

# PHYWWE



PHYSICS CHEMISTRY BIOLOGY

# Engaging experiments

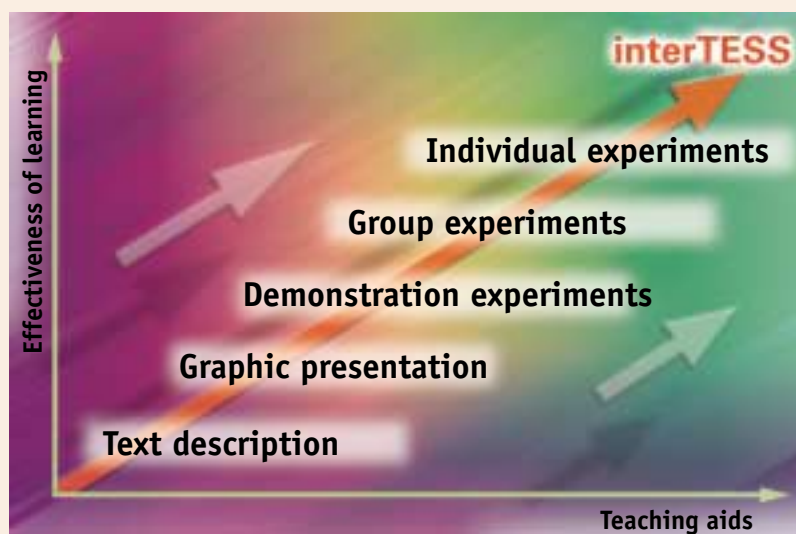
Education is the most valuable key resource of the future worldwide. “Anyone who doesn’t know anything must believe everything” – this line by Marie von Ebner-Eschenbach (Austrian author, 1830 – 1916) has been true since then, is true today and will be true tomorrow.

Natural science education forms the basis, gives students the basic tools for analyses, investigations and experiments. Indispensable skills for technological progress and economic success of a country. Many new technologies such as semiconductor technology or renewable energies are based on natural science relationships. Reason enough for emphasising and encouraging experiments in natural science topics.

PHYWE has been supplying equipment, experiments and literature for natural science education for more than 90 years. Our experience and expertise makes us a reliable partner. Our tradition of high-quality workmanship, the realisation of necessary quality standards and a large number of innovations and inventions have established the PHYWE brand name worldwide and it has become a byword in the international market for natural science teaching equipment.

Our core skills lie in the development, production and sale of equipment, systems, experiments and literature for natural science education at schools and universities. Our range of products and services include in detail:

- Worldwide advice on fitting out specialist rooms for physics, chemistry, biology and engineering
- Equipment optimally focussed on your needs
- Complete teaching systems for student and teacher experiments
- Complete equipping of school and university natural sciences departments
- Didactically prepared experiments – safe to setup and perform
- Topic-related experiment literature / multimedia software
- Individual training courses on our products and systems
- Project support and realisation
- After sales support



**PHYWE – Engaging experiments.  
This statement is more than just an  
advertising slogan.**

Performing experiments and drawing own conclusions are verifiably the most effective way to learn. The greater the active participation, the more concentrated the completion of the tasks, contents are retained better and longer and learning success is all the more effective. Performing experiments with Phywe equipment, literature and multimedia software inspires schoolchildren and students.

**Engaging experiments is so much more ...  
see for yourself on the following pages!**

Phywe is your competent partner in the complete cycle of product development, production, customer support and after sales service for scientific teaching tools.

### Classroom planned and equipped according to your wishes:



### A typical equipment could consist of e.g.:

- ❶ Interactive Boards**  
Combine the advantages of Computer Assisted Learning with PHYWE’s excellent didactic experimental equipment
- ❷ Demonstration experiments**  
Transparent and open design shows the experiment and effects, aiding in the learning experience
- ❸ Computer-assisted Experiments**  
The Cobra3 Interface system in combination with measurement software “measure” allow easy, fast and reliable experimental results with modern components
- ❹ Students experiments**  
Modular design of components allows easy integration and cost savings
- ❺ Equipment storage**  
System components are perfectly matched:  
Storage + Equipment + Experimental Literature
- ❻ Power supplies**  
Made in Germany sturdiness, precision and reliability, satisfy the highest demands for quality



Your Project is our Project: Whether you Teach, or represent a School, a City, a District, a Province, State or Country... We have made it our business to develop, improve and support your scientific teaching needs

### Laboratory for Advanced Studies



### A typical equipment could consist of e.g.:

- ❶ Magnetic demonstration board**  
Clear vertical set-up, flexible positioning, easy assembly and minimum preparation time.
- ❷ Equipment storage**  
Rapid completeness control and easy to transport. All Phywe equipment can also be stored in cupboards.
- ❸ X-Ray Experiments**  
Full protected equipment for safe use at schools with three different X-Ray tubes.
- ❹ Ultrasonic experiments**  
Detailed instructions are available for every experiment.



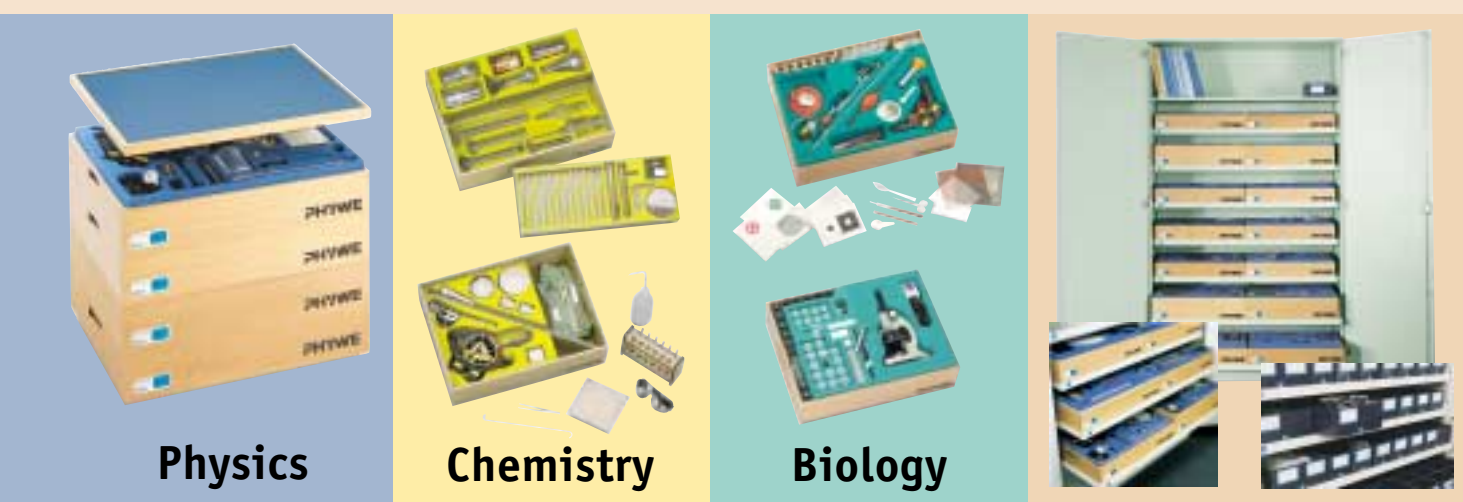
Worlddidac Quality Charter certified company

### TESS – The advantages of Experimental System for Students:

1. **simple to operate**; safe and quick set-up for the students
2. **robust and safe**
3. **ideal for use with detailed experimental descriptions**=> **Student work sheet** with precise statement of problem, set-up instruction, prepared record tables, questions and drawing aid for evaluation. **Teacher's sheet** with theoretical fundamentals, examples of measuring results and diagrams
4. for all topics in the field of Physics, Chemistry and Biology
5. extendable with **interTESS Software**: the students need less support from teachers

## The System components

**Storage in wooden boxes – stable, clearly arranged, stackable!**

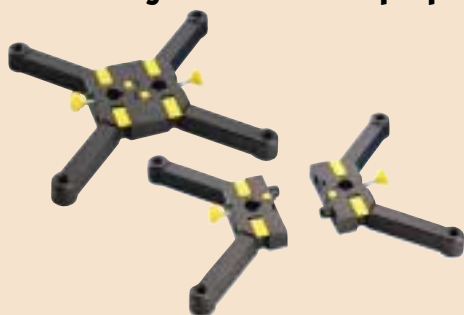


**Physics**

**Chemistry**

**Biology**

**Perfectly matched equipment – tested, robust, safe!**



**The support base**

Multifunctional, robust, for all student's experiments



**The power supply**

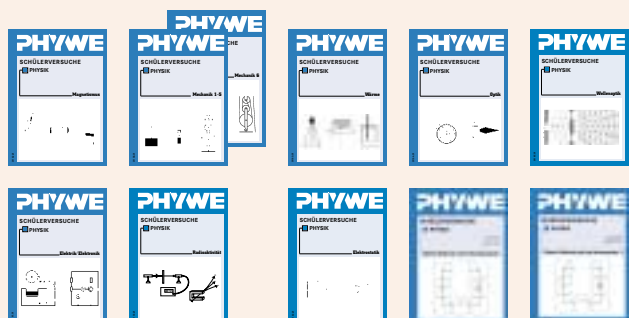
Regulated power supply – extensively electronically protected



**The optical lamp**

Multifunctional - as light box, colour mixing lamp or lamp with stem

**Experimental descriptions – detailed, reliable, student's and teacher's sheets!**



Mechanics, Thermodynamics, Optics, Electricity/Electronics, Radioactivity



Organic and Inorganic Chemistry



Biology, Microscopy

Chemistry of Polymers,  
Food Chemistry

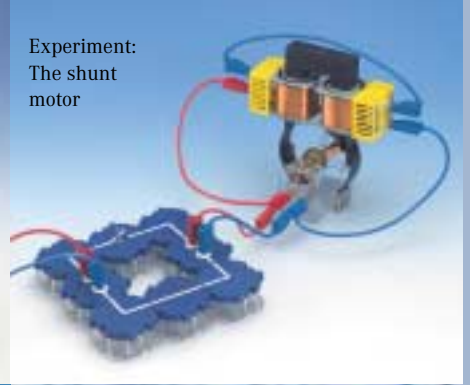
**Physics**



Experiment: Fixed pulley



Experiment: Specific heat capacity of solid bodies



Experiment: The shunt motor



Experiment: Polarisation by reflection (Brewster law)



Experiment: The Dutch telescope

**Chemistry**



Experiment: Melting or boiling point determination



Experiment: Model of a fire extinguisher



Experiment: Production of polystyrene foam

**Biology**



Experiment: Vascular bundles



Experiment: Production of curd



Experiment: Tarry substances in tobacco smoke



### TESS Physics

**Mechanics** (65 Experiments)

**Optics** (70 Experiments)

**Wave Optics** (29 Experiments)



**Heat** (34 Experiments)

**Electricity/Electronics  
EEP** (69 Experiments)



**Electric/Electronic  
Building Block System** (74 Experiments)

**Radioactivity** (16 Experiments)



**Electrostatics** (16 Experiments)

**Magnetism** (11 Experiments)

### TESS Chemistry

General Chemistry (97 Experiments)

Inorganic/  
Organic Chemistry (58 Experiments)

Chemistry of Polymers (36 Experiments)

Food Chemistry (52 Experiments)

### TESS Biology

General Biology (92 Experiments)

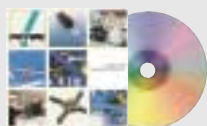
Microscopy (6 Work plans)



Phywe goes e-learning! Have better lectures with computer software interTESS now!

**You have the following advantages with interTESS:**

1. All the experiments can be copied and arranged from the software for example in Word => **build own worksheet**
2. The students will be guided step by step => **safer, easier, effective! Less preparing time for the teacher! More time for the student!**
3. The results can be stored directly in the software => **easier evaluation by the teacher!**
4. **The teacher function** can be accessed after the input of password. **Sample answer** are supplied for all and **typical measurement results!**



InterTESS Software CD-ROM:

Art. No. 01000.00

Demo-CD-ROM:

Art. No. 01000.10

Internet: [www.phywe.com/intertess](http://www.phywe.com/intertess)

# Demonstration Experiments with Natural Sciences on the Board

## PHYSICS – CHEMISTRY - BIOTECHNOLOGY

### Two board systems - One common idea!

One side of the Physics Board for:

Mechanics  
Heat

Electricity/Electronics  
Radioactivity

The other side for:

Optics

The Raster Board for:

Chemistry  
Biotechnology



### The Demonstration board can be combined optimal with the Mobile Experiment Stand!

1. All materials stored in the shelf of the Mobile Experiment Stand.
2. Clear vertical set-up on the board.
3. Easy assembly with the help of magnetic components.
4. The Mobile Experiment Stand can be pushed completely into the classroom.



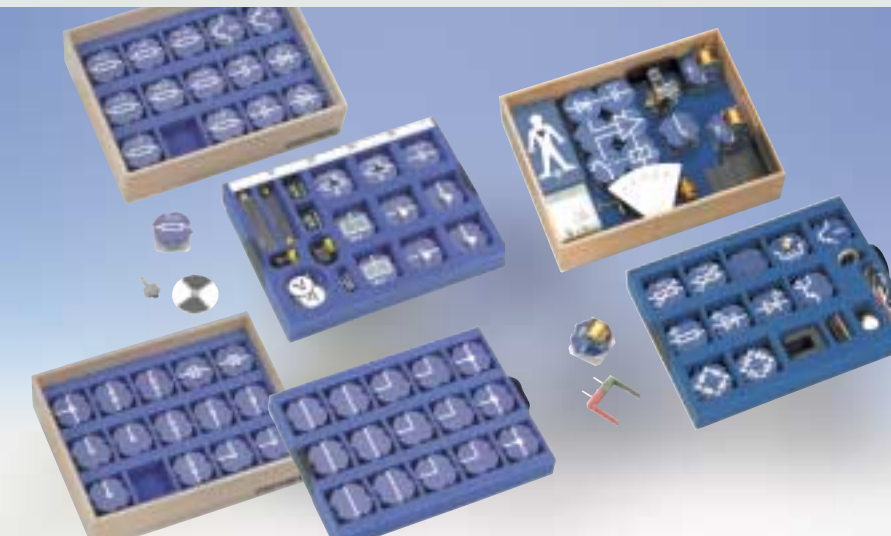
### Demonstration Board Physics

Mechanics

(49 Experiments)

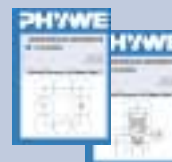


Demonstration Experiments on the Magnet Board, Mechanics 1 01152.02  
Demonstration Experiments on the Magnet Board, Mechanics 2 01153.02



Electric/Electronic  
Building Block System

(96 Experiments)



Demonstration Experiments on the Magnet Board, Electricity/Electronics with the Building Block System, Set 1 01001.02  
Demonstration Experiments on the Magnet Board, Electricity/Electronics with the Building Block System, Set 2 01003.02

### Optics (60 Experiments)



Demonstration Experiments on the Magnet Board, Optics 01151.02



### Thermodynamics (15 Experiments)



Demonstration Experiments on the Magnet Board, Heat 01154.02



### Radioactivity (19 Experiments)



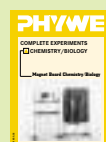
Demonstration Experiments on the Magnet Board, Radioactivity 01156.02



### Complete Experiments Chemistry/Biotechnology

#### Chemistry (24 Experiments)

#### Biotechnology (5 Experiments)



Complete Experiments Chemistry/Biotechnology 01855.02



# Cobra3: The System

From the Cobra3 Units to the measuring modules and sensors, “measure” measurement software and the experiment literature, all elements of the Cobra3 system are optimally matched with each other, from A–Z.

All system components can be very easily and precisely put together, just as you like!

## 4 Cobra3 Units



## Measuring modules



## Measuring sensors



## Over 200 experiment descriptions



## Accessories



## “measure” measuring software

Over 200 FREE experiments with preset measuring parameters, measuring curves and detailed descriptions



## Demonstration Displays



### Phywe Advantage:

- no oscilloscope necessary
- 500 kHz sampling rate for one analog input

### Phywe Advantage:

- 4 MHz time resolution for digital inputs
- limited 5 V voltage output for light barrier (indestructible)

# Cobra3: Computer-Assisted Experiments

More than 200 experimental descriptions are available as a handbook or on the CD-ROM for all topics in the field of Physics, Chemistry and Biology!

## Physics

1 Mechanics	(36 Experiments)
2 Acoustics	(20 Experiments)
3 Thermodynamics	(20 Experiments)
4 Electricity	(50 Experiments)
5 Optics	(5 Experiments)
6 Structure of Matter	(23 Experiments)

Physics Set (BASIC-UNIT): 12171.77



## Chemistry

1 Food chemistry	(26 Experiments)
2 Electro chemistry	(21 Experiments)
3 Calorimetry	(6 Experiments)
4 Chemical Kinetics	(7 Experiments)
5 Chem. Equilibrium	(9 Experiments)
6 Gas Laws	(12 Experiments)
7 Biochemistry	(22 Experiments)

Chemistry Set (BASIC-UNIT): 12172.77

Chemistry Set (CHEM-UNIT): 12174.77



## Biology

1 Human physiology	(24 Experiments)
2 Nervous systems	(10 Experiments)
3 Plant physiology	(12 Experiments)
4 Ecology and Environment	(27 Experiments)

Biology Set (BASIC-UNIT): 12173.77



## Measuring Software "measure"



The experimental descriptions are also installed on the CD-ROM measure. Just select the experiment you want and the measuring parameters, measuring diagrams and descriptions are loaded automatically.

No. 14500.00

## Handbook



Computer-assisted experiments with Cobra 3 – Physics

No. 01310.02

## Handbook



Computer-assisted experiments with Cobra 3 – Chemistry/Biology

No. 01320.02



The experiments presented in the LEP are intended for the heads of physics laboratory courses at universities, colleges of advanced technology, technical colleges and similar institutions and also for advanced courses in high schools.



## 1 Mechanics

Measurement Techniques	(1 Experiment)
Statics	(3 Experiments)
Linear Motion	(7 Experiments)
Rotational Motion	(8 Experiments)
Mechanical Oscillation	(11 Experiments)
Mechanics of Liquids and Gases	(8 Experiments)
Acoustics and Ultrasound	(23 Experiments)

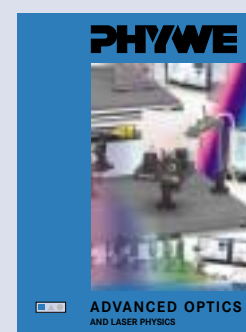


## 2 Optics

Geometrical Optics	(3 Experiments)
Interference	(7 Experiments)
Diffraction	(6 Experiments)
Photometry	(3 Experiments)
Polarisation	(4 Experiments)
Applied Optics	(11 Experiments)



## Advanced Optics



You can find more Advanced Optics in this brochure

Order No. 00117.02

**3 Thermodynamics**

Thermal expansion	(1 Experiment)
Ideal and Real gases	(7 Experiments)
Calorimetry	(2 Experiments)
Phase Transition	(4 Experiments)
Transport and Diffusion	(2 Experiments)
Applied Thermodynamics	(4 Experiments)



**4 Electricity**

Stationary Currents	(13 Experiments)
Electric Field	(8 Experiments)
Magnetic Field	(7 Experiments)
Electrodynamics	(12 Experiments)
Electromagnetic Oscillations	(6 Experiments)

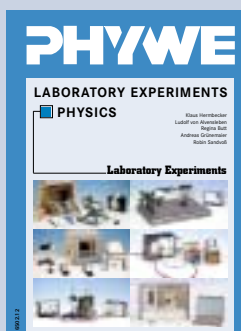


**5 Structure of matter**

Physics of electron	(13 Experiments)
Radioactivity	(16 Experiments)
Solid State Physics	(4 Experiments)
X-Ray Physics	(27 Experiments)



**Experimental Literature**



Laboratory Experiments  
Physics

Print Version  
No. 16502.32  
CD-ROM  
No. 16502.42





**1 Kinetic Theory** (13 Experiments)

**2 Calorimetry** (18 Experiments)



**3 Chemical Equilibrium** (17 Experiments)

**4 Interfacial Chemistry** (8 Experiments)



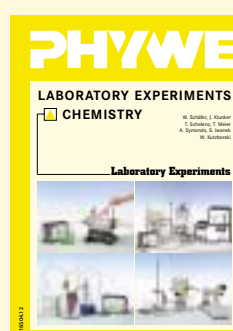
**5 Chemical Kinetics** (10 Experiments)

**6 Electro Chemistry** (20 Experiments)

**7 Photometry and Photochemistry** (4 Experiments)



## Experimental Literature



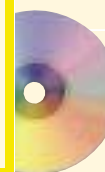
Laboratory Experiments  
Chemistry

Print Version

No. 16504.12

CD-ROM

No. 16502.42



1 Nervous System (6 Experiments)

2 Heart and Circulatory System (4 Experiments)

3 Musculature (2 Experiments)

4 Auditory Sense (3 Experiments)



5 Gravitational Sense (2 Experiments)

6 Temperature Sense (3 Experiments)

7 Visual Sense (6 Experiments)

8 Behaviour (3 Experiments)

9 Respiration (2 Experiments)



10 Ecology and Environment (8 Experiments)

11 Plant Physiology (5 Experiments)

12 Biochemistry (6 Experiments)



## Experimental Literature



Laboratory Experiments  
Biology

Print Version

No. 16506.02

CD-ROM

No. 16502.42



**X-Ray Unit, 35 kV****09058.99**

Microprocessor controlled fully protected device, includes

- Plug and play exchangeable X-Ray tubes (tubes with an iron, molybdenum and copper anode are deliverable)
- Integrated rate meter with fixed counter tube voltage for the direct determination of counting rates
- Built-in loudspeaker for acoustic verification of counter tube impulses
- Two demonstration displays for selected display of all operating and measured values
- Working channel
- Built-in internal lighting and integrated storage box
- Fluorescence screen and PC connection socket (RS232)

**The following topics can be treated:**

Radiography and X-Ray photography; Bremsspectra/characteristic X-Ray peaks of different anode materials; Ionisation currents and ion dose rate; Moseley's law; Laue and Debye Scherrer pictures; Determination of Planck's and Rydberg's constant; X-Ray spectroscopy; Duane-Hunt's displacement law; Bragg diffraction; absorption coefficients as a function of thickness, material and X-Ray energy, absorption edges; Model contrast fluid experiment; Compton scattering; Separation of  $Ka_1$  and  $Ka_2$  lines in higher order diffraction

**CO<sub>2</sub> Laser****P2260400****Complete System – didactical set up – detailed description**

The experimental equipment set is an open CO<sub>2</sub> didactic laser system. All components of the system can be handled individually and the influence of each procedure on the output power can be studied. The dependency on the electrical, mechanical and optical parameters can be analysed. One target in learning is the alignment of the CO<sub>2</sub> laser, particularly with help of a He-Ne laser.

**The following topics can be treated:**

- Alignment of the CO<sub>2</sub> laser and optimisation of its power output
- Check of the influence of the Brewster window position on the power output
- Investigation of the optical resonator stability
- Determination of the output power as function of the input power, amounts of different laser gases and gas flow
- Investigation of the conversion efficiency

**Cardanic gyroscope****02550.00****A precision mechanical masterpiece!**

Universal gyroscope for demonstration and quantitative investigation of the laws of gyroscopes and their applications.

- Gyro disk with reinforced edge (diameter 128 mm) set in a cardanic suspension with ball bearings
- Momentum of inertia can be varied in a wide range with help of screw-on disks and supplementary weights
- Application as a "chaotic pendulum"
- Different fixing of the gyroscope due to springs or clamping of the cardanic ring
- Angular velocity, moment of inertia, radius of gyration, ellipsoid of inertia, principal axis of inertia and principal moment of inertia, angular momentum
- Extensive experimental literature: Symmetric and asymmetric gyroscopes; Gyroscope free of forces or submitted to an angular momentum; Free or constraint gyroscope; Precession, nutation, quiet running, inertial momenta, degrees of freedom
- Function and particular technical characteristics of technical devices such as: directional gyro to keep orientation; artificial horizon, curve flight mistakes
- Gyroscope physics: Angular momentum, inertial radius, inertial ellipsoid, main inertial axes and momenta, torque

## Stern-Gerlach Experiment

P2511101

The historical Stern-Gerlach experiment to verify the electron spin was carried out with silver atoms, which have a  $2S_{1/2}$  ground state. This assures that the total angular momentum and the related magnetic moment are exclusively determined through the spin. If a beam of such atoms crosses an inhomogeneous magnetic field, it is split into two partial beams, due to the permitted spin states. This allows to determine the absolute value and the direction of the magnetic moment of the atoms. In the PHYWE Experiment, potassium is evaporated instead of silver as in the classical experiment. The compact and easy to use experimental set-up consists of the Stern-Gerlach apparatus a mobile high vacuum pump assembly and of further electric supply and measurement units required for the experiment.



## Large Diffusion Cloud Chamber

09043.93

### Make the natural radiation visible!

PHYWE has been developing and building for more than twenty years now large diffusion cloud chambers with an active observation area of up to  $800 \times 800$  mm. The refrigeration unit works fully automated and at very low operating costs. Thousands of visitors in science centers technology museums and power plants experience every day the fascinating drama of natural radiation in this unique cloud chamber.

In this cloud chamber all types of charged particles can be made visible:

- $\alpha$ -particles
- myons
- positrons
- positrons
- electrons
- mesons

A lock allows the introduction of artificial radioactive sources and radioactive gases, so that many interesting experiments can be performed. This makes the cloud chamber not only the center of interest for many visitors, but also an instrument for use in physics courses.



## Glass jacket system

02615.00

This system consists of a glass jacket plus special inserts and accessories. It was mainly developed for experiments with gases and can be used at school for teaching physics, chemistry and biology.

### The system is distinguished by the following advantages:

demonstrative and transparent – versatile and easy to assemble – clear and didactic – ideal for work with gases – handbook with detailed experiment descriptions – uncomplicated fast experimenting – accurate results – compact dimensions, easy to transport – can be stored completely assembled – components can be stored clearly set out in a special foam mat.

### The glass jacket system can be applied in the following fields:

- laws of gases
- gas reactions
- determination of molar masses
- calorimetry
- gas chromatography
- water vapor distillation



## Phywe Experiments descriptions – comprehensible, detailed, safe and for all topics in the fields of Physics, Chemistry and Biology!

More than 5.000 experiments descriptions are available for all topics in the field of Physics, Chemistry and Biology! There is a large choice of Experiment descriptions for Students, for teachers, for courses in colleges, universities and advanced courses in high schools. All experiments work optimal with Phywe equipment. Thus, the set-up and procedure of Phywe experiments is easy, quick, safe and reliable.



### Experimental literature Physics:

More than 80 Handbooks in the fields of: Mechanics, Acoustics, Thermodynamics, Electricity/Electronics, Optics, Physical Structure of Matter, Computer-assisted Experiments etc.

### Experimental literature Chemistry:

More than 20 Handbooks in the fields of: Organic/Inorganic, Physical Chemistry, Industrial Chemistry, Food Chemistry, Chromatography and Electrophoresis, Preparative Chemistry, Photometry and Spectroscopy etc.

### Experimental literature Biology:

More than 30 Handbooks in the fields of: Ecology and Environment, Senses, Nerves and Behaviour, Respiration and Circulation, Food Chemistry, Biochemistry and Biotechnology, Human Physiology, Plant Physiology etc.

#### Experimental objective

The first section gives a short description of the meaning, the purpose and the teaching objectives of the experiment.

#### Circuit diagram

The diagrams help to understand the laying of the cables and the signal paths in electrical or electronic experiment set-ups.

#### TIP:

For our Cobra3 interface experiments, we have preset software parameters for more than 200 preinstalled experiments. By selecting an experiment from the measuring software "measure", the parameter settings are automatically installed!

**Measuring made easy!**

#### Experimental procedure

The experimental procedure and evaluation is explained step by step.

#### Measuring results

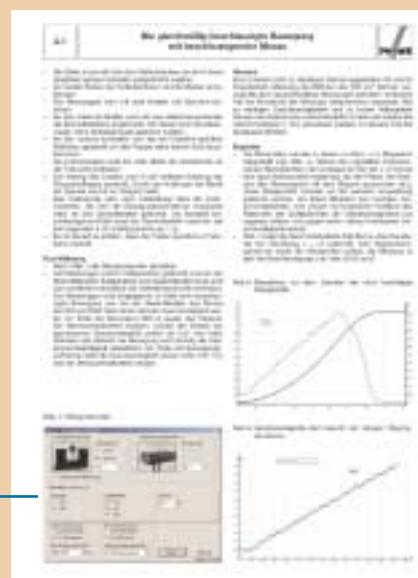
Facts and formulas about the experiment and the results facilitate a successful realisation of the experiment

#### Material list

The complete list of required equipment for the experiment

#### Photo of experiment

A photo of the experimental set-up facilitate the installation and arrangement of the equipment



### Special Product Flyers



#### PHYSICS – CHEMISTRY – BIOLOGY

The comprehensive catalogue for physics, chemistry and biology. Additionally you can find a large number of laboratory materials and an insight in our particularly successful teaching systems TESS, Cobra3 and Natural Sciences on the board. Available in English and Spanish.

Art. No: 00009.22



**interTESS – Phywe goes e-learning!** Combine the advantages of Computer Assisted Learning (CAL) with Phywe's excellent didactic experimental equipment to increase the Effectiveness of Learning!

Art. No. 00186.02



#### Large Diffusion Cloud Chamber

Art. No. 00192.02



#### PHYCON – The Starters' and Students' USB-Interface for Physics, Chemistry and Biology

Art. No. 00189.02



#### X-ray Unit, Microprocessor-controlled, 35 kV

Art. No. 00170.02



#### Demo-CD-ROM Software interTESS

Art. No. 01000.10



#### Demo-CD-ROM Measurement Softw. measure

Art. No. 14500.00



#### DVD Phywe Image film

Art. No. 00082.30

### Laboratory Experiments Physics, Chemistry, Biology

The experiments in the Phywe publication series "Laboratory Experiments" are intended for the heads of laboratories, colleges of advanced technology, technical colleges and similar institutions and also for advanced courses in high schools. Available in English.



Art. No: 00117.02



Art. No: 16505.32



Art. No: 16504.22



Art. No: 16507.02



Laboratory Experiments Physics, Chemistry and Biology is also available on CD-ROM.

Art. No: 16502.42

### Special brochures

Additionally there are special brochures for our particularly successful teaching systems:



Art. No: 00115.62



Art. No: 00116.02



Art. No: 00200.02

1. TESS – Training and Experimental Systems for Students (available in German, English, French and Spanish),
2. Demonstration Experiments with Natural Sciences on the board (available in German, English).
3. Cobra3 Interface-System (available in German, English)





**Do you want more detailed information?**

**Just fold out the page, fill in the form and  
mail or fax it!**

**Of course you can also order or download  
our brochures via internet!**

**[www.phywe.com](http://www.phywe.com)**

# PHYWE



[www.phywe.com](http://www.phywe.com)

Art. No. 00082.02

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