

# P100 MSL Physics

## Mobile Science Laboratory



A fully featured **Mobile Sciences Laboratory (MSL)** for the discipline of **Physics** to be operated by the teacher. It's designed for the demonstrations, experiments and laboratory work in the secondary level Physics curriculum topics. The complex includes laboratory equipment, instruments, digital instrumentation, interactive learning resources, multimedia and test materials, interrelated and complementary to each other for the experiments and observations on the program.

The P100 complex consists of:

- 1) The Universal Mobile cart base
- 2) The experimental kits for the teacher and
- 3) The Didactic application PCB103

The P100 is supplied with special didactic software application that allows training in the disciplines of Physics in the respective training programs by **using modern technology, interactive teaching tools and STEM methodology.**

The **PCB103 application** is based in Hypertext HTML form and includes at minimum the methods and facilities covered in the specifications of PCB103 Index, listed further in this document. The Physics Modules of the P100 mobile laboratory are driven by PCB103 application which is divided into topics, each topic is divided into sections and each section to subsection. In each subsection you can find the **Presentations**, the relevant **Multimedia or Video** support content and the **Simulations**. Furthermore, lab work is divided to the **Demonstrations** for the teacher and the **Activities** for the students. This distinction is due to the different materials used in the experiments. Different kits for Teacher (**PT** series) and Student (**PS** series) are provided. The cart can incorporate the teacher set and up to 4 student sets of kits. Ideally, 3 students can work per each set.

Inside the PCB103 application you can find different support modules as:

The **Inventory** which contains all the materials from the specific kits that are used in each lesson divided.

The **Glossary** which contains an alphabetical keyboard and by pressing each letter you can find words-meanings and terminology.

The **Application** which has two subunits: the **Simulators** (you can find simulations of specific experiments using the exact P100 equipment or generic lab simulations related to the sub topic) and the **Multimedia** presentations (showing a relevant phenomenon in some topics).

The **Science Support** module which is also divided in two subunits: the **Curriculum** (an index and search utility to find all the demonstrations and the activities numbered with links that take you to the experiment and is also mentioned the section or subsection to which it belongs) and the electronic **Manuals**, including Safety guides, Operational Videos etc. and all the sub applications needed by the teacher (i.e. Data Acquisition application, Classroom management applications, Student response application).

The provided kits and the facilities of the Mobile Science Cart offer all the equipment and support to implement the pedagogical processes in the subject of Physics. Analytically, the Physics topics, sections and subsections supported by the MSL kits and the PCB103 application are presented below.

### PCB103 INDEX

#### Mechanics

Dynamics - Kinetics

#### Energy

Work - Energy - Waves - Radiation

#### Matter & Thermo

Measurements - State of Matter - Thermodynamics

#### Electromagnetism

Static - Dynamic - Magnetism - Electromagnetism

#### Optics

Properties of Light - Light phenomena

## PHYSICS MSL KITS \*

<b>PT2010</b> Teacher Physics support kit	1
<b>PT2011</b> Mechanics	1
<b>PT2012</b> Matter and Thermo	1
<b>PT2013</b> Electromagnetism	1
<b>PT2014</b> Optics	1
<b>PCB1001</b> Support kit	1
<b>PS2021</b> Student Mechanics	1
<b>PS2030</b> General kit	1
<b>PS2031</b> Student Electromagnetism	1
<b>PS2041</b> Student Optics	1

\* Note: Quantity of sets per MSL cart

The **Didactic Application** also comes with **new add-on modules** such as:

**1. Classroom management system.**

**2. Student response system** which supports Android Pad and Smartphone user interface.

**3. Classroom Performance** Evaluation and Statistics.

**4. Teacher add-on content Link Interface.**

**5. Voice file add-on Annotation** utility.

## P100 for Physics

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All experiments are conducted either with the conventional measuring devices or with the use of data acquisition system which includes a variety of sensors and state of the art data loggers. There is a variety of sensors provided with the MSL kits in order for the students to enter in the Digital Laboratory Technology. Force, pressure, temperature electromagnetic field, voltage, acceleration, current, light, sound Photo gates are some of the sensors provided to the students to contact their experiments. More than 140 teacher and student activities are provided by the system.

Every subsection of the **PCB103** application covers a variety of subjects with the accompanied with relevant experiments, some to be conducted by the Teacher (demonstrations) and others by the Student (activities) as well as theoretical presentations for each concerned subject. All the required equipment for the experiments are granted by the Physics MSL kits.

Analytically:

◆The **Force** subsection covers: Demonstrations: Inertia, Newton's Third Law, Composition of forces (Non-Collinear forces), Equilibrium of a rigid body, Zero Gravity. Activities: Composition of Collinear forces, Composition of non-concurrent forces, Measuring interaction, Forces between two bodies, Determining center of gravity of flat object.

◆The **Friction** subsection covers: Demonstrations: Properties of friction 1 & 2 Activities: Relationship between kinetic friction and contact surface area and normal force

◆The **Elasticity** subsection covers: Demonstrations: Measuring force based on compression and stretching of the spring.

◆The **Balance and Moment** subsection covers: Demonstrations: Comparing masses using equal arm balance, Levers and Simple Machines, Pulleys and Simple Machines. Activities: Static Equilibrium Force and Moment.

◆The **Kinetics** subsection covers: Demonstrations: Uniform Motion in a straight-line, Dependence of trajectory on the frame of reference, Free Fall, Uniformly accelerated motion in a straight-line, Uniform circular motion. Activities: Measuring speed of uniform motion, Measure free fall acceleration, Measure centripetal acceleration.

◆The **Newton's Second Law** subsection covers: Demonstrations: Comparing masses of two interacting bodies based on their acceleration. Activities: Collision of bodies.

◆The **Oscillations** subsection covers: Demonstrations: Oscillation. Activities: The study of pendulum swing.

◆The **Work and Energy** subsection covers: Demonstrations: Mechanical oscillation. Activities: Relationship between kinetic energy and stopping distance, Measuring potential energy of a body, Efficiency of energy conversion on an inclined plane, Conversion of mechanical energy.

◆The **Sound** subsection covers: Demonstrations: Experiment conducted with a buzzer placed under enclosed glass seal.

◆The **Measurements** subsection covers: Demonstrations: How thermometer works. Activities: Measuring a mass of a body, Measuring density of solids, Measuring density of liquids,

Measuring air humidity.

◆The **States of Matter** subsection covers: Demonstrations: Demonstration samples of different crystals, Heating and air pressure, Barometer, Communicating vessels, Pascal ball, Hydraulic press, Archimedes Principle, - Separation of common plastics based on density, Diffusion in solutions, gases and water, Adhesion, Jet Propulsion of a Rocket, Brownian motion model Activities: Measuring atmospheric pressure, Measuring the buoyant force (Archimedes principle), Experiments showing forces effecting molecular attraction, Relationship between gas volume and pressure at constant temperature.

◆The **Thermodynamics** subsection covers: Demonstrations: Thermal Expansion of a solid body, Heat conductivity of various materials, Convection in liquids and gases, Thermal Radiation, Evaporation, Constant boiling temperature of a liquid at constant pressure, Less the pressure less the boiling temperature, Appearance of water on the outside of a ice-filled glass.

Activities: The study of heat exchange by mixing cold and hot water, Changing an internal energy by heating or by doing work it, Measuring specific heat capacity of substances, Specific heat capacity of melted ice, the study of evaporation process

◆The **Static Electricity** subsection covers: Demonstrations: Build-up of static charge, Two types of electric charge, How electroscope works and its design, Conservation of electric charges, Conductors and insulators, Electrostatic induction Activities: Trivoelectric principles, Observing collisions generating static electricity, Measuring electric charge, Conductors and

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dielectrics in the electric field.

◆The **Electrodynamics** subsection covers:

Demonstrations: Conductors and insulators, Capacitor Design, Capacitor Electric Field, DC Power Supplies, Measuring electric current with ammeter, Measuring electric current with voltmeter, Rheostat & resistance decade box (RHEOSTAT), Rheostat and resistance decade box (RESISTOR), The properties of semiconductors.

Activities: Making and testing DC circuits, Making and testing a simple galvanic cell, Measuring voltage, Relationship between current and voltage, Relationship between electrical resistance of the conductor and its length, cross-section and material, Measuring electrical resistance, Parallel circuits, Serial circuits, Measuring electric power, Semiconductor diode operation.

◆The **Magnetism** subsection covers:

Demonstrations: Magnetization of materials

Activities: The study of magnetic interactions

◆The **Electromagnetism** subsection covers:

Demonstrations: Oersted Experiment, Magnetic field caused by current flow Effect of magnetic field on current conductor, Design of electric motor, Electromagnetic Induction, Lenz's Law, DC Generator design, Alternator design, Design of transformer, Electromagnetic radiation (waves), How microphone and speaker works, How radio communication works. Activities: Electric current and its effect on magnetized pointer, Magnetic field and its effect on current, How electric motor works, the study of electromagnetic induction, Generating alternating current by coil rotation in a magnetic field -The study of electromagnetic spectrum using mobile phone.

◆The **Light Properties** subsection covers:

Demonstrations: Propagation of light in a straight line, Rotating colored disk (Visual perception). Activities: Propagation of light.

◆The **Optical phenomena** subsection covers:

Demonstrations: Reflection of light, Refraction of light, Ray tracing (converging lenses), Ray tracing (diverging lenses), Producing images using lenses,

Optical Instruments, Dispersion of white light, Using converging lens to produce white light.

Activities: Relationship between angle of incidence and angle of reflection, Characteristic properties of an image formed by a plane mirror, Measuring focal length of converging lens, Producing images using converging lens, Dispersion of light, Spectrum and its radiation.

The P100 interconnects the Teacher with the Students in a uniform platform.

**Theory** presentations with interfaces to any Student **Response system or Interactive board**, Teacher **Demonstrations**, **Lab Simulations**, **Virtual measurement simulations**, **Data acquisition** applications, **Multimedia** presentations, Student **experiments**, Student **activities** and student **quizzes and tests** jointly provide the most modern platform in Science teaching.

The application also includes various utilities as Glossary, Instructions for different devices in the mobile cart, the inventory of the Mobile lab and the software applications which are used during the teaching process.

