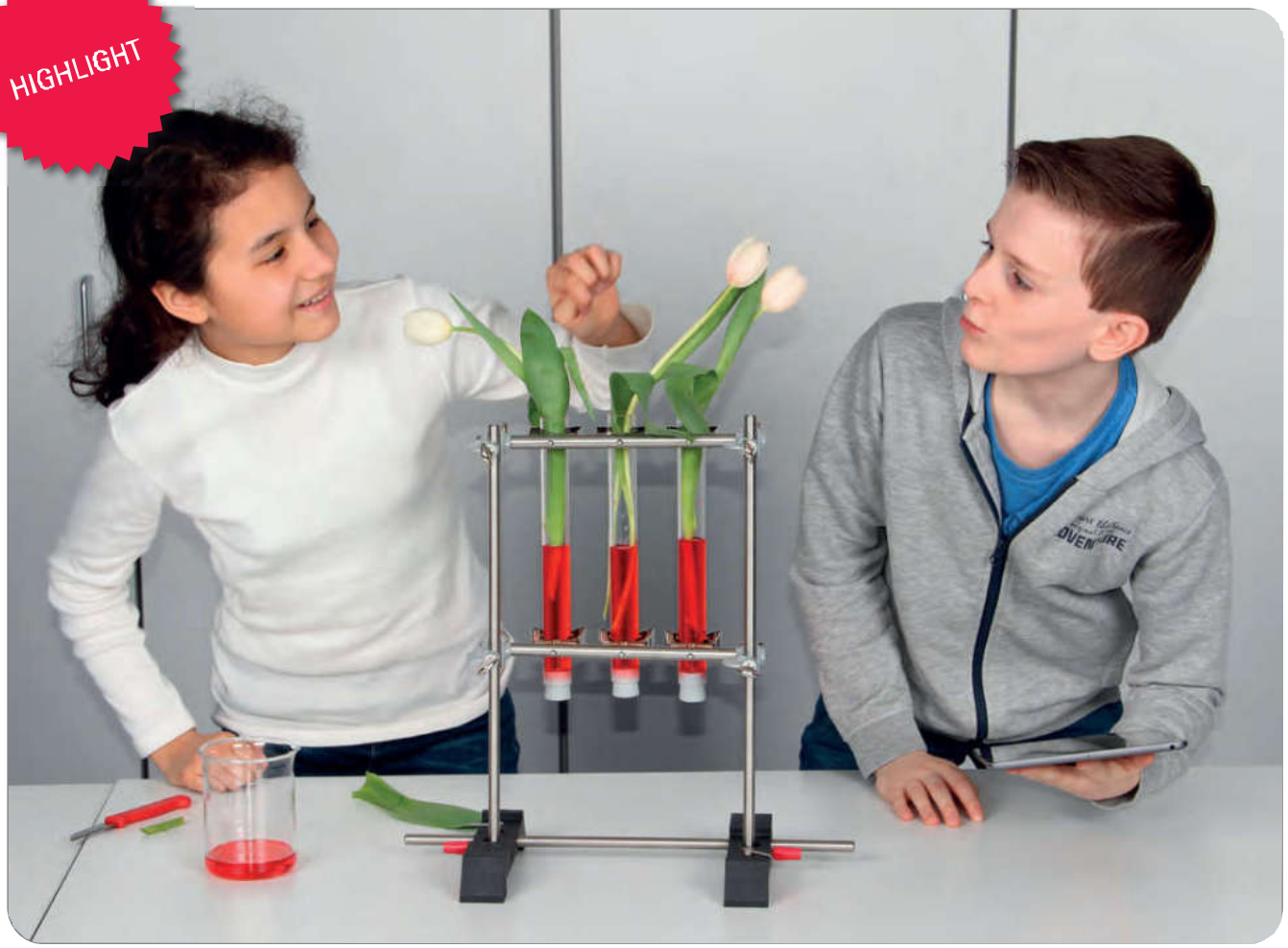


You can find detailed information on additional storage accessories from page 228.

BOTANY

The investigation of the shape and function of plants is easily accessible in forms of experiments. The Science Lab Set *Botany (BO)* can, for example, be used to examine leaves and flowers. A focus is placed on experiments for studying plant mechanisms, e.g. the water balance or photosynthesis.
A special emphasis lies on experiments that can easily be performed in one class/lecture and demonstrate the effects in a particularly impressive way.

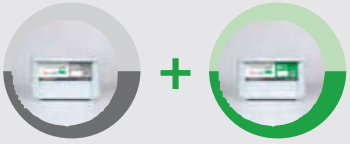
HIGHLIGHT

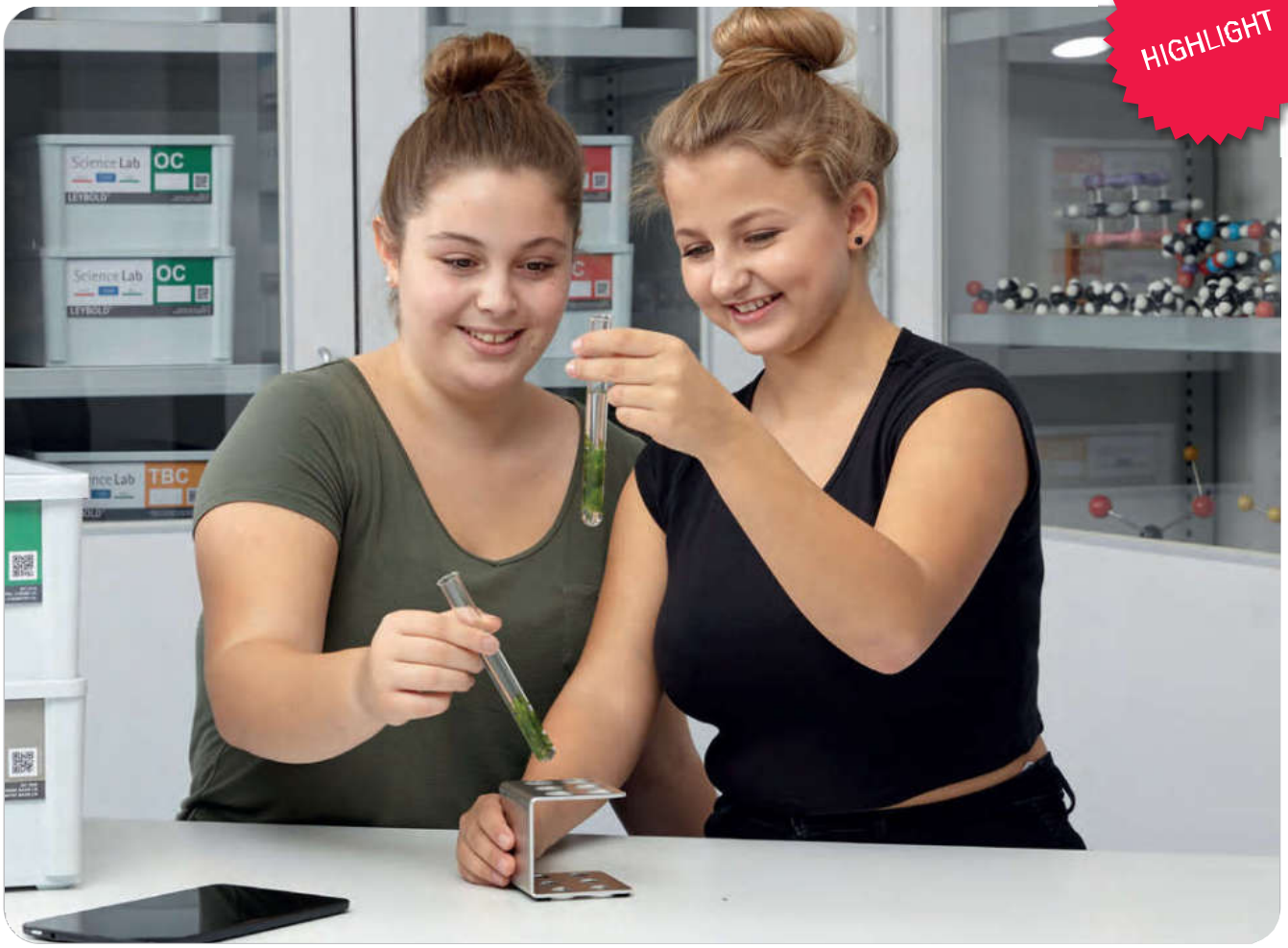


LB2.2.2.2 Water transport in a shoot

In this experiment, the path of the water in the shoot of a plant is visualised. To do this, a freshly cut shoot of a white-flowered plant is placed in dyed water.
For this experiment you will need the sets **Science Lab Biology Basic BB (207 300S)** and **Science Lab Botany BO (207 321S)**.

Overview of topics and sets

EXPERIMENT TOPICS		REQUIRED SETS		NO. EXPERIMENTS	DETAILS
LB2.0	INTRODUCTION TO METHODS	Biology Basic BB	Botany BO	32	PAGE 198
LB2.1	THE SHAPE OF PLANTS				
LB2.2	FUNCTION OF PLANTS	207 300S	207 321S		



LB2.2.3.1 Light-dependency during photosynthesis

In this experiment, rising air bubbles on the shoot of an aquatic plant are counted. To do this, one plant is exposed to light beforehand and one is kept in darkness.

For this experiment you will need the sets **Science Lab Biology Basic BB (207 300S)** and **Science Lab Botany BO (207 321S)**.

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

BOTANY BO

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

LB2.0	**INTRODUCTION TO METHODS**
LB2.0.0	Microscopy
LB2.0.0.1	Structure and functionality of an optical microscope
LB2.0.0.2	Making preparations
LB2.1	**THE SHAPE OF PLANTS**
LB2.1.1	Leaf
LB2.1.1.1	Examination of a leaf
LB2.1.1.2	Leaf structure of a moss leaf
LB2.1.1.3	Leaf cross-section with upper and lower epidermis
LB2.1.1.4	Surface cut: Stomata under the microscope
LB2.1.1.5	Plant cell: Structure of an onion cell
LB2.1.1.6	Organs for water evaporation
LB2.1.1.7	Many parts of a plant have evaporation protection
LB2.1.2	Flower
LB2.1.2.1	Examination of a flower
LB2.1.2.2	Pollen and pollen tube
LB2.1.3	Plant stem
LB2.1.3.1	Cross-section through a plant stem
LB2.1.4	Roots
LB2.1.4.1	Organs for water uptake
LB2.1.4.2	Root hair development
LB2.2	**FUNCTION OF PLANTS**
LB2.2.1	Germination and growth
LB2.2.1.1	Swelling
LB2.2.1.2	Swelling pressure
LB2.2.1.3	Dependence of germination on various factors
LB2.2.1.4	Light influences the germination of plants
LB2.2.1.5	Cellular respiration during germination
LB2.2.1.6	Selection capability of roots
LB2.2.2	Water balance
LB2.2.2.1	Plants cannot live without water
LB2.2.2.2	Water transport in a shoot
LB2.2.2.3	Water rises in capillaries
LB2.2.2.4	Importance of the stomata
LB2.2.2.5	Dependence of the water requirement on number and size of leaves
LB2.2.2.6	Water consumption of plants living in moist and dry habitats
LB2.2.2.7	Measurement of transpiration
LB2.2.3	Photosynthesis
LB2.2.3.1	Light-dependency during photosynthesis
LB2.2.3.2	Testing for oxygen during photosynthesis
LB2.2.3.3	Carbon dioxide and photosynthesis
LB2.2.3.4	Testing for starch during photosynthesis
LB2.2.3.5	Separation of leaf pigments via paper chromatography

32 EXPERIMENTS

LB2.2.1.4 Light influences the germination of plants (dry)

LB2.2.1.4 Light influences the germination of plants (wet)

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LB2.0 TO LB2.2 BOTANY

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE	CHEMICALS
Biology Basic BB	Botany BO	Mobile-CASSY 2 WiFi	Science Lab Biology digital	Chemical Set BO

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Botany BO (Set)

Student experiment set of the student experiment system Science Lab in the field of biology. Set-up material for one working group in pre-formed tray.
With the equipment set BO, together with the Science Lab Biology Basic BB (207 300S), 32 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the shape and function of plants. While working out the curriculum required topics, they are also trained in communication and assessment skills.

Scope of delivery:

Count	Name
2	Stand rod 25 cm, with holes
1	Capillary apparatus
1	Lamp socket, E27, Euro plug
6	Clip plug, large
2	Beaker Boro 3.3, 100 ml, squat
1	Tray, high
1	LED Plant lamp
3	Test tube Fiolax 16 mm x 160 mm
1	Beaker Boro 3.3, 400 ml, squat
1	Erlenmeyer flask 250 ml, narrow neck, SB 29

Count	Name
1	Funnel PP 75 mm Ø
3	Plastic tube 240 x 25 mm Ø
1	Fermentation tube 200 mm x 8 mm Ø
1	Pestle 88 mm
1	Mortar porcelain 70 mm Ø
1	Magnifier 8x
1	Rubber stopper solid, 14...18 mm Ø
3	Rubber stopper solid, 19...24 mm Ø
1	Rubber stopper, one 7-mm hole, 25...31 mm Ø

207 321S	Science Lab Botany BO (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

OVERVIEW OF ADVANTAGES

- Student experiments for parallel display and comparison of several samples (set-up with stand rod with holes)
- Includes microscopy experiments and basics of microscopy
- Impressive experiments, e.g. swelling pressure during germination, measurement of transpiration or oxygen detection during photosynthesis

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per student

Count	Cat.-No.	Name	Description
1	610 010	Laboratory safety goggles, Focomax	

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 300S	Science Lab Biology Basic BB (Set)	
1	656 017	Teclu burner, universal	
1	607 020	Safety gas hose with clamp 0.5 m	
1	MIK5738860	Microscop EduLed FLQ	
1	661 243	Wash bottle PE, 500 ml	
1	ADACB501	Compact scale 500 g : 0.1 g	
1	666 8471	Magnetic stirrer with hot plate	Photosynthesis experiment (LB2.2.3)

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 73	LIT: LB Science Lab Biology, digital	
1	679 320	Chemicals Science Lab Botany BO	
1	675 3410	Water, pure, 5 l	
1	610 290	Parafilm, 100 mm-w.	
1	661 055	Chromatography paper, 580 x 600 mm, 25 sheets	
1	661 080	Cobalt chloride test paper 2 x 7 cm, 100 stripes	
1	661 091	Boiling stones 100 g	
1	665 568	Microcapillaries	

Detailed information on **Mobile-CASSY 2 WiFi**, **sensors**, **literature packages** and **chemical sets** are available on the following pages.

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

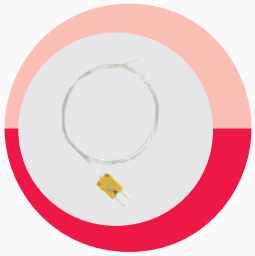
The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

INCLUDED IN SCOPE OF DELIVERY



Temperature probe NiCr-Ni, type K

Included with the purchase of the Mobile-CASSY 2 WiFi (524 005W).

MOBILE-CASSY 2 WIFI

With the Mobile-CASSY 2 WiFi, voltage *(U)*, current *(I)*, power *(P)* and energy *(E)* can be measured via 4 mm safety sockets.

CHEMICALS

Chemicals Science Lab Botany

Chemicals for carrying out student experiments in Science Lab Botany BO. The chemical set contains 15 different chemicals which can be used to perform every experiment at least 10 times.

679 320	Chemicals Science Lab Botany	

The individual chemicals from this set can be found in the chemicals overview which starts from page 220. There you will also find the relevant hazard symbols and classes as well as hazard warnings and safety instructions.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC
SUBJECT AREA

LIT: LB2 Botany

Printed version available in ring file or CNE subject area

Detailed experiment instructions for Science Lab Set Botany BO (207 321S).
Describes 32 experiments from the field of botany.

Topics:
Microscopy; Leaf; Flower; Plant stem; Roots; Germination and growth; Water balance; Photosynthesis

520 7321EN	LIT: LB2 Botany	

SUBJECT

LIT: LB Science Lab Biology, digital

Includes ALL subject areas

Comprehensive biology experiment instructions for the Science Lab.
Contains 139 experiments in the fields of human biology, botany, ecology and cell biology.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 73	LIT: LB Science Lab Biology, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

ECOLOGY

Ecology means more than the common use of the word "eco" would suggest. One of the aims of the Science Lab Set *Ecology (ECO)* is to observe and describe an ecosystem from as many perspectives as possible.

Students can measure the temperature and illuminance or compare soils from a forest and from the side of a road. Another area of experimental investigation will be biodiversity.

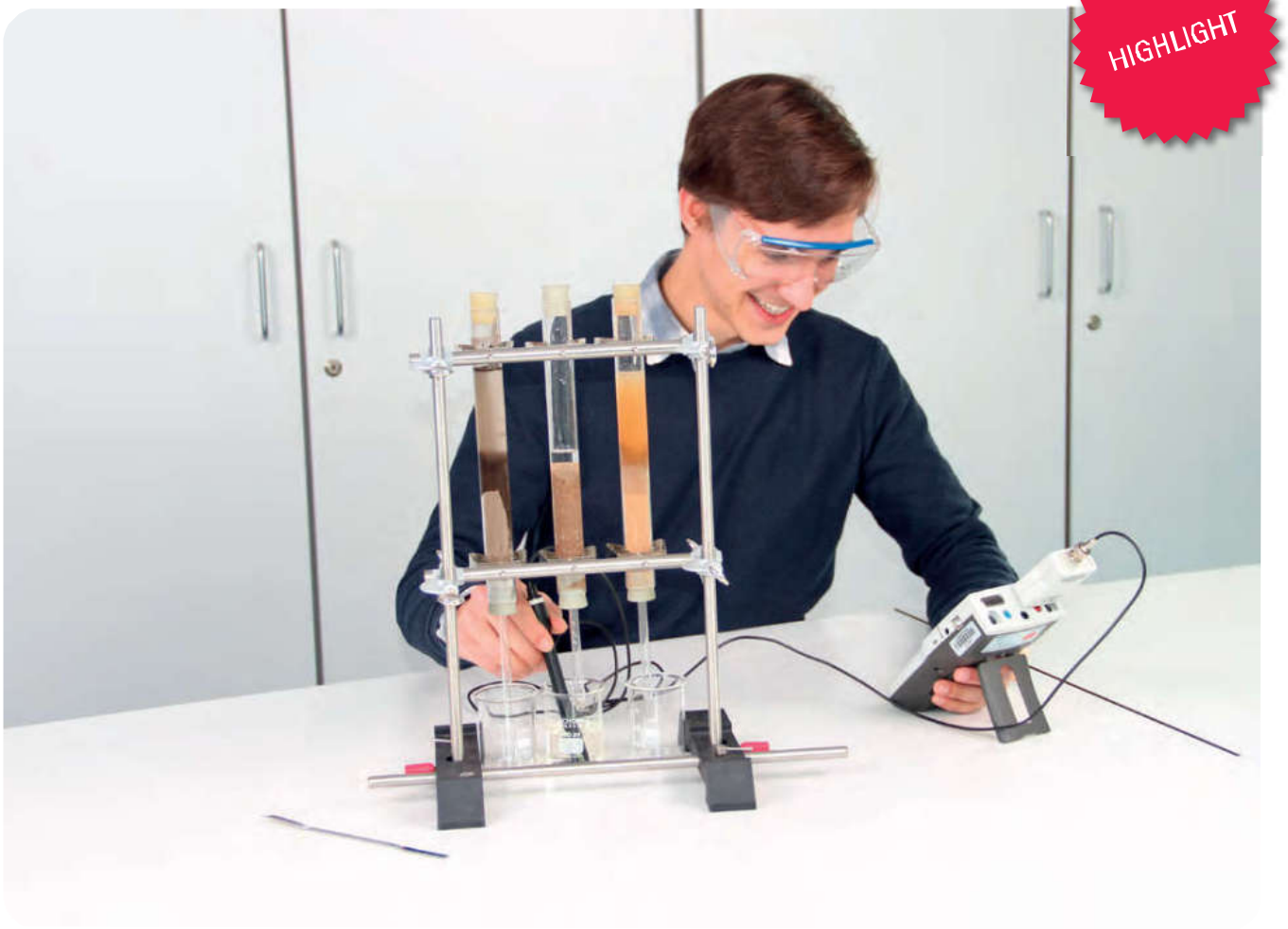
HIGHLIGHT

LB3.1.3.4 Observation of living organism in an infusion of hay

In this experiment, eukaryotic and prokaryotic single-cell and multi-cell organisms can be observed. In an infusion of hay, for example, bacteria, flagellated single-celled organisms, ciliates or rotifers can develop.
For this experiment you will need the sets **Science Lab Biology Basic BB (207 300S)** and **Science Lab Ecology ECO (207 331S)**.

Overview of topics and sets

EXPERIMENT TOPICS		REQUIRED SETS		NO. EXPERIMENTS	DETAILS
LB3.0	INTRODUCTION TO METHODS	Biology Basic BB	Ecology ECO	35	PAGE 206
LB3.1	ECOSYSTEMS				
LB3.2	ANALYSIS OF ECOSYSTEMS				
LB3.3	HUMANS AND THE ENVIRONMENT				
LB3.4	EVOLUTION	207 300S	207 331S		



LB3.2.2.3C pH value of soil samples

In this experiment, water flows through various soil samples. The pH values of the filtrates are determined using the Mobile-CASSY 2 WiFi. The students will find out that plants prefer specific soil properties and therefore can serve as a pH indicator.
For this experiment you will need the sets **Science Lab Biology Basic BB (207 300S)** and **Science Lab Ecology ECO (207 331S)**.

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

ECOLOGY ECO

OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors		
	LB3.0	**INTRODUCTION TO METHODS**
	LB3.0.0	Microscopy
	LB3.0.0.1	Structure and functionality of an optical microscope
	LB3.0.0.2	Making micro-preparations
	LB3.1	**ECOSYSTEMS**
	LB3.1.1	Abiotic factors
	LB3.1.1.1	Temperature-dependence of life processes
●	LB3.1.1.2C	Bergmann's rule (factor temperature) (with Mobile-CASSY 2 WiFi) DIGITAL
●	LB3.1.1.3C	Allen's rule (factor temperature) (with Mobile-CASSY 2 WiFi) DIGITAL
●	LB3.1.1.4C	Grouping as protection from cold (with Mobile-CASSY 2 WiFi) DIGITAL
	LB3.1.1.5	Insulating effect of body protection
	LB3.1.1.5C	Insulating effect of body protection (with Mobile-CASSY 2 WiFi) DIGITAL
	LB3.1.1.6	Comparison of leaf cross-sections: Sun leaf and shade leaf
	LB3.1.2	Biotic factors
	LB3.1.2.1	Interspecific competition in plants
	LB3.1.2.3	Symbiosis
	LB3.1.3	Biodiversity
	LB3.1.3.2	Analysis of ground fauna using sieves (Berlese funnels)
	LB3.1.3.4	Observation of living organisms in an infusion of hay
	LB3.1.4	Population ecology
	LB3.1.4.3	Food chain: Decomposers
	LB3.2	**ANALYSIS OF ECOSYSTEMS**
	LB3.2.1	Analysis of waterbodies on site
●●	LB3.2.1.2C	pH value of waterbodies (with Mobile-CASSY 2 WiFi) DIGITAL
●●	LB3.2.1.3C	Salt content of waterbodies (with Mobile-CASSY 2 WiFi) DIGITAL
	LB3.2.1.4	Chemical water parameters
●●●●	LB3.2.1.5C	Water protocol (with Mobile-CASSY 2 WiFi) DIGITAL
	LB3.2.1.6C	Temperature measurement in waterbodies (with Mobile-CASSY 2 WiFi) DIGITAL
	LB3.2.2	Forest and soil analysis
	LB3.2.2.1	Sedimentation of soil particles
	LB3.2.2.2	Soil and water
●●	LB3.2.2.3C	pH value of soil samples (with Mobile-CASSY 2 WiFi) DIGITAL
●●	LB3.2.2.4C	Humus formation and humus types (with Mobile-CASSY 2 WiFi) DIGITAL
●●	LB3.2.2.5C	Salt content of the soil (with Mobile-CASSY 2 WiFi) DIGITAL
●	LB3.2.2.6C	Abiotic factor: light intensity (with Mobile-CASSY 2 WiFi) DIGITAL
	LB3.2.2.7C	Temperature depending on location (with Mobile-CASSY 2 WiFi) DIGITAL
	LB3.2.2.8C	Diurnal variation measurements (with Mobile-CASSY 2 WiFi) DIGITAL
	LB3.3	**HUMANS AND THE ENVIRONMENT**
	LB3.3.1	Water pollution
	LB3.3.1.1	Foam - a substantial burden on the environment
	LB3.3.1.2	Eutrophication of waterbodies by phosphates
	LB3.3.1.4	Efficacy of gravel filters and activated charcoal filters
	LB3.3.2	Soil pollution
	LB3.3.2.1	Toxicity measurement of petrol with cress seeds
	LB3.3.2.2	Soil contamination with non-biological substances
	LB3.3.3	Air pollution
	LB3.3.3.1	Determination of emissions using the example of engine exhaust emissions
	LB3.4	**EVOLUTION**
	LB3.4.1	Adaptation to the environment
	LB3.4.1.1	Wing feathers of birds
	LB3.4.1.2	Examination of fish scales

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

● Conductivity sensor ● Conductivity adapter S ● pH sensor, BNC ● pH adapter S ● NiCr-Ni adapter S, type K ● Lux sensor M

35 EXPERIMENTS

LB3.1.1.5C Insulating effect of body protection

OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LB3.0 TO LB3.4 ECOLOGY

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE	CHEMICALS
Biology Basic BB	Ecology ECO	Mobile-CASSY 2 WiFi	Science Lab Biology digital	Chemical Set ECO

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Ecology ECO (Set)

Student experiment set of the student experiment system Science Lab in the field of biology. Set-up material for one working group in pre-formed tray. With the equipment set ECO, together with the Science Lab Biology Basic BB (207 300S), 35 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics of ecosystems, exploring ecosystems, humans and the environment and evolution. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
2	Stand rod 25 cm, with holes
1	Tape measure 2 m / 1 mm
1	Rubber rings, set of 8
6	Clip plug, large
3	Beaker Boro 3.3, 100 ml, squat
1	Tray, high
8	Test tube Fiolax 16 mm x 160 mm
2	Beaker Boro 3.3, 400 ml, squat
1	Funnel PP 75 mm Ø

Count	Name
3	Glass tube 80 x 8 mm Ø
3	Plastic tube 240 x 25 mm Ø
1	Sieve, plastic, 70 mm Ø
1	Magnifier 8x
1	Rubber stopper solid, 14...18 mm Ø
3	Rubber stopper solid, 19...24 mm Ø
3	Rubber stopper, one 7-mm hole, 19...24 mm Ø

207 331S	Science Lab Ecology ECO (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

OVERVIEW OF ADVANTAGES

- Contains microscopy experiments and basics for microscopy
- Student experiments for parallel display and comparison of several samples (set-up with stand rod with holes)
- Easy introduction to digital measurements and evaluation

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per student

Count	Cat.-No.	Name	Description
1	610 010	Laboratory safety goggles, Focomax	

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 300S	Science Lab Biology Basic BB (Set)	
1	656 017	Teclu burner, universal	
1	607 020	Safety gas hose with clamp 0.5 m	
1	MIK573886	Microscop EduLed FLQ	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	529 670	Conductivity sensor	
1	524 0671	Conductivity adapter S	
1	529 672	pH sensor, BNC	
1	524 0672	pH adapter S	
1	524 0673	NiCr-Ni adapter S, type K	
1	524 444	Lux sensor M	
2	666 1261	Temperature probe, Ni-Cr-Ni, fast, type K	Ecosystems (abiotic factors) experiments (LB3.1.1)
1	ADACB501	Compact scale 500 g : 0.1 g	

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 73	LIT: LB Science Lab Biology, digital	
1	679 330	Chemicals Science Lab Ecology ECO	
1	MA90204	Universal indicator paper pH 1...14, roll	
1	MA91201	Test sticks total water hardness	
2	MA91313	Test sticks Nitrate/Nitrite	
1	MA91315	Test sticks Ammonium	
1	MA91320	Test sticks Phosphate	
1	674 4640	Buffer solution pH 4.00, 250 ml	Analysis of ecosystems experiments (LB3.2.1, LB3.2.2)
1	674 4670	Buffer solution pH 7.00, 250 ml	Analysis of ecosystems experiments (LB3.2.1, LB3.2.2)
1	666 8036	Drying oven UNB, 30 l	Analysis of ecosystems experiments (LB3.2.2)

Detailed information on **Mobile-CASSY 2 WiFi**, **sensors**, **literature packages** and **chemical sets** are available on the following pages.

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

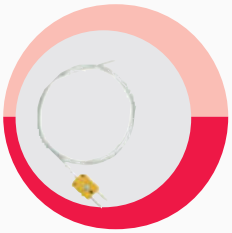
The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

SENSORS

INCLUDED IN SCOPE OF DELIVERY



Temperature probe NiCr-Ni, type K

Included with the purchase of the Mobile-CASSY 2 WiFi (524 005W).

SENSORS

Conductivity sensor

Conductivity sensor using four-wire technology with integrated Pt temperature sensor for use with chemistry box (524 067), conductivity adapter S (524 0671) and CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Open design for rapid response to changes in conductivity.
When conducting measurements a minimum distance of 1 cm from the side of the, as well as a minimum immersion depth of 2 cm are to be maintained.

529 670	Conductivity sensor	

Conductivity adapter S

Used in conjunction with the conductivity sensor (529 670), this adapter enables conductivity and temperature to be measured with CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836).

524 0671	Conductivity adapter S	

pH sensor, BNC

pH glass electrode in plastic shaft and BNC plug for use with the chemistry box (524 067), pH adapter S (524 0672) and CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836).
Low-maintenance pH electrode with solid electrolyte made of a conductive gel-like polymer.

529 672	pH sensor, BNC	

For storage 3 M Potassium chloride sol. is recommended (672 5250).

pH adapter S

Enables a pH electrode to be connected to CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Moreover, the voltage at the BNC socket can be measured at a very high resistance, e.g. for measuring electrochemical potentials.

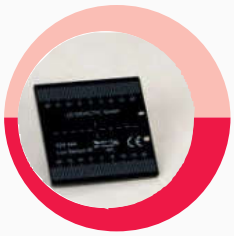
524 0672	pH adapter S	

NiCr-Ni adapter S, type K

Enables connection of two NiCr-Ni (type K miniature flat connector) thermocouples for temperature and differential tempature measurements with CASSY (524 013, 524 006, 524 005W, 524 018) or the universal measuring instruments (531 835, 531 836, 531 837).

524 0673	NiCr-Ni adapter S, type K	

SENSORS



Lux sensor M

For measuring the illuminance of visible light with Mobile-CASSY 2 WiFi (524 005W). The lux sensor has a flat design so that it can, for example, be inserted directly into the holder for diaphragms and slides (459 33). With the lux sensor, measurements can be performed along and orthogonal to the optical axis. A printed millimetre scale is used to position the sensor on the optical axis and also enables the recording of intensity distributions of different diffraction objects (e.g. 469 731) without additional equipment.

524 444	Lux sensor M	

You can find detailed information on these and other sensors from page 229.

CHEMICALS

Chemicals Science Lab Ecology

Chemicals for carrying out student experiments in Science Lab Ecology. The chemical set contains 11 different chemicals which can be used to perform every experiment at least 10 times.

679 330	Chemicals Science Lab Ecology	

The individual chemicals from this set can be found in the chemicals overview which starts from page 220. There you will also find the relevant hazard symbols and classes as well as hazard warnings and safety instructions.

LITERATURE PACKAGES

Here you will find an overview of our literature packages. You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC
SUBJECT AREA

LIT: LB3 Ecology

Printed version available in only file of ONE subject area

Detaile experiment instructions for Science Lab Set ECO (207 331S). Describes 35 experiments from the field of ecology.

Topics:
Microscopy; Abiotic factors; Biotic factors; Biodiversity; Population ecoloy; Analysis of waterbodies on site; Forest and soil analysis; Water pollution; Soil pollution; Air pollution; Adaptation to the environment

520 7331EN	LIT: LB3 Ecology	

SUBJECT

LIT: LB Science Lab Biology, digital

includes ALL subject areas

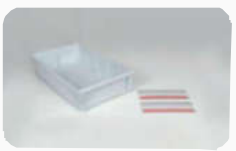
Comprehensive biology experiment instructions for the Science Lab.
Contains 139 experiments in the fields of human biology, botany, ecology and cell biology.
Includes all interactive experiment instructions (Lab Docs) as html file.

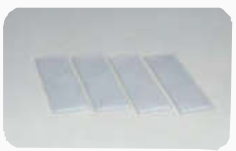
520 73	LIT: LB Science Lab Biology, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES




You can find detailed information on additional storage accessories from page 228.

CELL BIOLOGY

All living beings are made up of cells. The experiments from the Science Lab set *Cell Biology (CE)* therefore begins with the structure of single-cell and multi-cell organisms.

Furthermore, the inner life of the cell is of relevance in the classroom. Students can examine the functions of the cell membrane and enzymes as well.

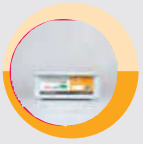
HIGHLIGHT

LB4.1.2.3 Comparison between an animal and a plant cell

Using high-quality micropreparations, the differences and similarities of animal and plant cells can be examined.
For this experiment you will need the sets **Science Lab Biology Basic BB (207 300S)** and **Science Lab Cell Biology CE (207 341S)**.

Further information about our curriculum-compliant topics and student experiments as well as the corresponding sets can be found on the following pages.

Overview of topics and sets

EXPERIMENT TOPICS		REQUIRED SETS		NO. EXPERIMENTS	DETAILS
LB4.0	INTRODUCTION TO THE METHODS	Biology Basic BB	Cell biology CE	19	PAGE 214
LB4.1	STRUCTURE OF THE CELL				
LB4.2	PROCESSES IN THE CELL	207 300S	207 341S		

LB4.2.3.3 Temperature-dependent enzyme effect using the example of catalase

In this experiment, the temperature dependence of the catalase enzyme is examined. To do this, the splitting of hydrogen peroxide using catalase is carried out at different temperatures. A temperature-dependent development of gas can be observed.

For this experiment you will need the sets **Science Lab Biology Basic BB (207 300S)** and **Science Lab Cell Biology CE (207 341S)**.

CELL BIOLOGY CE

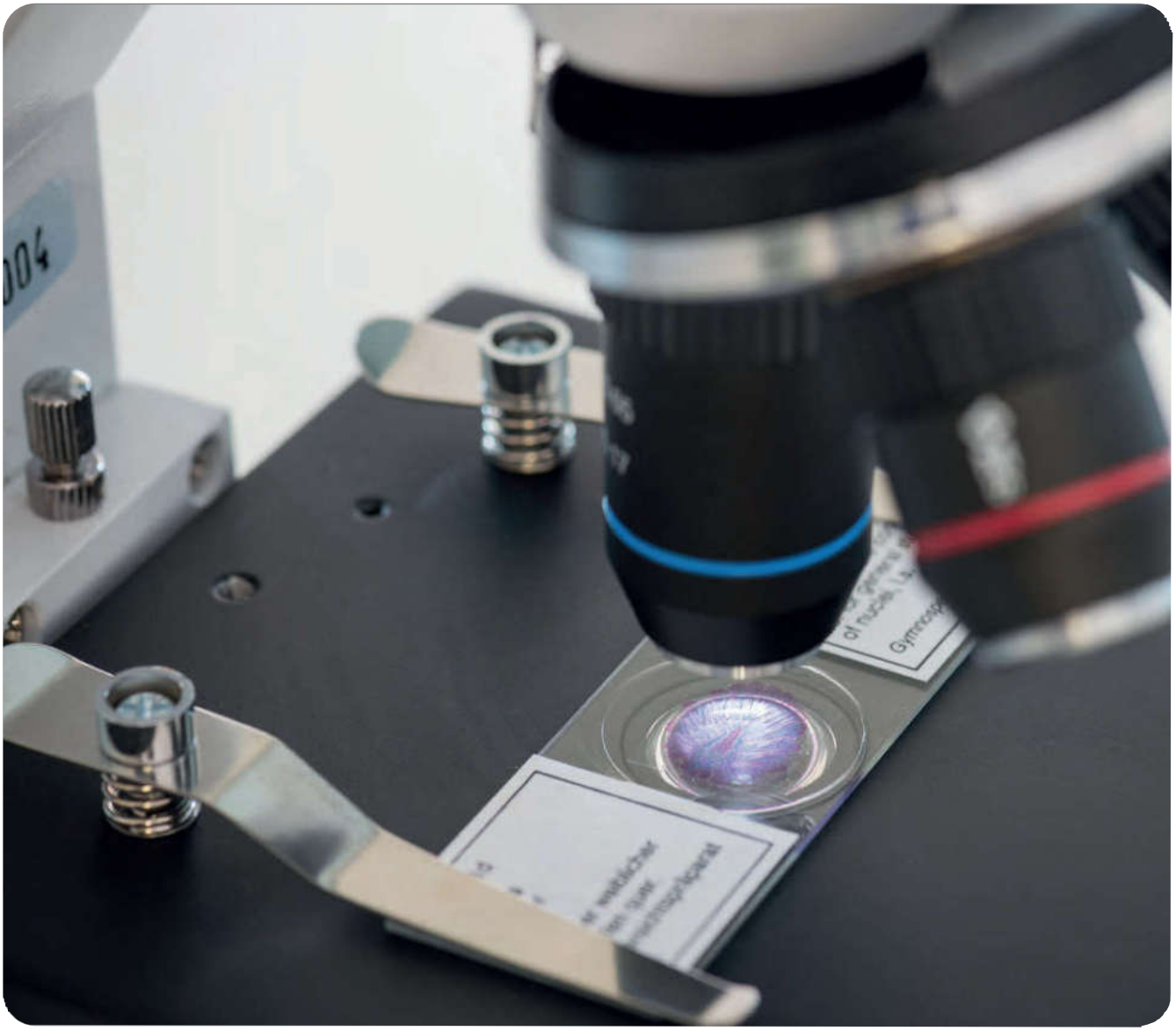
OVERVIEW OF OUR CURRICULUM-COMPLIANT EXPERIMENTS

Sensors		
	LB4.0	INTRODUCTION TO METHODS
	LB4.0.0	Microscopy
	LB4.0.0.1	Structure and functionality of an optical microscope
	LB4.0.0.2	Making micro-preparations
	LB4.1	STRUCTURE OF THE CELL
	LB4.1.1	Single-cell organisms
	LB4.1.1.1	Microscopy of yeast cells
	LB4.1.1.2	Microscopy of mould
	LB4.1.1.3	Live/dead staining of yeast cells
	LB4.1.2	Multi-cell organisms
	LB4.1.2.1	Plant cell: Structure of an onion cell
	LB4.1.2.2	Animal cell: Cells of the oral mucosa, uncoloured
	LB4.1.2.3	Comparison between an animal and a plant cell
	LB4.1.2.4	Colouration of an onion skin
	LB4.2	PROCESSES IN THE CELL
	LB4.2.1	The cell membrane
	LB4.2.1.1	Plasmolysis and deplasmolysis
	LB4.2.1.2	Diffusion and osmosis
	LB4.2.2	Cell cycle
	LB4.2.2.1	Prepare mitosis stages of an onion root
	LB4.2.3	Enzymes
	LB4.2.3.1	Effect of the enzyme catalase on yeast
●●	LB4.2.3.2C	Urea splitting by urease and inhibition (with Mobile-CASSY 2 WiFi) DIGITAL
	LB4.2.3.3	Temperature-dependent enzyme effect using the example of catalase
	LB4.2.3.3C	Enzyme effect and temperature using the example of catalase (with Mobile-CASSY 2 WiFi) DIGITAL
●●	LB4.2.3.4C	Temperature-dependent urea splitting by urease (with Mobile-CASSY 2 WiFi) DIGITAL
	LB4.2.3.5	Enzyme activity dependent on pH value
	LB4.2.4	Transport processes
	LB4.2.4.1	Cytoplasmic streaming in waterweed

19 EXPERIMENTS

For experiments marked with „C", the measurements are carried out **digitally** with the Mobile-CASSY 2 WiFi.

● Conductivity sensor ● Conductivity adapter S



OVERVIEW OF EQUIPMENT REQUIRED FOR PERFORMING EXPERIMENTS

LB4.0 TO LB4.2 CELL BIOLOGY

BASIC SET	TOPIC SET	DIGITAL MEASURING DEVICE	LITERATURE	CHEMICALS
Biology Basic CB	Cell biology CE	Mobile-CASSY 2 WiFi	Science Lab Biology digital	Chemical Set CE

Detailed information on the above listed and **additionally required products** are available on the following pages.

Science Lab Cellular Biology CE (Set)

Student experiment set of the student experiment system Science Lab in the field of biology. Set-up material for one working group in pre-formed tray.
With the equipment set CE, together with the Science Lab Biology Basic BB (207 300S), 19 experiments at school, college and university level for worldwide curriculums can be performed.
The students deal with the topics cell structure and cell processes. While working out the curriculum required topics, they are also trained in communication and assessment skills. In combination with the Mobile-CASSY 2 WiFi (524 005W), there are additional evaluation options which enable the students digital learning.

Scope of delivery:

Count	Name
3	Beaker Boro 3.3, 100 ml, squat
1	Tray, high
6	Test tube Fiolax 16 mm x 160 mm
1	Beaker Boro 3.3, 400 ml, squat
1	Funnel PP 75 mm Ø
2	Graduated pipette 10 ml

Count	Name
1	Pipetting aid
1	Pestle 88 mm
1	Mortar porcelain 70 mm Ø
6	Rubber stopper solid, 14...18 mm Ø
1	Microscopic specimens set
207 341S	Science Lab Cellular Biology CE (Set)

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

OVERVIEW OF ADVANTAGES

- Focus on enzymatic experiments
- First steps in digital measurements and evaluation

STUDENT MEASURING DEVICE

DIGITAL CLASS / EDUCATION

Mobile-CASSY 2 WiFi

The universal student measuring device with WiFi for all measuring tasks in physics, chemistry and biology.

524 005W	Mobile-CASSY 2 WiFi	

You can find detailed information on the Mobile-CASSY 2 WiFi on page 228.

ADDITIONALLY REQUIRED TO PERFORM ALL EXPERIMENTS

Additionally required per student

Count	Cat.-No.	Name	Description
1	610 010	Laboratory safety goggles, Focomax	

Additionally required per working group

Count	Cat.-No.	Name	Description
1	207 300S	Science Lab Biology Basic BB (Set)	
1	MIK573886	Microscope EduLed FLQ	
1	656 017	Teclu burner, universal	
1	607 020	Safety gas hose with clamp 0.5 m	
1	524 005W	Mobile-CASSY 2 WiFi	for digital experiments
1	529 670	Conductivity sensor	
1	524 0671	Conductivity adapter S	
1	668 8471	Magnetic stirrer with hot plate	
1	666 851	Stirring magnet 25 mm x 6 mm Ø, circular	Enzymes experiments (LB4.2.3)

Additionally required per class

Count	Cat.-No.	Name	Description
1	520 73	LIT: LB Science Lab Biology, digital	
1	679 360	Chemicals Science Lab Cell Biology	
1	675 3410	Water, pure, 5 l	
1	MA90204	Universal indicator paper pH 1...14, roll	

Detailed information on **Mobile-CASSY 2 WiFi**, **sensors**, **literature packages** and **chemical sets** are available on the following pages.

SENSORS

INCLUDED IN SCOPE OF DELIVERY

Temperature probe NiCr-Ni, type K

Included with the purchase of the Mobile-CASSY 2 WiFi (524 005W).

SENSORS

Conductivity sensor

Conductivity sensor using four-wire technology with integrated Pt temperature sensor for use with chemistry box (524 067), conductivity adapter S (524 0671) and CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Open design for rapid response to changes in conductivity.
When conducting measurements a minimum distance of 1 cm from the side of the, as well as a minimum immersion depth of 2 cm are to be maintained.

529 670	Conductivity sensor	

Conductivity adapter S

Used in conjunction with the conductivity sensor (529 670), this adapter enables conductivity and temperature to be measured with CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836).

524 0671	Conductivity adapter S	

You can find detailed information on these and other sensors from page 229.

LB4.1.2.4 Colouration of an onion skin

CHEMICALS

Chemicals Science Lab Cell Biology

Chemicals for carrying out student experiments in Science Lab Cell Biology CE. The chemical set contains 15 different chemicals which can be used to perform every experiment at least 10 times.

679 360	Chemicals Science Lab Cell Biology	

The individual chemicals from this set can be found in the chemicals overview which starts from page 220. There you will also find the relevant hazard symbols and classes as well as hazard warnings and safety instructions.

LITERATURE PACKAGES

Here you will find an overview of our literature packages.
You can find detailed information on our literature on the internet at www.leybold-shop.com.

TOPIC
SUBJECT AREA

LIT: LB4 Cell Biology

Detailed experiment instructions for the Science Lab set Cell Biology CE (207 341S). Describes 19 experiments from the field of cell biology.

Topics:
Microscopy; Single-cell orgnisms; Multi-cell organisms; The cell membrane; Cell Cycle; Enzymes; Transport processes

520 7341EN	LIT: LB4 Cell Biology	

SUBJECT

LIT: LB Science Lab Biology, digital

Comprehensive biology experiment instructions for the Science Lab.
Contains 139 experiments in the fields of human biology, botany, ecology and cell biology.

Includes all interactive experiment instructions (Lab Docs) as html file.

520 73	LIT: LB Science Lab Biology, digital	

Technical data of the digital version:

- Product key for literature (activation & selection of one literature language in LeyLab)
- Can then be used in LeyLab and Document Center (school/institute licence)
- System requirements:
  Document Center:
  - PC with Windows 7 or higher; internet access during installation; local network for distribution to students
  LeyLab:
  - PC, tablet or smartphone with a current browser; internet access

ADDITIONAL STORAGE ACCESSORIES





You can find detailed information on additional storage accessories from page 228.

CHEMICALS

The following overview shows which chemicals are required for the individual topics. They are sorted by article no.

		CHEMISTRY					BIOLOGY							
ART.-NO.	NAME	AC	OC	PC	TC	BC	HU	BO	ECO	CE	GHS - PICTOGRAMS (GLOBALLY HARMONISED SYSTEM OF CLASSIFI			
661 082	Stopcock grease, 60 g	x									-			
670 0400	Acetone, 250 ml	x	x			x		x				GHS02		GHS07
670 0430	Acetone, 500 ml				x							GHS02		GHS07
670 2010	Activated charcoal, granulated, 250 g								x		-			
670 2020	Activated charcoal, granulated, 500 g	x									-			
670 2390	Aluminium, sheets, 50 g	x		x							-			
670 2500	Aluminium, grit, 100 g	x									-			
670 3110	Formic acid, 98 %-100 %, 250 ml		x									GHS02		GHS05
670 3600	Ammonia solution, 25 %, 250 ml	x		x								GHS05		GHS07
670 3650	Ammonia solution, diluted, 2 mol/l, 500 ml	x	x	x	x				x			GHS05		
670 3900	Ammonium carbonate, 100 g									x		GHS07		
670 3910	Ammonium carbonate, 500 g	x										GHS07		
670 4000	Ammonium chloride, 100 g			x								GHS07		
670 4010	Ammonium chloride, 250 g	x										GHS07		
670 4900	Ammonium sulfate, 250 g					x					-			
670 5200	Ammonium thiocyanate, 50 g			x								GHS07		
670 6870	Azur-eosin-meth. sol, 100 ml									x		GHS02		GHS07
670 7200	Barium chloride, 100 g	x										GHS06		
670 7300	Barium chloride solution, 10 %, 100 ml	x										GHS07		
670 7410	Barium hydroxide, 250 g			x								GHS05		GHS07
670 8200	Petroleum ether, 90...110 °C, 250 ml	x										GHS02		GHS07
670 8210	Petroleum ether, 100...140 °C, 500 ml	x	x			x			x			GHS02		GHS08
670 8300	Benzoic acid, 50 g		x			x						GHS07		
671 0340	Bromide/Bromate solution, 250 ml				x						-			
671 0350	Bromide/Bromate solution, 500 ml		x								-			
671 0800	Bromothymol blue solution, 0.1%, 50 ml	x		x							-			
671 1010	1-Butanol, 1 l		x									GHS02		GHS05
671 1210	2-Butanol, 1 l		x									GHS02		GHS07
671 1300	Tertiary butanol, 100 ml		x									GHS02		GHS05
671 2000	Calcium, granules, 25 g	x										GHS02		
671 2200	Calcium carbide, pieces, 100g		x									GHS02		GHS05
671 2310	Calcium carbonate, precipitated, 500 g	x			x						-			
671 2400	Calcium chloride, granulated, 100 g	x										GHS07		
671 2900	Calcium hydroxide, 50 g	x	x		x							GHS05		GHS07
671 2950	Calcium hydroxide solution, 250 ml							x				GHS05		
671 2960	Calcium hydroxide solution (lime water), 1 l						x					GHS05		
671 3200	Calcium oxide, powder, 100 g					x						GHS05		
671 4100	Cetyl alcohol, 50 g		x								-			
671 4910	Schulze's solution, 50 ml					x						GHS05		GHS07
671 5600	Citric acid monohydrate, 100 g		x		x							GHS07		
671 5700	Cyclohexane, 250 ml		x									GHS02		GHS08
671 5910	Cyclohexene, 100 ml		x									GHS02		GHS08
671 8250	Iron powder, coarse, 250 g	x									-			
671 8300	Iron powder, reduced, 50 g	x									-			
671 8410	Iron wool, 200 g	x	x								-			
671 8700	Iron(III) chloride-6-hydrate, 50 g	x	x	x								GHS05		GHS07
671 9000	Iron(III) oxide, 100 g	x									-			
671 9100	Iron(II) sulfate-7-hydrate, 100 g	x		x								GHS07		
671 9310	Eosine, yellow, 25 g									x		GHS05		
671 9500	Acetic acid, 99 %-100 %, 250 ml		x									GHS02		GHS05
671 9550	Acetic acid, dil., (approx. 2 mol/l), 500 ml	x	x		x	x						GHS05		
671 9560	Acetic acid, 0.1 mol/l, 500 ml			x							-			
671 9570	Acetic acid, 0.1 mol/l, 1 l	x									-			
671 9630	Ethyl acetate, 250 ml			x								GHS02		GHS07
671 9640	Acetic ethylester, 500 ml		x									GHS02		GHS07
671 9700	Ethanol, absolute, 250 ml		x									GHS02		GHS07

For explanation and detailed information on hazard warnings, precautionary statements and GHS pictograms please consult the CLP regulation. Also please always observe the regulations that apply to your country.

CATION AND LABELLING OF CHEMICALS)	HAZARD STATEMENTS	PRECAUTIONARY STATEMENTS	SIGNAL WORDS
	-	-	-
	H225 H319 EUH066 H336	P210 P233 P305+P351+P338	Danger
	H225 H319 EUH066 H336	P210 P233 P305+P351+P338	Danger
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	H226 H314	P260 P280 P301+P330+P331 P305+P351+P338 P309+P310	Danger
GHS09	H314 H335 H400	P280 P273 P301+P330+P331 P305+P351+P338 P309 P310	Danger
	H315 H318	P280 P305+P351+P338 P332+P313 P309+P310	Danger
	H302	-	Warning
	H302	-	Warning
	H302 H319	P305+P351+P338	Warning
	H302 H319	P305+P351+P338	Warning
	-	-	-
	H302 EUH032 H312 H332 H412	P273 P302+P352	Warning
	H225 H319	P210 P280 P305+P351+P338 P337+P313	Danger
	H332 H301	P301+P310	Danger
	H302	P301+P312	Warning
	H332 H302 H314	P280 P301+P330+P331 P305+P351+P338 P309+P310	Danger
GHS08 GHS09	H225 H304 H315 H336 H411	P101 P102 P103 P210 P260 P262 P243 P301+P330+P331 P403+P233	Danger
GHS07 GHS09	H225 H304 H315 H336 H411	P210 P273 P302+P352 P301+P310 P331	Danger
	H302 H319	P305+P351+P338	Warning
	-	-	-
	-	-	-
	-	-	-
GHS07	H226 H302 H318 H315 H335 H336	P280 P302+P352 P305+P351+P338 P313	Danger
	H226 H319 H335 H336	P210 P261 P280 P303+P361+P353 P305+P351+P338 P403+P233	Warning
GHS07	H226 H315 H318 H335 H336	P210 P302+P352 P304+P340 P305+P351+P338	Danger
	H261	P402+P404	Danger
	H261 H318	P280 P262 P305+P351+P338 P310 P370+P378 P404	Danger
	-	-	-
	H319	P305+P351+P338	Warning
	H315 H318 H335	P260 P280 P302+P352 P304+P340 P305+P351+P338 P313	Danger
	H315 H318	P280 P302+P352 P305+P351+P338	Danger
	H315 H318	P280 P302+P352 P305+P351+P338	Danger
	H318	P260 P280 P305+P351+P338	Danger
	-	-	-
GHS09	H302 H314 H400 H410	P280 P273 P303+P361+P353 P305+P351+P338 P310 P501	Danger
	H319	P305+P351+P338	Warning
GHS07 GHS09	H225 H304 H410 H315 H336	P210 P240 P273 P301+P310 P331 P403+P235	Danger
GHS07 GHS09	H225 H302 H304 H411	P210 P262 P273	Danger
	-	-	-
	-	-	-
	-	-	-
	H302 H315 H318	P280 P302+P352 P305+P351+P338 P313	Danger
	-	-	-
	H302 H315 H319	P302+P352 P305+P351+P338	Warning
	H318	P280d P305+P351+P338 P310	Danger
	H226 H314 H290	P280 P301+P330+P331 P307+P310 P305+P351+P338	Danger
	H315 H319 H290	P280 P305+P351+P338 P332+P313 P337+P313 P302+P352	Warning
	-	-	-
	-	-	-
	H225 H319 EUH066 H336	P210 P240 P305+P351+P338	Danger
	H225 H319 EUH066 H336	P210 P240 P305+P351+P338	Danger
	H225 H319	P210 P280 P305+P351+P338 P337+P313	Danger

		CHEMISTRY					BIOLOGY					
ART.-NO.	NAME	AC	OC	PC	TC	BC	HU	BO	ECO	CE	GHS - PICTOGRAMS (GLOBALLY HARMONISED SYSTEM OF CLASSIFI	
671 9720	Ethanol, denaturated, 1 l	x	x	x		x				x		GHS02		GHS07
671 9740	Ethanol, denaturated, 250 ml				x							GHS02		GHS07
671 9800	Ethylene glycol, 250 ml		x									GHS07		
671 9900	Fehling's solution I, 100 ml					x	x					GHS09		
672 0000	Fehling's solution II, 100 ml					x	x					GHS05		
672 0700	D(-)-Fructose, 50 g					x					-			
672 0970	Gypsum, burned, pure, 500 g				x						-			
672 0980	Gypsum, burned, pure, 1 kg							x			-			
672 1000	Glass wool, 10 g				x				x		-			
672 1010	Glass wool, 100 g	x									-			
672 1100	D(+)-Glucose, 100 g	x	x								-			
672 1110	D(+)-Glucose, 250 g						x				-			
672 1120	D(+)-Glucose, 1 kg					x					-			
672 1190	Glycerine, 99 %, 50 ml	x									-			
672 1200	Glycerol, 99 %, 100 ml		x		x	x			x		-			
672 1300	Glycine (Glycocoll), 50 g	x									-			
672 1700	Urea, 100 g		x							x	-			
672 1800	n-Heptane, 50 ml		x									GHS02		GHS08
672 1810	n-Heptane, 250 ml	x										GHS02		GHS08
672 2490	Charcoal, small pieces, 500 g				x						-			
672 2520	Wooden turnings, 100 St.	x	x	x	x	x					-			
672 3290	Immersion oil, 5 ml								x			GHS07		GHS09
672 3400	Indigo carmine, 10 g							x			-			
672 3700	Iodine, 25 g	x										GHS07		GHS08
672 3900	Lugol's solution, 100 ml							x				GHS08		
672 3911	Lugol's solution, 1 l		x									GHS08		
672 3920	Lugol's solution, 50 ml			x		x	x					GHS08		
672 4900	Potassium bromide, 50 g				x							GHS07		
672 4930	Potassium bromide solution, approx. 1 M, 250 ml			x							-			
672 5000	Potassium carbonate, 100 g			x								GHS07		
686 666	Potassium chloride, 50 g						x				-			
672 5200	Potassium chloride, 100 g	x	x	x							-			
672 6000	Potassium ferrocyanide (II), 50 g	x									-			
672 6100	Potassium ferrocyanide (III), 50 g	x		x							-			
672 6320	Potassium hydrogen tartrate, 250 g		x								-			
672 6400	Potassium hydroxide, 250 g	x										GHS05		GHS07
672 6500	Potassium iodate, 25 g	x										GHS03		GHS05
672 6600	Potassium iodide, 25 g				x						-			
672 6630	Potassium iodide, 250 g	x									-			
672 6670	Potassium iodide solution, approx. 1 M, 250 ml			x							-			
672 6710	Potassium sodium tartrate, 250 g					x					-			
672 6800	Potassium nitrate, 100 g						x					GHS03		
672 6810	Potassium nitrate, 250 g	x		x								GHS03		
672 6850	Potassium nitrate solution, approx. 1 mol/l, 250 ml							x			-			
672 7000	Potassium permanganate, 100 g		x									GHS03		GHS07
672 7400	Potassium thiocyanate, 100 g			x								GHS07		
672 7580	Carbolic fuchsin solution, 100 ml								x			GHS05		GHS08
672 7660	Carmine acetic acid, 50 ml									x		GHS07		
672 8600	Copper, sheets, 50 g			x	x						-			
672 8620	Copper, sheets, 250 g	x									-			
672 8800	Copper, powder, 50 g	x		x								GHS09		
672 9100	Copper(II) chloride, 50 g			x								GHS07		GHS09
672 9500	Copper(II) oxide, powder, 50 g	x			x							GHS07		GHS09
672 9510	Copper(II) oxide, powder, 100 g		x									GHS07		GHS09
672 9600	Copper(II) sulfate-5-hydrate, 100 g		x	x		x				x		GHS07		GHS09
672 9630	Copper(II) sulfate-5-hydrate, 500 g	x										GHS07		GHS09
672 9650	Copper(II) sulfate solution 1 %, 50 ml							x						
672 9660	Copper(II) sulfate solution, 1 mol/l (15 %), 500 ml	x		x		x						GHS07		GHS09
673 0130	Lavender oil, 10 ml						x					GHS07		GHS08
673 0210	Linseed oil, 250 ml				x						-			

CATION AND LABELLING OF CHEMICALS)					HAZARD STATEMENTS	PRECAUTIONARY STATEMENTS	SIGNAL WORDS
					H225 H319	P210 P280 P305+P351+P338 P337+P313	Danger
					H225 H319	P210 P280 P305+P351+P338 P337+P313	Danger
					H302	-	Warning
					H411	P273 P391	-
					H314	P280 P303+P361+P353 P305+P351+P338 P310	Danger
					-	-	-
					-	-	-
					-	-	-
					-	-	-
					-	-	-
					-	-	-
					-	-	-
					-	-	-
					-	-	-
					-	-	-
					-	-	-
					-	-	-
	GHS07		GHS09		H225 H304 H315 H336 H410	P210 P273 P301+P310 P331 P302+P352 P403+P235	Danger
	GHS07		GHS09		H225 H304 H315 H336 H410	P210 P273 P301+P310 P331 P302+P352 P403+P235	Danger
					-	-	-
					-	-	-
					H302 H411	P273	Warning
					-	-	-
	GHS09				H302 H312 H332 H315 H319 H335 H372 H400	P261 P302+P352 P304+P340 P305+P351+P338 P314 P273	Danger
					H373	P260 P314	Warning
					H373	P260 P314	Warning
					H373	P260 P314	Warning
					H319	P305+P351+P338 P337+P313	Warning
					-	-	-
					H315 H319	P302+P352 P305+P351+P338	Warning
					-	-	-
					-	-	-
					H412	P273	-
					EUH032	-	-
					-	-	-
					H314 H302 H290	P280 P301+P330+P331 P305+P351+P338 P309+P310	Danger
					H272 H318	P221 P280 P305+P351+P338	Danger
					-	-	-
					-	-	-
					-	-	-
					-	-	-
					H272	P210	Warning
					H272	P210	Warning
					-	-	-
	GHS09				H272 H302 H410	P210 P273	Danger
					H302 EUH032 H312 H332 H412	P273 P302+P352	Warning
					H315 H318 H341	P280 P302+P352 P305+P351+P338 P310	Danger
					H315 H319	P280 P302+P352 P305+P351+P338 P337+P313	Warning
					-	-	-
					-	-	-
					H400	P273 P391 P501	Warning
					H302 H410	P273	Warning
					H302 H410	P260 P273	Warning
					H302 H410	P260 P273	Warning
					H302 H319 H315 H410	P273 P302+P352 P305+P351+P338	Warning
					H302 H319 H315 H410	P273 P302+P352 P305+P351+P338	Warning
					H315 H304	P301+P310 P331 O280 P302+P352	Danger
					H319 H315 H410	P273 P305+P351+P338 P302+P352	Warning
					-	-	-

		CHEMISTRY					BIOLOGY								
ART.-NO.	NAME	AC	OC	PC	TC	BC	HU	BO	ECO	CE	GHS - PICTOGRAMS (GLOBALLY HARMONISED SYSTEM OF CLASSIFI			
673 0500	Lithium chloride, 25 g	x	x									GHS07		
673 0840	Magnesia rods, 25 pieces	x			x	x					-			
673 1000	Magnesium, ribbon, 25 g	x		x								GHS02		
673 1100	Magnesium, powder, 50 g	x										GHS02		
673 1150	Magnesium, turnings, 50 g		x	x								GHS02		
673 1230	Magnesium chloride solution, approx. 1 M, 250 ml			x							-			
673 1500	Magnesium oxide, 50 g	x									-			
673 2200	Manganese(IV) oxide, 100 g			x						x		GHS03		GHS07
673 2210	Manganese(IV) oxide, 500 g	x										GHS03		GHS07
673 2500	Marble, pcs., 250 g				x						-			
673 2720	Methanol, 1 l		x									GHS02		GHS06
673 2920	Methylene blue solution, 100 ml					x				x		GHS02		GHS07
673 3050	Methylene orange solution, 0.1 %, 100 ml	x									-			
673 4510	2-Naphthol, 100 g				x							GHS07		GHS09
673 5000	Sodium acetate-3-hydrate, 50 g	x									-			
673 5590	Sodium carbonate-10-hydrate, 500 g	x										GHS07		
673 5600	Natrium carbonate, anhydrous, 100 g	x		x								GHS07		
673 5610	Sodium carbonate, anhydrous, 250 g				x	x						GHS07		
673 5690	Sodium chloride, 2,5 kg				x						-			
673 5700	Sodium chloride, 250 g			x		x	x			x	-			
673 5720	Sodium chloride, 1 kg	x	x								-			
673 5740	Sodium chloride solution, approx. 1 M, 500 ml			x							-			
673 6300	Sodium dithionite, 25 g							x				GHS02		GHS07
673 6310	Sodium dithionite, 250 g				x							GHS02		GHS07
673 6600	Sodium bicarbonate, 250 g		x					x			-			
673 6610	Sodium bicarbonate, 500 g		x								-			
673 6780	Sodium hydrogen sulfite solution, 40%, 250 ml		x									GHS07		
673 6800	Sodium hydroxide, pellets, 100 g		x		x							GHS05		
673 6810	Sodium hydroxide, pellets, 250 g			x								GHS05		
673 6830	Sodium hydroxide, pellets, 500 g	x										GHS05		
673 7100	Sodium nitrite, 50 g				x							GHS03		GHS06
673 7410	Trisodium phosphate dodecahydrate, 250 g								x			GHS07		
673 7600	Sodium sulfate-10-hydrate, 100 g	x									-			
673 8000	Sodium thiosulfate-5-hydrate, 100 g			x							-			
673 8010	Sodium thiosulfate-5-hydrate, 250 g	x									-			
673 8380	Sodium hydroxide solution, 32%, 250 ml	x										GHS05		
673 8400	Sodium hydroxide solution, diluted, aprox. 2 M, 500 ml		x	x	x	x						GHS05		
673 8410	Sodium hydroxide solution, 0.1 mol/l, 500 ml		x									GHS05		
673 8411	Sodium hydroxide solution, 0.1 mol/l, 1 l	x		x								GHS05		
673 8420	Sodium hydroxide solution, 1 mol/l, 500 ml		x		x	x	x			x		GHS05		
673 8421	Sodium hydroxide solution, 1 mol/l, 1 l	x		x								GHS05		
673 8600	Clove oil, 10 ml						x					GHS07		GHS08
673 9390	2-Nitrobenzaldehyde, 5 g				x							GHS07		
674 0000	Oleic acid, 50 ml				x						-			
674 0100	Olive oil, 100 ml							x			-			
674 0620	Pancreatin, 25 g						x					GHS07		GHS08
674 0700	Paraffine, hard, 100 g	x	x								-			
674 0800	Paraffine, thick, 100 ml	x									-			
674 0810	Paraffine, thick, 250 ml		x								-			
674 1200	1-Pentanol, 100 ml		x									GHS02		GHS07
674 1420	Pepsin for biochemistry, 25 g						x					GHS08		GHS07
674 2000	Bead catalyst, 500 g		x								-			
674 2200	Petroleum ether, 40...70 °C, 250 ml		x	x				x				GHS02		GHS08
674 2500	Phenolphthaleine solution, 100 ml	x		x			x					GHS02		GHS08
674 3440	Phosphoric acid, 10 %, 100 ml	x										GHS07		
674 3950	Culture medium (agar) for fungi, for 1 l						x				-			
674 4050	Plate-count agar, for 1 l						x				-			
674 4320	1-Propanol, 1 l		x									GHS02		GHS05
674 4410	2-Propanol, 1 l		x									GHS02		GHS07
674 4450	Propanal, 100 ml		x									GHS02		GHS07

CATION AND LABELLING OF CHEMICALS)	HAZARD STATEMENTS	PRECAUTIONARY STATEMENTS	SIGNAL WORDS
	H302 H315 H319	P302+P352 P305+P351+P338	Warning
	-	-	-
	H228	P370+P378	Warning
	H260 H250	P210 P370+P378 P402+P404	Danger
	H228 H261 H252	P210 P402+P404	Danger
	-	-	-
	-	P260	-
	H272 H302 H332	P221	Danger
	H272 H302 H332	P221	Danger
	-	-	-
 GHS08	H225 H301 H311 H331 H370	P210 P233 P280 P302+P352 P309+P310	Danger
	H226 H319	P210 P280 P305+P351+P338 P337+P313	Warning
	-	-	-
	H332 H302 H400	P273	Warning
	-	-	-
	H319	P280 P305+P351+P338	Warning
	H319	P260 P305+P351+P338	Warning
	H319	P260 P305+P351+P338	Warning
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	H251 H302 EUH031	P370+P378	Danger
	H251 H302 EUH031	P370+P378	Danger
	-	-	-
	-	-	-
	H302 EUH031	P262	Warning
	H314 H290	P280 P301+P330+P331 P309+P310 P305+P351+P338	Danger
	H314 H290	P280 P301+P330+P331 P309+P310 P305+P351+P338	Danger
	H314 H290	P280 P301+P330+P331 P309+P310 P305+P351+P338	Danger
 GHS09	H272 H301 H400	P273 P309+P310	Danger
	H319 H315	P302+P352 P305+P351+P338	Warning
	-	-	-
	-	-	-
	-	-	-
	H314 H290	P280 P303+P361+P353 P305+P351+P338 P310 P301+P330+P331	Danger
	H314 H290	P280 P303+P361+P353 P305+P351+P338 P310 P301+P330+P331	Danger
	H290	P234 P390	Warning
	H290	P234 P390	Warning
	H314 H290	P280 P301+P330+P331 P305+P351+P338 P309+P310	Danger
	H314 H290	P280 P301+P330+P331 P305+P351+P338 P309+P310	Danger
	H302 H312 H304 H317 H319 H412	P280 P301+P310 P305+P351+P338 P331	Danger
	H302 H315 H319 H335	P261 P305+P351+P338	Warning
	-	-	-
	-	-	-
	H315 H319 H335 H317 H334	P280 P302+P352 P304+P341 P342+P311 P305+P351+P338	Danger
	-	-	-
	-	-	-
	-	-	-
	H226 H332 H335 H315	P302+P352	Warning
	H315 H319 H335 H334	P302+P352 P304+P341 P305+P351+P338 P342+P311	Danger
	-	-	-
 GHS07  GHS09	H225 H304 H315 H336 H411 EUH066	P210 P240 P273 P301+P310 P331 P403+P235	Danger
	H225 H350 H341	P210 P233 P281 P308+P313	Danger
	H315 H319	P280 P302+P352 P305+P351+P338 P313	Warning
	-	-	-
	-	-	-
 GHS07	H225 H318 H336	P210 P233 P280 P305+P351+P338 P313	Danger
	H225 H319 H336	P210 P233 P305+P351+P338	Danger
	H225 H315 H319 H335	P210 P233 P302+P352 P304+P340 P305+P351+P338	Danger

		CHEMISTRY					BIOLOGY					
ART.-NO.	NAME	AC	OC	PC	TC	BC	HU	BO	ECO	CE	GHS - PICTOGRAMS (GLOBALLY HARMONISED SYSTEM OF CLASSIFI	
674 4510	Propionic acid, 250 ml		x								GHS05	
674 4950	Quartz sand, 100 g				x						-	
674 5830	Rose oil, artificial, 10 ml						x				GHS05	GHS07
674 5700	Resorcin, 50 g					x					GHS07	GHS09
674 6050	D(+)-Sucrose, 100 g	x	x	x		x			x	x	-	
674 6060	D(+)-Sucrose, 250 g						x				-	
674 6650	Nitric acid, diluted, approx. 2 mol/l, 500 ml	x									GHS05	
674 6750	Hydrochloric acid, conc., 25 %, 250 ml	x	x	x		x					GHS05	GHS07
674 6800	Hydrochloric acid, 10 %, 500 ml				x	x					GHS05	GHS07
674 6810	Hydrochloric acid, 10 %, 1 l	x									GHS05	GHS07
674 6900	Hydrochloric acid, 1 mol/l, 500 ml					x	x	x		x	GHS05	
674 6910	Hydrochloric acid, 1 mol/l, 1 l	x		x							GHS05	
674 6920	Hydrochloric acid, approx. 2 mol/l, 500ml	x		x							GHS05	
674 6960	Hydrochloric acid, 0.1 mol/l, 1 l	x		x							GHS05	
674 6700	Hydrochloric acid, fuming, 37 %, 250 ml		x								GHS05	GHS07
674 7350	Schiffs's reagent, 250 ml		x								GHS05	
674 7610	Sulfur, sublimed, 500 g	x		x							GHS07	
674 7850	Sulfuric acid, 95-98 %, 250 ml		x								GHS05	
674 7891	Sulfuric acid, 35 %, 1 l			x							GHS05	
674 7900	Sulfuric acid, 5 mol/l, 100 ml	x									GHS05	
674 7920	Sulfuric acid, diluted, approx. 2 N, 500 ml	x	x	x	x						GHS05	
674 7950	Sulfuric acid, 0.5 mol/l, 1l			x			x				GHS05	
674 8200	Sea sand, purified, 250 g		x		x			x			-	
674 8210	Sea sand, purified, 1 kg	x									-	
674 8211	Sea sand, purified, 500 g								x		-	
674 8610	Silver nitrate, 25 g			x							GHS03	GHS05
674 8710	Silver nitrate solution, 5 %, 100 ml	x			x						GHS05	GHS09
674 8800	Silver nitrate solution, 0,1 mol/l, 250 ml		x								GHS07	GHS09
674 8810	Silver nitrate solution, 0,1 mol/l, 1 l			x							GHS07	GHS09
674 9050	Silicone oil, 100 ml				x						-	
674 9100	Sorbic acid, 25 g					x					GHS07	
674 9200	Starch, soluble, 100 g						x				-	
674 9210	Starch, soluble, 250 g				x						-	
674 9220	Starch, soluble, 50 g	x	x	x		x					-	
674 9520	Polystyrene (Styropor P), 100 g	x									-	
674 9680	Sudan black, 1 g					x	x				-	
674 9710	Sulphanilic acid, 50 g				x						GHS07	
675 0200	Tannin, 50 g					x					-	
675 1600	Thymolphthalein solution, 0.1 %, 50 ml	x									GHS02	GHS07
675 1650	Tillman's reagent, 50 ml					x					-	
675 2530	L(-)-Tyrosine, 25 g					x					-	
675 2570	Universal Indicator, 100ml	x									GHS02	GHS07
675 2800	Urease (1 U/mg), 1 g									x	-	
675 3100	Vaseline, 50 g							x			-	
675 3270	Vitamin C, 50 g					x					-	
675 3500	Hydrogen peroxide, 30 %, 250 ml	x		x						x	GHS05	GHS07
675 3510	Hydrogen peroxide, 30 %, 1 l						x				GHS05	GHS07
675 3520	Hydrogen peroxide, 5 %, 50 ml		x								GHS07	
675 3550	Cotton wad, 200 g	x	x	x		x		x	x		-	
675 3600	L(+)-Tartaric acid, 100 g		x								GHS07	
675 4700	Cellulose acetate, 100 g		x								-	
675 4800	Zinc, granulated, 100 g	x									-	
675 4900	Zinc, powder, 100 g	x		x							GHS09	
675 4901	Zinc, powder, 25 g				x						GHS09	
675 5000	Zinc, sticks, 100 g	x									-	
675 5110	Zinc chloride, dry, 250 g		x								GHS05	GHS07
675 5220	Zinc iodide solution, 50 %, 50 g			x							GHS07	
675 5300	Zinc oxide, 50 g	x									GHS09	
675 5510	Zinc sulfate solution, approx. 1 M, 500 ml			x							GHS07	
675 5700	Tin, foil, 100 x 0.10 mm, 50 g	x			x						-	

CATION AND LABELLING OF CHEMICALS)					HAZARD STATEMENTS	PRECAUTIONARY STATEMENTS	SIGNAL WORDS
					H314	P280 P301+P330+P331 P305+P351+P338 P309+P310	Danger
					-	-	-
		GHS09			H318 H317 H315 H411	P280 P305+P351+P338 P333+P313 P302+P352	Danger
					H302 H315 H319 H400	P273 P302+P352 P305+P351+P338	Warning
					-	-	-
					-	-	-
					H314 H290	P280 P305+P351+P338 P309+P310 P301+P330+P331	Danger
					H314 H335 H290	P280 P301+P330+P331 P309+P310 P305+P351+P338	Danger
					H315 H319 H335 H290	P280 P261 P304+P340 P305+P351+P338 P312 P403+P233	Warning
					H315 H319 H335 H290	P280 P261 P304+P340 P305+P351+P338 P312 P403+P233	Warning
					H290	P390	Warning
					H290	P390	Warning
					H290	P390	Warning
					H290	P390	Warning
					H314 H335 H290	P280 P301+P330+P331 P309+P310 P305+P351+P338	Danger
					H290	P234 P262	Warning
					H315	P302+P352	Warning
					H314 H290	P280 P301+P330+P331 P309 P310 P305+P351+P338	Danger
					H290 H314	P260 P280 P301+P330+P331 P305+P351+P338 P310	Danger
					H290 H314	P280 P301+P330+P331 P309 P310 P305+P351+P338	Danger
					H290 H315 H319	P280 P305+P351+P338 P337+P313 P302+P352	Warning
					H290	-	Warning
					-	-	-
					-	-	-
					-	-	-
		GHS09			H272 H314 H410	P273 P280 P301+P330+P331 P305+P351+P338 P309+P310	Danger
					H314 H410	P280 P273 P302+P352 P305+P351+P338 P332+P313 P337+P313	Danger
					H315 H319 H410	P280 P273 P302+P352 P305+P351+P338 P332+P313 P337+P313	Warning
					H315 H319 H410	P280 P273 P302+P352 P305+P351+P338 P332+P313 P337+P313	Warning
					-	-	-
					H315 H319 H335	P302+P352 P305+P351+P338	Warning
					-	-	-
					-	-	-
					-	-	-
					-	-	-
					-	-	-
					H315 H319 H317	P280 P302+P352 P305+P351+P338	Warning
					-	-	-
					H226 H319	P210 P280 P305+P351+P338 P337+P313	Warning
					-	-	-
					-	-	-
					H225 H319	P210 P280 P305+P351+P338 P337+P313	Danger
					-	-	-
					-	-	-
					-	-	-
					H302 H318	P280 P305+P351+P338 P313	Danger
					H302 H318	P280 P305+P351+P338 P313	Danger
					H319	P280 P305+P351+P338 P337+P313	Warning
					-	-	-
					H319	P305+P351+P338	Warning
					-	-	-
					-	-	-
					H410	P273	Warning
					H410	P273	Warning
					-	-	-
		GHS09			H302 H314 H335 H410	P273 P280 P301+P330+P331 P305+P351+P338 P309+P310	Danger
					H315 H319	P302+P352 P305+P351+P338	Warning
					H410	P273	Warning
					H319 H412	P273 P305+P351+P338	Warning
					-	-	-

Mobile-CASSY 2 WiFi

Measuring device for student experiments and demonstrations in the natural sciences:

- Large measured value display switches on automatically after start-up or when a sensor is attached (no boot time and no further keys to press)
- 4 mm safety sockets for *U*, *I*, *P* and *E* as well as Type K socket for NiCr-Ni temperature probe integrated
- For all CASSY sensors and sensors M
- The touch wheel – with a turn of the wheel quickly change to the appropriate screen or the appropriate list entry
- Measurement time, measurement interval, trigger and pre-trigger (advance) are adjustable
- Graphs of measured values with freely selectable coordinate axes and selectable evaluation methods (e.g. zoom and straight line fitting)
- Measured values and screen shots can be saved on an integrated micro SD card and copied onto a USB stick
- Full support from CASSY Lab 2 (524 220), via USB lead for teaching by demonstration with the projector
- Support leg allows easy viewing angle.
- WiFi integrated.

Technical data:

- Graphics display: 9 cm (3.5"), colour QVGA (adjustable up to 400 cd/m²)
- Inputs: 3 (can be used simultaneously)
- Input A: *U* or CASSY sensor or sensor M
- Input B: *I* or CASSY sensor or sensor M
- Input ϑ: temperature
- Measuring range *U*: ±0.1/±0.3/±1/±3/±10/±30 V
- Measuring range *I*: ±0.03/±0.1/±0.3/±1/±3 A
- Measuring range ϑ: -200 ... +200 °C / -200 ... +1200 °C
- Sensor connections: each 2 for CASSY sensors and sensors M
- Sampling rate: max. 500,000 values/second
- Operation: large capacitive touch wheel (42 mm)
- Resolution: 12 bit
- Time resolution of the timer inputs: 20 ns
- Loudspeaker: integrated for key tones and GM counter tube (can be disabled as required)
- Data storage device: integrated micro SD card for more than a thousand measurement files and screen shots, optionally also via a USB stick
- WiFi: 802.11 b/g/n as access point or client (WPA/WPA2)
- VNC server: integrated
- Battery capacity: 14 watt-hours (AA size, replaceable)
- Battery life: 8 h during operation, several years on standby
- Kensington lock: as anti-theft protection
- Dimensions: 175 mm x 95 mm x 40 mm

Scope of delivery:

- Mobile-CASSY 2 WiFi
- Battery charger
- NiCr-Ni temperature sensor
- Quick start guide

524 005W	Mobile-CASSY 2 WiFi

Additionally recommended:

Count	Cat.-No.	Name
1	524 0034	Charging adapter for 4 Mobile-CASSY 2 WiFi
1	524 0039	Storage tray Mobile-CASSY 2 WiFi

Charging adapter for 4 Mobile-CASSY 2 WiFi

For the simultaneous charging of up to 4 Mobile-CASSY 2 WiFi (524 005W) with just one plug-in power supply.

Technical data:

- Charging time: unchanged compared to single charging
- Connection: hollow socket for 12 VAC plug-in connector (incl. in the scope of delivery of every Mobile-CASSY 2 WiFi)
- Fuse: 1.1 A (self-resetting)
- Dimensions: 195 mm x 17 mm x 36 mm
- Weight: 70 g

524 0034	Charging adapter for 4 Mobile-CASSY 2 WiFi

Storage tray Mobile-CASSY 2 WiFi

For safe storage of up to 8 Mobile-CASSY 2 WiFi (524 005W). Together with two adapters (524 0034) all 8 Mobile-CASSY 2 WiFi can be simultaneously charged in the storage tray.

Technical data:

- Dimensions: 27 cm x 45 cm x 16.5 cm

Scope of delivery:

- Storage tray with foam inlay

524 0039	Storage tray Mobile-CASSY 2 WiFi

Recommended accessories: 2 charging adapters (524 0034)

Pressure sensor S, ±70 hPa

For measuring very small pressure differences with CASSY (524 013, 524 006, 524 018, 524 005W) or the universal measuring instruments (531 835, 531 836, 531 837), e.g. at flow experiments in the wind tunnel (373 12) or the Venturi tube (from 373 091). Connection to the experiment via two hose nozzles (4 mm diam.). Incl. PVC tubing (667 192) and two connectors with nipple (604 520).

Technical data:

- Measuring ranges: ±0.7/±2.1/±7/±21/±70 hPa
- Resolution: 0.05% of the measuring range
- Dimensions: 70 mm x 50 mm x 25 mm
- Weight: 75 g

524 066	Pressure sensor S, ±70 hPa

Force sensor M, ±50 N

For measuring force components up to ±50 N (e.g. spring pendulum or centrifugal force components) with Mobile-CASSY 2 WiFi (524 005W). Its rigid design enables the measurement of force components in any position of the force sensor.

Technical data:

- Measurement ranges: ±5/±50 N
- Resolution: 0.1 % of the measurement range
- Compensation (Tare): ±50 N in every measurement range
- Fixing: with securing bolts on stand equipment
- Connection: Mini-DIN
- Connection cable length: 0.3 m

524 434	Force sensor M, ±50 N

Light barrier M

Cascadable photoelectric barrier for measuring period durations, travelling time, paths and velocities on the student track or during free fall with Mobile-CASSY 2 WiFi (524 005W).

Technical data:

- Time resolution: 100 ns
- Path resolution: 5 mm when utilising the spoked wheels
- Cascading: up to 5 photoelectric barriers (e.g. for travelling time measuring or up to 5 sequential relocity measurements on one track)
- Fixing: locking in place under the student track (460 81/460 82) or via M6 threads
- Connection cable length: 1 m
- Connection: Mini-DIN
- Supply voltage: 5 V DC via Mini-DIN
- Dimensions: 120 mm x 115 mm x 30 mm
- Weight: 180 g

524 431	Light barrier M

Recommended accessories:

- Spoked wheel (524 4322)
  For fixing on a light barrier M for continuous path and velocity measuring.
- Start jig, trolley (524 4323)
  For fixing on a light barrier M for automatic start of the time measuring when starting the movement on a track (instead of a holding magnet).
- Start jig, ball (524 4324)
  For fixing on a light barrier M for automatic start of the time measuring when starting a free fall of a ball (instead of a holding magnet).

Microphone M

For measuring sound level, frequency and the voltage of acoustic signals with Mobile-CASSY 2 WiFi (524 005W).

Technical data:

- Measuring variables: Voltage, frequency, sound level
- Frequency range: 50 ... 20,000 Hz
- Sound level ranges: 40 ... 100 dB, 60 ... 120 dB (also automatically)
- Sampling rate: maximum 500,000 values/s
- Connection: Mini-DIN
- Connection cable length: 1.2 m

524 442	Microphone M

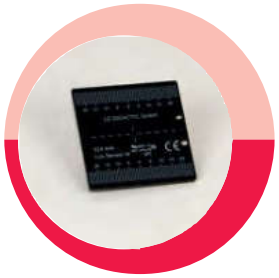
Magnetic field sensor M, ±100 mT

For measuring the tangential or axial magnetic flux density up to ±100 mT with Mobile-CASSY 2 WiFi (524 005W).

Technical data:

- Measurement ranges: ±10/±100 mT
- Resolution: 0.05 % of the measurement range
- Measurement direction: switchable between axial and tangential
- Connection: Mini-DIN
- Connection cable length: 1.2 m

524 436	Magnetic field sensor M, ±100 mT



Lux sensor M

For measuring the illuminance of visible light with Mobile-CASSY 2 WiFi (524 005W). The lux sensor has a flat design so that it can, for example, be inserted directly into the holder for diaphragms and slides (459 33). With the lux sensor, measurements can be performed along and orthogonal to the optical axis. A printed millimetre scale is used to position the sensor on the optical axis and also enables the recording of intensity distributions of different diffraction objects (e.g. 469 731) without additional equipment.

Technical data:

- Measuring ranges: 0...100 lx, 0...1 klx, 0...10 klx, 0...100 klx
- Dimensions of the sensor: 0.4 mm x 0.4 mm
- Spectral sensitivity: 480 ... 650 nm
- Dimensions: 50 mm x 50 mm x 2.4 mm
- Connection: Mini-DIN
- Length of connecting cable: 1.20 m

524 444	Lux sensor M

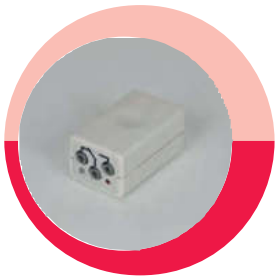
GM adapter M

For measuring radioactive radiation with a Geiger-Müller counter tube (559 01 or 559 012) with Mobile-CASSY 2 WiFi (524 005W).

Technical data:

- Counter tube voltage: 200 ... 650 V (adjustable)
- Counter tube input: Coaxial socket
- Connection: Mini-DIN
- Connection cable length: 0.3 m

524 440	GM adapter M



Relay M

The Relay M is an actuator for the Mobile-CASSY 2 WiFi (524 005W). It facilitates controlling an experiment on the basis of the input quantities of the Mobile-CASSY 2 WiFi. This allows for the retrofitting of an output X or Y as an addition to the inputs A and B. The simultaneous use of the 4mm socket remains possible.

Technical data:

Output: changeover relay with LED (max. 30 V/2 A)
Trigger: 2 independet triggers for switching on and off
Deadtime: Δt selectable as „off" or 1/5/10/30 s
Connection: Mini-DIN
Length of the connecting cable: 0.30 m

524 446	Relay M

Conductivity sensor

Conductivity sensor using four-wire technology with integrated Pt temperature sensor for use with chemistry box (524 067), conductivity adapter S (524 0671) and CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Open design for rapid response to changes in conductivity.
When conducting measurements a minimum distance of 1 cm from the side of the, as well as a minimum immersion depth of 2 cm are to be maintained.

Technical data:

- Cell constant 0.58 cm^{-1}
- Measuring range: 0 ... 1 S/cm
- Temperature range: -25 ... +100 °C
- Connections: 6-pole DIN socket
- Dimensions: 160 mm x 16 mm diam.
- Weight: 75 g

529 670	Conductivity sensor

Conductivity adapter S

Used in conjunction with the conductivity sensor (529 670), this adapter enables conductivity and temperature to be measured with CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836).

Technical data:

- Measuring ranges: Conductivity (with sensor 529 670): 10/30/100/300 µS/cm, 1/3/10/30/100/300 mS/cm, 1 S/cm
- Resolution 0.005 µS/cm in the smallest measuring range
- Temperature measurement and compensation: -25 ... +100 °C
- Connections: 8-pole DIN socket for conductivity sensor with temperature measurement
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 0671	Conductivity adapter S

Additionally required:

Count	Cat.-No.	Name
1	529 670	Conductivity sensor

pH adapter S

Enables a pH electrode to be connected to CASSY (524 013, 524 006, 524 005W, 524 018) or the universal chemistry measuring instrument (531 836). Moreover, the voltage at the BNC socket can be measured at a very high resistance, e.g. for measuring electrochemical potentials.

Technical data:

- Measuring ranges pH: 0 ... 14 pH
- Resolution pH: 0.01 pH
- Measuring ranges potential: ±1/±2 V
- Input resistance: > 10^{13} Ω
- Connection: BNC socket
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 0672	pH adapter S

Additionally recommended:

Count	Cat.-No.	Name
1	529 672	pH sensor, BNC
1	667 416	Single-rod redox probe BNC
1	667 4172	pH sensor with plastic shaft, BNC
1	667 4242	pH probe with glass shaft, BNC

pH probes with BNC connection

- Measuring range: 0 ... 14 pH
- Resolution: 0.01 pH
- Suitable for: 524 067 and 524 0672

Cat.-No.	Designation
529 672	pH sensor, BNC
667 4172	pH sensor with plastic shaft, BNC
667 4242	pH probe with glass shaft, BNC

Electrochemistry box M

Mobile power supply for experiments as well as voltage und current measuring device in conjunction with the Mobile-CASSY 2 WiFi (524 005W). For power supply upt to 300mA as well as the intuitive, parallel measurement of the voltage up to ±20 V and the current up to ±2 A.

Technical data:

- 1 Output: 4 mm safety sockets
- Current: 0 to 300mA (30 ranges), power limited to 1.5 W
- 2 Inputs (current and voltage measurement): 4 mm safety sockets, differential
- Current measuring range: up to ±2 A, self-resetting fuse
- Resolution: 0,1 mA
- Voltage measuring range: up to ±20 V, input resistance 1 MΩ
- Resolution: 1 mV
- Connection: Mini-DIN
- Connection cable length: 1.20 m

524 450	Electrochemistry box M	

Pulse sensor S

For measurement of the pulse frequency with the aid of an infrared sensor which is attached to the ear lobe or finger tip, whereby the sensitivity is adjusted automatically. The individual pulse beats are indicated by a LED. The pulse sensor is electrically isolated from CASSY (524 013, 524 006, 524 005W, 524 018).

524 0471	Pulse sensor S

Blood pressure sensor S

For blood pressure measurements using the oscillometric method with Sensor-CASSY 2 (524 013) or Pocket-CASSY (524 006, 524 018) without stethoscope and microphone. The pressure variations which are caused by the pulse waves are transmitted by the arm collar and measured together with the falling pressure in the arm collar. Alternative for use with the Mobile-CASSY 2 WiFi (524 005W) after the auscultatoric method (designed by Korotkov). The characteristic noise phenomena are listened to with a stethoscope (additionally required). The universal biology measuring instrument (531 837) gives an audible sound for the pressure variations.

Technical data:

- Pressure range: 375 mm Hg (500 hPa)

524 0501	Blood pressure sensor S

Spirometer box

For pneumotachographic measurement of various pulmonary volumes, the flow-volume curve and the forced expiratory volume per second with CASSY (524 013, 524 006, 524 005W, 524 018).
Technical data:

- Measuring range: -14.0 ... +14.0 l/s
- Accuracy of measurement: ±2.5%

Scope of delivery:

- 1 Spirometer box
- 1 Adapter
- 30 Bacteria filter
- 30 Mouth pieces

524 056	Spirometer box

Reaction test adapter S

For measuring reaction times, controlled by a hand or foot button, and for determining nerve conductor speed. Signalling accomplished as selected, either via three-colour LEDs (hand key) or acoustic signal (foot button) or software.

524 0461	Reaction test adapter S

Additionally required:

Count	Cat.-No.	Name
1	662 148	Hand-held button
1	662 149	Foot switch

NiCr-Ni adapter S, type K

Enables connection of two NiCr-Ni (type K miniature flat connector) thermocouples for temperature and differential temperature measurements with CASSY (524 013, 524 006, 524 005W, 524 018) or the universal measuring instruments (531 835, 531 836, 531 837).
Technical data:

- Max. measuring ranges (dependent on sensor): -200 ... +200 °C/-200 ... +1200 °C
- Resolution: 0.1 K/1 K
- Differential temperature measuring ranges: -20 ... +20 °C/-200 ... +200 °C
- Resolution: 0.01 K/0.1 K
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 0673	NiCr-Ni adapter S, type K

Additionally recommended:

Count	Cat.-No.	Name
1	529 676	Temperature probe, NiCr-Ni, 1.5 mm, type K
1	666 1261	Temperature probe, NiCr-Ni, fast, type K
1	666 1263	Temperature probe, NiCr-Ni, 3 mm, type K
1	666 1264	Temperature probe, NiCr-Ni, for surface measurement, type K

USB power bank 2200 mAh

Power bank with 2200 mAh suitable for LED lamp (459 094), triple LED lamp (459 098) and laser class 1, red (459 097). The 5V DC USB plug-in power supply unit (459 095) can be used to charge the power bank.

459 099	USB power bank 2200 mAh

Variable transformer 2...24 V/ 5 A

Power supply unit for electrical and simple electronic experiments. Output voltage adjustable in steps; overload protected with circuit breakers. All outputs galvanically isolated from the mains, floating. Particularly suited for student experiments at all age levels thanks to safe separation in accordance with BG/GUV-SI 8040 (conforms to German RiSU).

Technical data:

- Output voltages: 2-24 V AC and DC, in steps of 2 V
- DC voltage: bridge rectification
- Load capacity: 5 A, aggregated
- Connector: two 4 mm connector pairs for AC and DC
- DC and AC part may be used simultaneously, but are not galvanically isolated
- Electrical isolation: Isolating transformer in accordance with DIN EN 61558-2-6, (compliant to german RiSU)
- Input voltage: 230 V, 50/60 Hz
- Dimensions: 203 mm x 225 mm x 117 mm
- Weight: 2.8 kg

521 353	Variable transformer 2...24 V/ 5 A

AC/DC power supply 0...24 V / 5 A

Power supply unit with high load capacity for continiously adjustable DC and AC voltage and digital display. All outputs are overload protected by circuit breakers and are therefore particularly suited for practical experiments. All outputs galvanically isolated from the mains, floating. From a safety standpoint, particularly suited for student experiments at all age levels thanks to safe separation in accordance with BG/GUV-SI 8040 (conforms to german RiSU).

Technical data:

- Output voltages: 0-24 V AC and DC, continiously adjustable
- DC voltage: bridge rectification, smoothed
- Load capacity: 5 A, aggregated
- Display: switchable between AC and DC
- Connector: two 4 mm connector pairs for AC and DC
- DC and AC may be used simultaneously, but are not galvanically isolated
- Electrical isolation: Isolating transformer in accordance with DIN EN 61558-2-6, (compliant to german RiSU)
- Input voltage: 230 V, 50/60 Hz
- Dimensions: 256 mm x 225 mm x 117 mm
- Weight: 6 kg

521 391	AC/DC power supply 0...24 V / 5 A

Variable low-voltage transformer 1...12 V / 6 A

Power supply unit for electrical and simple electronic experiments. Output voltage adjustable in steps; overload protected with circuit breakers. All outputs galvanically isolated from the mains, floating. Particularly suited for student experiments at all ages due to safe separation in accordance with BG/GUV-SI 8040 (conforms to german RiSU).

Technical data:

- Output voltages: 1-12 V AC and DC, in steps of 1 V
- DC voltage: bridge rectification
- Load capacity: 6 A, aggregated
- Connector: two 4 mm connector pairs for AC and DC
- DC and AC part may be used simultaneously, but are not galvanically isolated
- Electrical isolation: Isolating transformer in accordance with DIN EN 61558-2-6, (compliant to german RiSU)
- Input voltage: 230 V, 50/60 Hz
- Dimensions: 203 mm x 225 mm x 117 mm
- Weight: 2.8 kg

521 352	Variable low-voltage transformer 1...12 V / 6 A

AC/DC power supply PRO 0...12 V/3 A

Standard student power supply with continously adjustable and regulated DC output voltage, AC voltage adjustable in steps, and digital display; AC and DC outputs galvanically isolated, reliable overload protection and circuit protection by electronic current limitation (DC) and circuit breaker (AC). All outputs galvanically isolated from the mains, floating. Particularly suited for student experiments at all age levels thanks to safe separation in accordance with BG/GUV-SI 8040 (conforms to german RiSU).

Technical data:

- Output voltages: 0 ... 12 V DC, continiously adjustable, stabilised 2/4/6/12 V AC
- Output current: max. 3A
- Residual ripple DC: < 100 mV
- Notification
- Overload protection: DC electronic, AC with resettable circuit breaker
- Connections: 4 mm safety sockets
- Connection voltage: 230 V, 50/60 Hz
- Electrical isolation: Isolating transformer in accordance with DIN EN 61558-2-6, (compliant to german RiSU)
- Dimensions: 203 mm x 225 mm x 117 mm
- Weight: 3 kg

521 487	AC/DC power supply PRO 0...12 V/3 A

AC/DC power supply 0...12 V/3 A

Simple student power supply with continously adjustable and regulated DC output voltage, AC voltage adjustable in steps; AC and DC outputs galvanically isolated, reliable overload protection and circuit protection by electronic current limitation (DC) and circuit breaker (AC). All outputs galvanically isolated from the mains, floating. Particularly suited for student experiments at all age levels thanks to safe separation in accordance with BG/GUV-SI 8040 (conforms to german RiSU).

Technical data:

- Output voltages: 0...12 V DC, continiously adjustable, stabilised 2/4/6/12 V AC
- Output current: max. 3A
- Residual ripple DC: < 100 mV
- Overload protection: DC electronic, AC with resettable circuit breaker
- Connections: 4 mm safety sockets
- Connection voltage: 230 V, 50/60 Hz
- Electrical isolation: Isolating transformer in accordance with DIN EN 61558-2-6, (compliant to german RiSU)
- Dimensions: 203 mm x 225 mm x 117 mm
- Weight: 3 kg

521 491	AC/DC power supply 0...12 V/3 A

Tray, low

For storage of equipment and materials, especially for student experiment materials. High load capacity and the possibility of free labeling by „supplied" label holder. Stackable with or without lid 647 003. Possibility of multifunctional subdivision by separate fold divider (647 004, 647 005, 647 006).

Technical data:

- Material: styrene-butadiene (SB)
- Dimensions: 450 mm x 270 mm x 108 mm
- Stackable
- High load capacity
- Multifunctional subdivision possibility

647 001	Tray, low

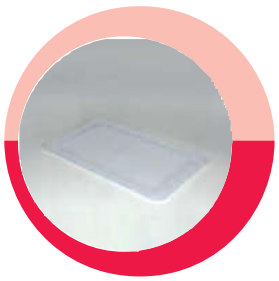
Tray, high

For storage of equipment and materials, especially for student experiment materials. High load capacity and the possibility of free labeling by „supplied" label holder. Stackable with or without lid 647 003. Possibility of multifunctional subdivision by separate fold divider (647 004, 647 005, 647 006).

Technical data:

- Material: styrene-butadiene (SB)
- Dimensions: 450 mm x 270 mm x 162 mm
- Stackable
- High load capacity
- Multifunctional subdivision possibility

647 002	Tray, high



Lid for tray

To cover the trays 647 001and 647 002. Stackability of the trays remains even with lid.

Technical data:

- Material: Polypropylene (PP)
- Dimensions (outside): 455 mm x 275 mm x 18 mm

647 003	Lid for tray

Label holder, set of 8 pieces

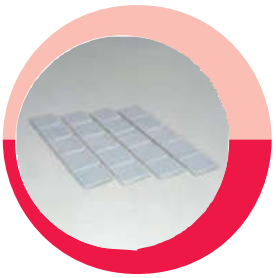
For holding the labels of the trays 647001 (low) and 647002 (high). Suitable for the labeling of 4 complete trays.

Technical data:

- Dimensions: 210 mm x 77 mm
- Quantity: 8 pieces

647 007	Label holder, set of 8 pieces

Fold devider, long, set of 4 pieces



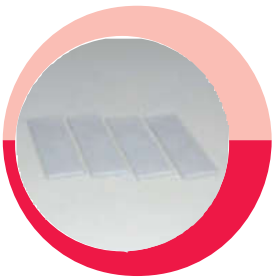
For subdivision of the trays 647 001 and 647 002. Each tray can be divided into 2 sections longitudinally with one fold divider.

Technical data:

- Material: styrene-butadiene (SB)
- Dimensions: 401 mm x 70 mm
- Quantity: 4 pieces

647 004	Fold devider, long, set of 4 pieces

Fold devider, medium, set of 4 pieces



For subdivision of the trays 647 001 and 647 002. Each tray can be divided up to 5 sections transversely with the fold dividers.

Technical data:

- Material: styrene-butadiene (SB)
- Dimensions: 246 mm x 70 mm
- Quantity: 4 pieces

647 005	Fold devider, medium, set of 4 pieces

Fold devider, short, set of 4 pieces

For subdivision of the trays 647 001 and 647 002. In combination with the fold divider, long (647 004), each tray can be divided up to 10 sections longitudinally and transverseley with the fold dividers.

Technical data:

- Material: styrene-butadiene (SB)
- Dimensions: 120 mm x 70 mm
- Quantity: 4 pieces

647 006	Fold devider, short, set of 4 pieces

Additionally required:

Count	Cat.-No.	Name
1	647 004	Fold devider, long, set of 4 pieces

Student experiments

for school and university

NATURAL SCIENCES

FUNDAMENTAL

LP1.1.3.2 Hydrostatic pressure

LC1.1.1.2C Boiling point

LB3.2.2.8C Diurnal variation measurements

PHYSICS

CHEMISTRY

BIOLOGY

PROFESSIONAL

LP5.3.2.2 Complementary crossed gratings (Babinet's principle)

LC2.1.2.1 Detection of hydrogen and carbon

LB3.2.2.3C ph value of soil samples

PROFESSIONAL

For further questions or an offer please contact us:

SALES@LD-DIDACTIC.DE

NATURAL SCIENCES FUNDAMENTAL

LP6.2.7.1C The influence of a magnet on beta radiation

PHYSICS CHEMISTRY BIOLOGY ENGINEERING

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