Lower Saxon learning workshop for solar energy systems NILS
At the Institute for Solar Energy Research Hamelin ISFH executive director Prof. Dr. R. Brendel
Associated institute of Leibniz University Hanover
NILS-ISFH is a cooperation between the ISFH and the Lower Saxony ministry of education and cultural affairs
Am Ohrberg , D-31860 Emmerthal, Germany – Phone +49 5151 999 100 – Fax +49 05151 999 400 or +49 03222 3706689 (Schanz)
email: nils@isfh.de web: www.nils-isfh.de www.isfh.de mobile: +49 175 766 06 07 (W.R. Schanz)
www.sundidactics.de

NILS- ISFH

Photovoltaic experimentation system SUSE

- Photovoltaic experimentation systems for school classes, job training, solar projects, professional development
- Ready-to-use devices and construction kits
- Extensive experimentation manuals
- Class sets kindergarten-elementary school- secondary school- college
- >50 devices for photovoltaic experiments

Electricity from solar energy

Eco-friendly and sustainable

Photovoltaic Experimentation System

SUSE

Electricity from Solar Energy

Photovoltaics and optoelectronics in school + job training + professional development

ESD Education for Sustainable Development

Catalogue EN

NILS-ISFH + SUNdidactics

Photovoltaic experimentation system SUSE

An experimental teaching and training system on photovoltaics and optoelektronics
for education in preschool, school job training, professional development
for preschool, elementary school, secondary school, trade school, college

SUSE photovoltaic experimentation devices 2019

Fit for renewable energy! Competency in solar energy with photovoltaic experiments!

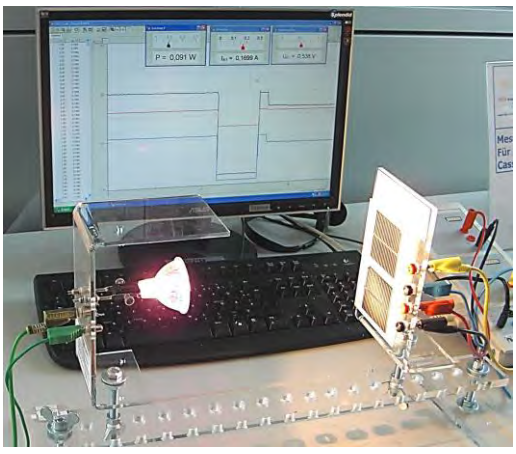
Innovative, robust and powerful photovoltaic experimentation devices with extensive and school tested experimentation manuals. Function tested ready-to-use devices and construction kits for science and technology education for all school forms/levels, STEM projects, technological or environmental work groups, ESD projects, job training, professional development for teachers. The SUSE PV experimentation are in use at many schools worldwide.

Single devices + learning stations + photovoltaic class sets

Top:
Solar vehicle SUSE SF6USB with solar filling station SUSE 4.51 and DC-DC converter SUSE 4.17

Bottom:
Solar module SUSE CM316

Experiments with solar modules on the roof of the ISFH



Experiment (shadowing) mit SUSE 5.0, 5.16, 5.22 + PC measurement interface

- SUSE photovoltaics (PV) experimentation devices were developed by W. R. Schanz in close cooperation with the learning workshop NILS at the Institute for Solar Energy Research ISFH - an associated research institute of the Leibniz University Hanover. All devices are tested in a school setting and suitable for the use with children and teenagers. Some devices are available as construction kits, technically complex devices however are only available as ready-to-use devices.

- Detailed technical manuals (1-2 pages per device!) can be found at www.sundidactics.de/Download in German and English versions.

- With the SUSE PV experimentation devices, 70 learning stations spanning kindergarten, elementary school, up to college can be set up.

- By using edge polished, highly transparent, and stable plexiglass supports, a robust, practice-oriented construction, visible and open technology, and an appealing design, as well as practice-oriented, high quality technology with a high efficiency and a high didactical value are achieved.

- For each SUSE photovoltaics device there are an extensive manual with a device description, technical data, elaborate, detailed experimentation manuals, basic information texts, and in-depth physical/technological information. For interested parties beyond the German-speaking area, English versions of the device files and experimentation manuals are available. Manuals can be found at www.sundidactics.de.

- All SUSE photovoltaic experimentation devices are field-tested in school and job training practice and are well-suited for experimental use in general education and vocational schools as well as other training systems.

- The application range in school spans from elementary school up to college (physics or technology classes), advanced training for teachers of elementary and secondary schools, also extracurricular basic and advanced training and kindergarten.

- Solar didactic and technical consulting by W.R. Schanz: via phone +49(0)1757660607, via email at nils@isfh.de or info@sundidactics.de.

- The SUSE photovoltaic devices and the experimentation manuals are constantly refined technically and didactically, the robust solar cells specially designed for these device systems have a high efficiency, extensive, tested technical data, and in-depth measurement graphs, measured at the characteristics lab of the ISFH.

- For education: The SUSE photovoltaics handbook with > 3000 pages / 4 GB on DVD: Basics of solar energy, solar radiation, photovoltaics, solarthermics, semiconductor technology, technology of solar modules, systems technology, presentations, student term papers, videos.

- Delivery and invoicing service for ready-to-use devices, construction kits, and components through our distribution company SUNdidactics www.sundidactics.de info@sundidactics.de . SUNdidactics is WEEE- and LUCID-certified.

- Delivery of photovoltaics class sets and learning stations for kindergarten, elementary school, secondary school, as well as custom sets with intensive consulting and training

Prices = net prices
Plus shipping and VAT 19% in GermanySpecial regulations apply in the EU and worldwide. We are happy to outline those to you.

Material construction kit price on delivery of construction kits for the self-assembly of the SUSE PV devices consisting of all electrical and mechanical parts + pre-cut, polished plexiglass plate with extensive construction and experimentation manuals
Operational warranty only for the delivered individual parts
Red:
Operational, tested ready-to-use device with operational warranty and extensive experimentation manual

Device system SUSE 4.xx and SUSE CMxxx
= Devices on 75° plexiglass bracket
For operation outdoors, on the basic device SUSE 4.0, or on overhead projectors, for experiments in primary and secondary school

Device system SUSE 5.xx
= Devices with support rod 8 mm for operation on optical bench SUSE 5.0 or on conventional optical benches or pod systems, operation outdoors on optical bench or in the lab with halogen lamp
For experiments in secondary school, college, and vocational schools

Consultation or orders of individual devices or class sets

By mail: W.R. Schanz, SUNdidactics Solar Systems, Schaperbleek 15, 31139 Hildesheim, GERMANY
By fax: SUNdidactics Solar Systems, fax no.: + 49 3222 370 66 89
By e-mail: info@sundidactics.de
By phone: +49 175 766 06 07, Return call upon consultation
Order form: www.sundidactics.de/Bestellformular

Outline of the SUSE photovoltaics device catalogue

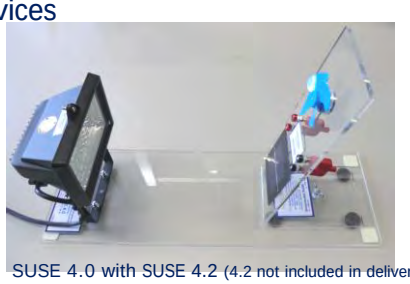
Top:
PV Experiments at the summer university Rinteln

Bottom:
Elementary school students conduct experiments with SUSE PV modules

System 4.xx System 4.xx- Photovoltaic devices and accessories for ISCED level 2 (lower secondary education)

SUSE 4.0

Solid acrylic glass base plate 6mm with halogen lamp 230V 120W and mount for all SUSE 4.xx experimentation devices
incl. switchable triple power strip
480mm x 160mm x 6 mm
With extensive operation manual
Ready-to-use device 34**,95 €**
Technical manual and operation manual at www.sundidactics.de/Download



SUSE 4.0 with SUSE 4.2 (4.2 not included in delivery)

SUSE 4.2

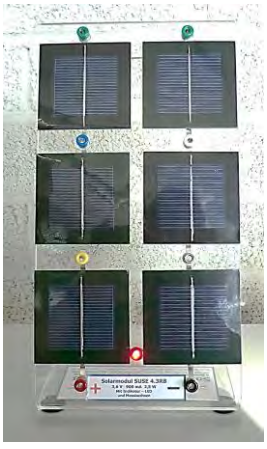
Our classic: Solar module with 1 high performance solar cell + solar motor with 4 jacks + bridging connector with integraded jack + propeller on plexiglass base plate 400mm x 100mm x 6mm bent to 75°
Beginners module for over 40 experiments
U_{oc} = 0,64 V I_{sc} = 990 mA SUSE 4.2 →
With extensive operation manual
Ready-to-**use device 39,49 €**
Technical manual and operation manual at www.sundidactics.de/Download

SUSE 4.2S

similar to 4.2, but switch instead of bridging connector
With extensive operation manual
Ready-to-use device 39**,49 €**
Technical manual and operation manual at www.sundidactics.de/Download

SUSE 4.3 RB

Solar module with 6 solar cells in internal series connection with 2 jacks per solar cell + indicator LED
3,84 V / 990 mA at S = 1000 W/m²
On plexiglass base plate 480mm x 160mm x 6 mm, bent to 75°
Also well suited as a solar filling station for solar vehicles 1, 1.2, and SF4
With extensive operation manual
Ready-to-use device 59**,98 €**
Technical manual and operation manual at www.sundidactics.de/Download



A System 4.xx- Photovoltaic devices and accessories for ISCED level 2 (lower secondary education)

SUSE 4.12

Storage module with 2 supercap capacitors in series connection, therefor charging voltage up to V_{max} = 5 V possible, storage capacity ca. 20 J
With push button for quick discharge
With 2 jacks 4mm for the connection of lab wires
On plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
With extensive technical data and experimentation manuals
Ready-to-use device **16,98 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.12USB

Storage module with 2 supercap capacitors in series connection, therefor charging voltage up to V_{max} = 5 V possible, storage capacity ca. 20 J
For the use in 5V USB systems
With push button for quick discharge
With USB coupling
On plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
With extensive technical data and experimentation manuals
Ready-to-use device **16,98 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.15

LED module with LED red, green, blue, white, IR, or rainbow with series resistor, as a light source to be connected to solar modules (min. 3 solar cells in series connection), V_{max} available as 5V DC, 12V DC, or 24V DC on plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
With 2 jacks 4mm for the connection of lab wires
Red also directly usable as a solar cell with V_{oc} of ca. 1,5 V
With extensive technical data and experimentation manuals
Ready-to-use device **15,49 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.15USB

USB lamp with 8 white LEDs
Flexible goose neck and USB-A plug
for use in the solar USB systems
V = 5V DC, I ca. 80 mA, length ca. 45 cm
With extensive technical data and experimentation manuals
Ready-to-use device **11,49 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.16

Solar motor on plexiglass support with propeller and binding posts for a connection to solar cells or solar modules.
For voltages of 0,3 – 5V DC, also applicable as DC generator, V up to ca. 3V. With 2 jacks 4mm for the connection of lab wires.
On plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
With extensive technical data and experimentation manuals
Ready-to-use device **15,98 €**
Technical and operation manual at sundidactics.de/Download

A System 4.xx- Photovoltaic devices and accessories for ISCED level 2 (lower secondary education)

SUSE 4.16USB like SUSE 4.16, but with USB-A coupling instead of binding posts, for the use in solar USB systems.
With extensive technical data and experimentation manuals
Ready-to-use device **15,98 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.17 DC-DC converter, solar smartphone charger
Input 7....24 V DC, output 5V DC at USB socket, for connecting solar modules with 14....36 solar cells in series connection. With input jack pair and input LED, output USB socket 5 V DC,
1200 mA. For charging smartphones, tablets, powerbank rechargeable batteries, incl. charging cable with USB to micro USB plug with integrated input reverse voltage protection diode
With extensive technical data and experimentation manuals
Ready-to-use device **23,95 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.17M DC-DC converter in small configuration
Version A with cable stub and USB socket, input 6...24V DC, Output 5V/1A DC
Version B with double USB socket embedded in the casing, input 6...24V DC, output 2x 5V/1A DC
with input reverse voltage protection diode and 2 indicator LEDs, green input LED and red output LED
high-quality DC-DC converter with high efficiency > 92% with amplified output current
With extensive technical data and experimentation manuals
Ready-to-use device **22,95 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.19 Piezoelectric signal generator to be connected to 2-8 solar cells in series connection. Acoustic verification of PV voltage of 1V DC – 5V DC. Signal frequency 2,6 kHz.
With extensive technical data and experimentation manuals
Ready-to-use device **14,98 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.20 LED module with 3 LEDs: IR 950 nm, red 620 nm, blue 470 nm to be connected to solar modules or for the use as a high voltage solar cell (voltage at red LED with irradiation: 1,5 V!) on plexiglass support 310mm x 80mm x 3mm
With extensive technical data and experimentation manuals
Ready-to-use device **22,89 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.20IRRB LED module with 3 LEDs: Infrared (IR), red, blue
to be connected to solar modules, individually switchable
Input 3- 5V DC, on plexiglass support 160mm x 80mm x 3mm
LEDs are also directly usable as mini solar cells.
With extensive technical data and experimentation manuals
Ready-to-use device **29,89 €**
Technical and operation manual at sundidactics.de/Download

A System 4.xx- Photovoltaic devices and accessories for ISCED level 2 (lower secondary education)

SUSE 4.24A

Analog measurement device for measuring the irradiance of the sunlight or light sources, calibrated in W/m², no battery required
Especially suited for experiments on ISCED levels 1-3 (primary and secondary schools), on plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
Display of 0-100 corresponding to an irradiance of S = 0....1000 W/m²
With detailed technical and experimentation manuals

Ready-to-use device 33,**95 €**
Construction kit **23,98 €**

Technical and operation manual at sundidactics.de/Download
The measurement device SUSE 5.23 with a digital display is found in the level 3 section

Well suited for self-construction and calibration by student groups!

SUSE 4.31

Low-cost solar module/solar filling station with 4 solar cells in internal series connection, 5 connection sockets, and red indicator LED
4 solar cells 0,62 V/ 450 mA in internal series connection: 2,48 V / 450 mA at the black-red socket pair with
S= 1000W/m² and T = 25°C
Especially suited as a solar filling station for the solar vehicles SF1 and SF4, as well as experiments on photovoltaics. Each solar cell offers its own socket pair.
On plexiglass support 310mm x 80mm x 3mm, bent roof- shaped to 75°
With detailed technical and experimentation manuals

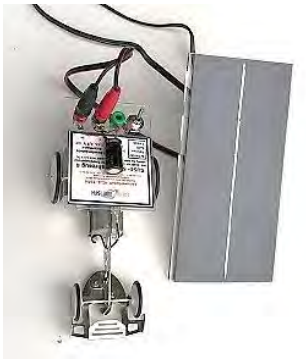
Construction kit with pre-drilled and bent plexiglass support **19,95 €**
Ready-to-use device **21,95 €**
Ready-to-use device with solar vehicle 4 **36,95 €**

Technical and operation manual at sundidactics.de/Download

SUSE 4.32

Low-cost solar module/solar filling station with 4 solar cells in internal series connection
2,48 V / 630 mA /1200 mW S= 1000W/m² and T = 25°C

Especially suited as a solar filling station for the solar vehicles SF1 and SF4, as well as experiments on photovoltaics. With connection cable 0,5 m with bunch plugs red (+) and black (-) or cable with phone jack 3,5 mm.
On plexiglass support 160 mm x 80mm x 3mm with lifting screw
With detailed technical and experimentation manuals



Construction kit with pre-drilled and bent plexiglass support 16,95 **€**
Ready-to-use device **19,95 €**
Construction kit set with solar vehicle 4 **29,95 €**
Set of Ready-to-use devices with solar vehicle 4 **34,95 €**

Technical and operation manual at sundidactics.de/Download

SUSE 4.33

1,92 V / 1000 mA solar module
with 3 high-performance solar cells in pluggable series connection, 6 jacks and 2 connection plugs with panel jacks
On Plexiglass support 400mm x 100mm x 6 mm, bent to 75°
With extensive technical data and experimentation manuals

Ready-to-use device 56,**98 €**

The measurement device displays the module voltage of 1,76 V with a slightly clouded sky.
Technical and operation manual at sundidactics.de/Download

Multimeter not included in delivery

A System 4.xx- Photovoltaic devices and accessories for ISCED level 2 (lower secondary education)

SUSE 4.34

Solar module 2,48 V / 630 mA / 1,2 W

Especially suited as a solar filling station for the solar vehicles SF1 and SF4. On plexiglass support 330mm x 80mm x 3mm, bent to 75°, 4 solar cells in internal series connection, with 2 jacks and cable 0,5 m with phone jack, red indicator LED showing operational readiness

With extensive technical data and experimentation manuals

Ready-to-**use device 25,95 €**

Technical and operation manual at sundidactics.de/Download

SUSE 4.35

Solar module 4,9 V / 630 mA / 2,4 W

Especially suited as a solar filling station for the solar vehicle SF1.2, for experiments with the storage module SUSE 4.12, all LED modules SUSE 4.15, solar radio 4.36. On plexiglass support 330mm x 160mm x 3mm, bent to 75°. 8 solar cells in internal series connection, 2 jacks or 1m cable with 2 bunch plugs and green indicator LED.

With extensive technical data and experimentation manuals

Ready-to-**use device 37,95 €**

Technical and operation manual at sundidactics.de/Download

Multimeter not included in delivery

SUSE 4.36

SUSE radio Radio music with solar energy!!

VHF/MF radio (Grundig brand) with speaker + headphones

incl. 1m connecting cable with 2 plugs 4mm red/black for operation at ca. 3V (2,8 ....5V),

for operation with 6 solar cells in series connection,

e.g.. 1x SUSE 4.3 or 2x SUSE 4.33/ 2x SUSE CM7MSB /6 x SUSE 4.2 .....

With extensive technical data and experimentation manuals

Ready-to-use device **25,98 €**

SUSE 4.36USB 25,98 € USB-A cable instead of 4mm banana plug

Technical and operation manual at sundidactics.de/Download

SUSE 4.41-10

SUSE 4.42-20

10 Watt solar module (left-hand photo)

20 Watt solar module (right-hand photo)

Open circuit voltage ca. 22 V

Professional solar module with indicator LED

36 mono- or polycrystalline solar cells in internal serial connection, output box

Output 1: V_{OC}: 21,5 V V_{MPP}: 17,7 V

I_{SC} ca. 630 mA (10W)

I_{SC} ca. 1,2 A (20W)

Output 2: 5V/1A DC at USB socket

Stable aluminum frame, ideal for charging 12 V rechargeable batteries via charge controller or as a phone charger via output 2. With solid, adjustable ground/table positioner, green indicator LED

With extensive technical data and experimentation manuals

Ready-to-use device 10W **49,95 €**

Ready-to-use device 20W **57,95 €**

Technical and operation manual at sundidactics.de/Download

Module design can optically deviate from the design shown in the photo
Bottom: Output box on the module's back side

SUSE 4.43-30

30 Watt solar module

Professional solar module with indicator LED, 36 mon solar cells in internal series connection

Output 1: V_{OC}: 21,3 V, V_{MPP}: 17,8 V , I_{SC}: 1,82 A , I_{MPP}: 1,69 A

Output 2: 5V DC/1A at USB socket

Solid aluminum frame 605x345x25 mm

A System 4.xx- Photovoltaic devices and accessories for ISCED level 2 (lower secondary education)

SUSE 4.43-30

Ideal for charging 12 V rechargeable batteries via charge controller or as a phone charger via the USB socket. With solid, adjustable ground/table positioner, green indicator LED

With extensive technical data and experimentation manuals

Ready-to-use device 30W **67,95 €**

Technical and operation manual at sundidactics.de/Download

SUSE 4.44

Voltage regulator for SUSE 4.41/4.42

Input 14...22V Output 9V or 12V const., 2A max., necessary for operating 9V or 12V devices respectively at solar devices

With input and output sockets 4mm

With input and output LEDs green/red

Short-circuit-proof, temperature secured

With extensive, detailed experimentation manual

Ready-to-use device **23,95 €**

Technical and operation manual at sundidactics.de/Download

SUSE 4.50-10 10W

solar module with integrated DC-DC converter and USB output 5V DC/1,0A

Powerful 10 W module (like SUSE 4.52) with 18 high-quality monocrystalline solar cells in internal series connection

Output 1: Module output 10,8V/1,22A

Output 2: 5V DC USB, 1000mA

2x indicator LED red/green, with positioner for table or ground, with 1x cable USB A-A, 1x cable USB A-µ

With extensive technical data and experimentation manuals

Ready-to-use device **49,95 €**

Technical and operation manual at sundidactics.de/Download

Top: Front side
Bottom: Back side with electronics box

SUSE 4.50-10GS

10W solar module with integrated DC-DC converter and USB output 5V DC/1,0A

Version for suncatcher box ES, for safety reasons without output 1, specifically for experiments in primary school

Ready-to-use device **47,95 €**

With extensive technical data and experimentation manuals

Technical and operation manual at sundidactics.de/Download

SUSE 4.51

5 W solar module with high efficiency factor

11,2V / 590 mA / 5W at S= 1000 W/m² and T = 25°

18 solar cells in internal series connection, with 1,5 m connection cable with bunch plug 4 mm

Stable aluminium frame with solar glass cover and adjustable ground/table positioner.

Especially suited for charging and operating smartphones and tablets with the USB adapter SUSE 4.17.

With extensive technical data and experimentation manuals

Ready-to-use device **28,95 €**

Technical and operation manual at sundidactics.de/Download

Displayed is the open circuit voltage 11,04 V

A System 4.xx- Photovoltaic devices and accessories for ISCED level 2 (lower secondary education)

SUSE 4.52

10 W solar module with high efficiency factor
10,8V /1200 mA / 10W
18 mono solar cells in internal series connection, with 1,5 m connection cable with bunch plug 4 mm. Stable aluminium frame with solar glass cover and adjustable ground/table positioner.
Especially suited for charging and operating smartphones and tablets with the USB adapter SUSE 4.17 also under heavily clouded conditions!

With extensive technical data and experimentation manuals
Ready-to-use device **41,95 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.55

Adapter module for measuring the characteristic curves, power, MPP, and determining the efficiency factor of SUSE solar modules with multimeters or measurement data acquisition systems (e.g. CassyLab, Vernier, or similar)For solar modules with 1 solar cell: SUSE 4.55-1
For solar modules with 3 - 6 solar cells: SUSE 4.55-6
For solar modules with 12- 18 solar cells: SUSE 4.55-18

With extensive technical data and experimentation manuals
Ready-to-use device **22,95 €**
Technical and operation manual at sundidactics.de/Download

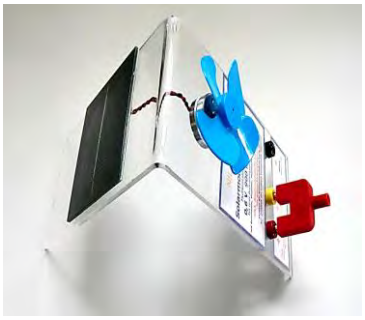
SUSE CM4MSB

Robust solar module for class levels 3-6
SUSE PV module (0,64 V /990 mA)+ solar motor + switch + propeller + socket pair (binding posts). Electric motor disengageable. On plexiglass support 330mm x 80mm x 3mm

With detailed technical and experimentation manuals
Ready-to-use device 21,95 **€**
Technical and operation manual at sundidactics.de/Download

SUSE CM4MBV

Robust and versatile solar module
For class levels 4- 10
0,64 V / 990 mA, with solar cell, solar motor, 3 jacks and connector plug
On plexiglass support 330mm x 80mm x 3mm, bent roof-shaped to 75°



With detailed technical and experimentation manuals
Ready-to-use device 25**,95 €**
Technical and operation manual at sundidactics.de/Download

Solar modules of the CM3xx and CM6xx series: Inexpensive experimentation modules, well suited for self-construction by student groups, with extensive and interesting experimentation manuals!

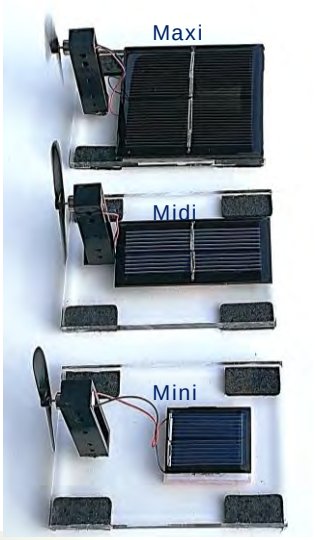
SUSE CM310 CM308 CM309 CM311 CM315 CM316 CM318 CM400 CM6B CM6MS

A System 4.xx- Photovoltaic devices and accessories for ISCED level 2 (lower secondary education)

SUSE CM307

Basic solar module in 3 modifications mini- midi- maxi

Solar module + solar motor + propeller on plexiglass plate
Dimensions plexiglass plate 80 x 60 x 3 mm
Solar module with 2 solar cells 1,2 V in internal series connection
mini solar module 1 I sc 80 mA for bright sunshine
midi solar module 2 I sc 160 mA for slightly clouded sky
maxi solar module 3 I sc 480 mA for clouded sky
Construction kit:
mini 3,95 € / midi 4,95 € /maxi 6,55 €
Tested ready-to-use device:
mini 4,95 € / midi 5,95 € / maxi 7,55 €
With detailed, extensive construction and experimentation manual
Technical and operating manual at www.sundidactics.de/Download



SUSE CM308

Basic solar module with solar cell and measurement jacks 0,62V/450mA

for experiments on series and parallel connections
On plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
Construction kit:
Pre-drilled and bent plexiglass support, all component parts, simple montage and soldering work
With detailed technical and experimentation manuals
Construction kit 6**,99 €**
Tested ready-to-use device **7,99 €**
Technical and operation manual at sundidactics.de/Download

SUSE CM310

Simple beginner's solar module with solar cell, solar motor, propeller

Without measurement jacks/switch 0,62V/450 mA
On plexiglass support 160mm x 80mm x 3mm, bent to 75°
Construction kit: Pre-drilled and bent plexiglass support with built-in motor, simple montage and soldering work
With detailed technical and experimentation manuals
Construction kit 6**,99 €**
Tested ready-to-use device 8**,99 €**
Optionally with blue fan blade or black propeller
Technical and operation manual at sundidactics.de/Download

SUSE CM311

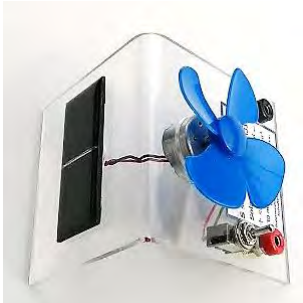
Beginner's solar module with measurement jacks

On plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
with solar cell 0,62V/450mA , solar motor + propeller + 2 measurement jacks black/red
Construction kit:
Pre-drilled and bent plexiglass support with built-in motor, simple montage and soldering work
With detailed and extensive experimentation manual
Construction kit **9,99 €**
Tested ready-to-use device 10**,99 €**
Technical and operation manual at sundidactics.de/Download

SUSE CM315

Solar module with measurement jacks and switch

On plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
With solar cell 0,62V/450mA and 2 measurement jacks black/red + switch
Construction kit: Pre-drilled and bent plexiglass support with built-in motor, simple montage and soldering work
With detailed and extensive experimentation manual
Construction kit 10**,99 €**
Tested ready-to-use device 12**,99 €**
Technical and operation manual at sundidactics.de/Download



A System 4.xx- Photovoltaic devices and accessories for ISCED level 2 (lower secondary education)

SUSE CM316

Solar module with 3 measurement jacks and switch, solar motor, and propeller

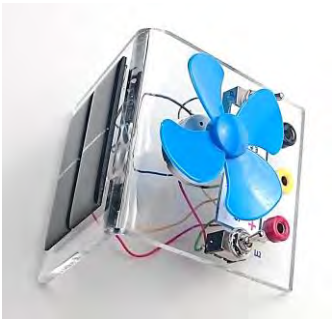
On plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
With solar cell 0,62V/450mA and 3 measurement jacks + switch black/red/green (black-red: solar cell, black-green: motor)
Construction kit: Pre-drilled and bent plexiglass support with built-in motor, simple montage and soldering work
With detailed and extensive experimentation manual

Construction kit 11,**99 €**
Tested ready-to-use device **16,99 €**
Technical and operation manual at sundidactics.de/Download

SUSE CM318

Dual solar module with 2 solar cells, solar motor, propeller, 2 switches, and 3 jacks. 2x 0,62 V/450 mA with on-off switch for solar motor and selector switch to toggle parallel and series connection. With 3 measurement jacks red/yellow/black for 1 solar cell (black-yellow) and 2 solar cells (black-red) On plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
With detailed and extensive experimentation and construction manual

Construction kit **15,95 €**
Pre-drilled plexiglass support, switch, + solar cells with soldered hookup wires, solar motor + propeller
Ready-to-use device **18,95 €**
Technical and operation manual at sundidactics.de/Download



SUSE CM400

Simple photovoltaic experimentation device
Especially suited for class levels 3-6
Thin layer solar cell 3V/20mA with LED optionally red, orange, green, yellow, blue
On plexiglass support 160x80mm bent to 75°
With detailed and extensive experimentation and construction manual

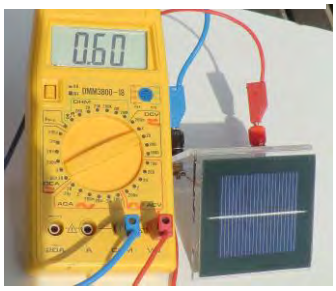
Construction kit 4,20 **€**
Pre-drilled and bent plexiglass support, solar cell with soldered hookup wires, LED, type plate sticker, manual
Ready-to-use device 5,50 **€**
Technical and operation manual at sundidactics.de/Download

The measurement device displays open circuit voltage of 0,6 V.

SUSE CM6B

Solar module with big solar cell
On plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
V_{oc}= 0,64V / I_{sc} = 1020mA
With 2 jacks for plugging in lab wires
On plexiglass support 155 x 80 x 3 mm, bent roof-shaped
With detailed and extensive experimentation and construction manual

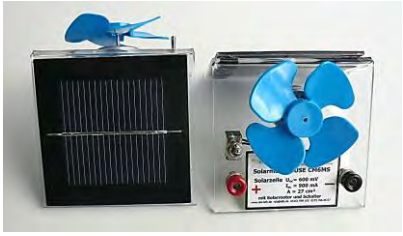
Ready-to-use device 17,**95 €**
Technical and operation manual at sundidactics.de/Download



SUSE CM6MS

Powerful solar module with big solar cell,solar motor, propeller and switch to switch off the solar motor, to be applied in ISCED levels 1-3
V_{oc}= 0,64V / I_{sc} = 1020mA
On plexiglass support 160mm x 80mm x 3mm, bent roof-shaped to 75°
With detailed and extensive experimentation and construction manual
For ISCED levels 1-3

Construction kit **18,95 €**
10+ units **16,95 €**
Ready-to-use device **22,95 €** 10+ units **19,95 €**
Technical and operation manual at sundidactics.de/Download



The SUSE Solarboat 4

The SUSE solar boat 4 consist of a plexiglass support (330 x 80 x 3 mm) bent to 90° with solar cells on the horizontal surface and a solar motor with a propeller on the vertical surface. The photos show the solar boats 3 and 4.
The solar boat 4 is equipped with the solar module SUSEmod 6 (4 solar cells) and delivers a voltage of 2,4 V. With this, the boat reaches a high speed.
The SUSE solar boat 4 with measurement jacks for PV experiments
The boat's hull consists of 2 empty 0,7-1 l beverage bottles, the plexiglass support is mounted on the two bottles with adhesive tape after completion – and the solar boat is ready! For more stability on the water, the bottles can be filled with a little water, so that they are partially immersed in the water.
If the solar cells connected in series are illuminated by the sunlight, the generated electric current runs to the electric motor, which spins fast and pushes the boat forward with the big 3 bladed air fan.

With detailed and extensive experimentation and construction manual

Solar boat construction kit 4 with plexiglass support, motor and propeller, measurement jacks, solar module SUSEmod6 2,4 V / 630 mA, moulded waterproof **22,95 €**

Technical and operation manual at sundidactics.de/Download Ready-to-use device **25,95 €**

Solar electric mobility

SUSE solar vehicles with solar charging stations

Solar racer 703

Small solar vehicle with solar cell, electric motor, transmission
Drives on smooth surfaces with sunlight or the light of a light bulb/ halogen lamp, dimensions: 55mm x 40mm x 14mm
With extensive operational description

Construction kit **7,95 €**

Technical and operation manual at sundidactics.de/Download

Solar mini racer 704 – smallest solar car in the world

Small, steerable solar car, robust metal design, dashes on smooth surfaces with illumination by the sun or light bulbs/ halogen light
Dimensions: 33mm x 22mm x 14 mm
With extensive operational description

Ready-to-use device **8,95 €**

Technical and operation manual at sundidactics.de/Download

The SUSE solar vehicles 1-6

Solar vehicles are a particular challenge, because they are supposed to drive not only in bright sunshine, but also under a clouded sky. We offer you a thought-out concept for the successful construction and use of solar vehicles. The energy conversion processes can be substantiated and documented with measurements in experiments.

SUSE solar vehicle 1

The car does not feature its own solar cell, but instead is charged at a solar "filling station", a solar module from the SUSE series with V = 2,5 V_{max} is required for this, a self-built solar module from solar cell fragments can also be used. For energy storage a supercapacitor is used, that is charged by the solar module (even under very dim weather conditions) and feeds the current to the electric motor of the vehicle after flicking the switch. On the circuit

Suitable solar charging station: SUSE 4.34

board there are jacks for physical measurements. Storage capacity of the supercapacitor: 10 J

With extensive technical and experimentation manuals

Construction kit	**21,95 €**
Ready-to-use device	**24,95 €**

Technical and operation manual at sundidactics.de/Download

SUSE solar vehicle 1.2

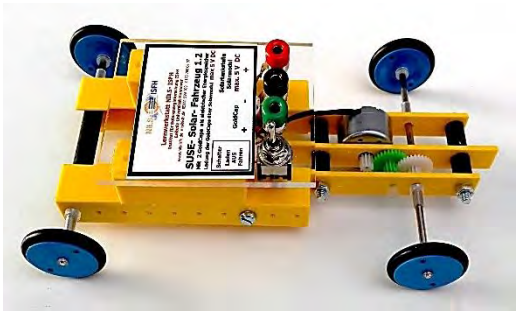
Setup like solar vehicle 1, but with 2 supercapacitors in series connection, therefor double the stored energy 20 J and double the speed. Maximum voltage: 5V DC, to be connected to solar modules with up to 8 solar cells, with 3 jacks. The vehicle can also be charged with a 4,5 V battery.

With extensive technical and experimentation manuals

Suitable 5V solar charging station: SUSE 4.35 or SUSE 4.3RB

Construction kit	**24,95 €**
Ready-to-use device	**27,95 €**

Technical and operation manual at sundidactics.de/Download



Suitable solar charging station: SUSE 4.3RB or SUSE 4.35. The storage capacitor is located inside the vehicle below the jacks.

SUSE solar vehicle 2

The solar vehicle 2 is based on the chassis of the solar vehicle 1, but is fitted with its own solar module SUSEmod6 (2,4V - 630mA), which is connected to the solar motor over a switch. Because of the powerful solar module, the vehicle drives outdoors with sunny weather as well as under a clouded sky. Indoors the module can be illuminated by a halogen lamp or a red light lamp.

Dimensions: 200 x 95 x 42 mm

With extensive technical and experimentation manuals

Construction kit	**22,95 €**
Ready-to-use device	**24,95 €**

Technical and operation manual at sundidactics.de/Download

SUSE solar vehicle 3

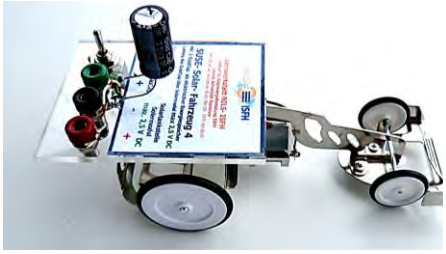
The SUSE solar vehicle 3 is a further development of the solar vehicle 2, here a GoldCap serves as energy storage, so that the car can also drive under dim weather conditions. The solar module charges the energy storage, a switch can be switched to charge/OFF/drive, with 3 jacks for experiments. Dimensions: 200 x 95 x 42 mm

With extensive technical and experimentation manuals

Construction kit	**24,95 €**
Ready-to-use device	**27,95 €**

Technical and operation manual at sundidactics.de/Download

SUSE solar vehicle 4 →



Solar dragster vehicle with metal chassis, electric motor, and gear. With GoldCap as energy storage, 3 jacks: 2 charging jacks measurement jack green, operating switch, charging display Dimensions: 150mm x 90mm x 90 mm, optionally with jack bush with SUSE 4.34.

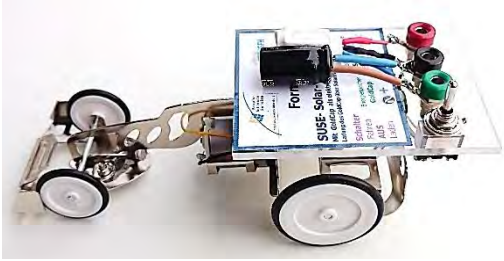
As a solar charging station the solar module SUSE 4.34 (2,4V/627mA) is optimally suited. The multimeter (not included in delivery) displays the module voltage of 2,42 V. Solar vehicle 4K with 3,5 mm audio jack instead of red jack.

With extensive technical and experimentation manuals

A System 4.xx- Photovoltaic devices and accessories for ISCED level 2 (lower secondary education)

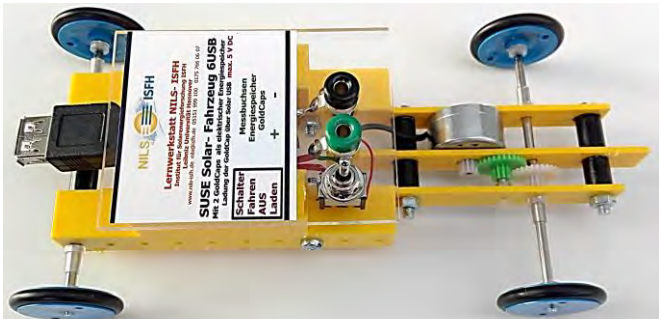
Construction kit (pre-assembled) **19,95 €**
Ready-to-use device **22,95 €**
Set solar vehicle 4 + solar module SUSE 4.34 + charging cable Ready-to-use devices **39,95 €**
Technical and operation manual at sundidactics.de/Download

SUSE solar vehicle 4.5
Update of the solar vehicle 4 with additional voltage regulator
Usable for charging at solar modules with 4.....24 V DC
With extensive technical and experimentation manuals
Ready-to-**use device** **26,95 €**
Technical and operation manual at sundidactics.de/Download



Solar vehicles

SUSE solar vehicle 6USB
The SUSE solar vehicle 6USB contains a SuperCap storage capacitor and can be charged via a USB socket at the rear end using a solar module with 5V DC. The vehicle can also be charged at any other USB socket (PC, laptop, powerbank rechargeable battery...).



A multimeter can be connected to the green-black jack pair to measure the charging and discharging processes during charging and driving operation. As a solar charging station, the solar module SUSE 4.50 with USB output or any other solar module with 5...20W combined with the DC-DC converter SUSE 4.17 with USB output is suitable. USB cable with 2x A plugs included in delivery.
With extensive technical and experimentation manuals
Ready-to-use device **25,95 €** with USB cable 2x A plug
Technical and operation manual at sundidactics.de/Download

Set solar electric mobility:
Solar vehicle + solar charging station SUSE solar vehicle 6USB with 10W solar module SUSE 4.50-10 with DC-DC converter for 5V USB socket, with USB charging cable (plugs A-A), and USB measurement device (measuring V,I,Q) as seen in the photo. For qualified experiments on solar electric mobility.
Also suitable for charging smartphones and powerbank battery packs.
Because of the high module power also suited for a heavily clouded sky outdoors.
With extensive technical and experimentation manuals
Set of Ready-to-**use devices** **65,98 €**
Technical and operation manual at sundidactics.de/Download

Solar module SUSE 4.50-10 USB measurement device USB cable Solar vehicle SF6USB

Solar electric mobility – inexpensive vehicles for beginners

SUSE solar runabout
for primary school and lower secondary school

An inexpensive, simple solar vehicle to be operated in bright sunshine or indoors with halogen or red light lamps. Robust chassis with 2 cell solar module, micro motor, gear. Suitable for primary school from grade 3/4 on or lower secondary school. Dimensions: 80mm x 70mm x 35mm, solar module 1,2 V/85 mA.

As construction kit or ready-to-use device.
With extensive technical and experimentation manuals

Construction kit **5,50 €**

Technical and operation manual at sundidactics.de/Download

SUSE solar runabout turbo
for primary school and lower secondary school

Setup with a bigger solar cell with twice the area and twice the power for a higher speed.
For operation in bright sunshine or under a slightly clouded sky or indoors with halogen or red light lamps. Robust chassis with 2 cell solar module, micro motor, gear. Suitable for primary school from grade 3/4 on or lower secondary school. Dimensions: 80mm x 70mm x 45mm, solar module 1,28 V/450 mA.

As construction kit or ready-to-use device.
With extensive technical and experimentation manuals

Construction kit **7,49 €**
Ready-to-use device 8,99 **€**

Technical and operation manual at sundidactics.de/Download

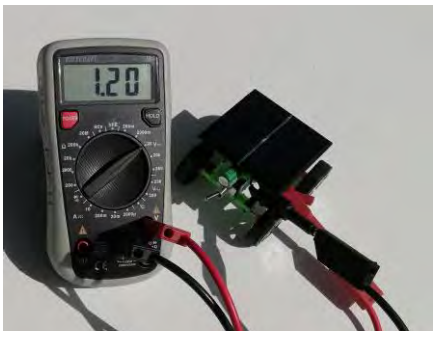
SUSE solar runabout turboSC
for primary school and lower secondary school

In bright sunshine, under a slightly clouded sky or with halogen or red light lamps, the super capacitor is charged by the solar cell.
The charging duration in bright sunshine is ca. 1-2 minutes. Afterwards the car can drive even in dim rooms with the energy from the capacitor. Robust chassis with 2 cell solar module, micro motor, gear, switch, and storage capacitor.
With a multimeter the charging and discharging can be measured. Suitable for primary school from grade 4 on or lower secondary school. Dimensions: 80mm x 70mm x 45mm, solar module 1,28 V/450 mA.

As construction kit or ready-to-use device.
With extensive technical and experimentation manuals

Construction kit 9**,99 €**
Ready-to-use device 11,99 **€**

Technical and operation manual at sundidactics.de/Download



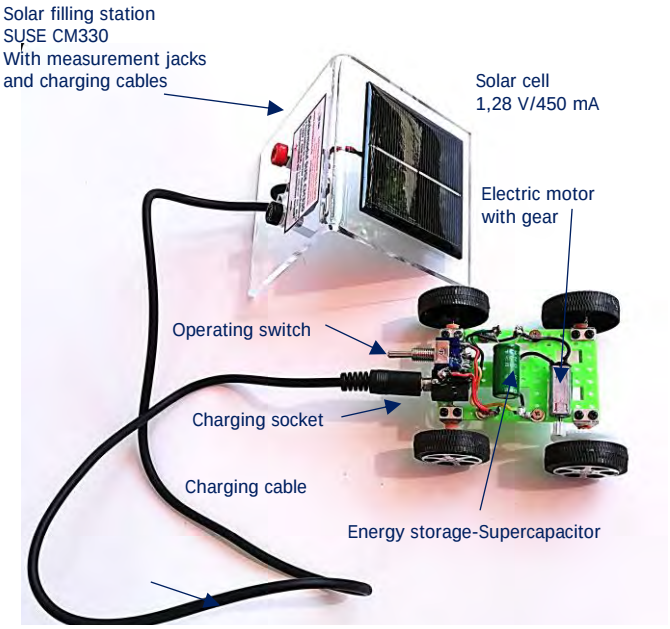
With a
capacitor can be measured.

A System 4.xx- Photovoltaic devices and accessories for ISCED level 2 (lower secondary education)

SUSE solar runabout turboST

Solar vehicle + external solar filling station

The solar runabout turbo ST features a supercapacitor for energy storage on top of the basic vehicle, a switch, and a charging socket.
The solar filling station SUSE CM330 with a jack pair and a charging cable accompany the vehicle.
At the jack pair, measurements on photovoltaics can be conducted independent from the function as a 'gas station'. Also the charging process can be measured while 'refueling'.
The charging process can be conducted in the natural sunlight outdoors or indoors with a red light lamp or a halogen spotlight.
With one charge the vehicle drives ca. 30 m.



Construction kit vehicle + Construction kit solar filling station	18**,99 €**
Ready-to-use device	24,99 **€**
Construction kit vehicle	**9,99 €**
Ready-to-use device	12,99 **€**
Construction kit solar filling station	**9,99 €**
Ready-to-use device	12,99 **€**

Each with extensive technical description + experimentation manuals
Technical and experimentation manuals at www.sundidactics.de/Download

Technical data solar runabout turbo ST:

Dimensions: 85mm x 70mm x 40mm, operating switch (charge – OFF – drive), charging socket, energy storage supercapacitor 3,3F/2,5V.

Technical data solar filling station SUSE CM330:

Dimensions: Plexiglass support 160mm x 80mm x 3mm, bent to 75°, solar module 60mm x 60mm, 1,28 V/450 mA, with jack pair for 4mm banana plugs and charging cable 700 mm with phone jack 3,5 mm.

Solar heat - thermal energy from solar radiation

SUSE solar thermal collector GS

Stagnation collector for primary and lower secondary school

Collector for the generation of thermal energy from solar radiation (stagnation collector), construction made of plexiglass, with absorber sheet with 2 exchangeable surfaces: selective black and aluminum silver, additionally black and white. With a digital thermometer + battery (button cell). Complete plexiglass design!

Setup on bent plexiglass support 450 x 160 x 6 mm, removable plexiglass cover plate 245 x 160 x 3 mm. Interior height with absorber sheet 15mm, lateral feed through opening for thermometer, temperature measurement with thermometer or measuring sensor of the multimeter.

Upper feed through opening for test tube to demonstrate the solar warm water production.

With detailed, extensive technical and experimentation manuals

Collector outdoors on a meadow, the thermometer displays the absorber temperature of 82°C.

Ready-to-use device (1 unit): **64,95 €**

Technical and operation manual at sundidactics.de/Download

SUSE lab wires for experiments

for the conduction of experiments with 4 mm lab plugs, 50 cm in length, stackable, contacts nickel plated, cross section 1mm², I_{max} = 3A, V_{max} = 50V.

Wire in red or black	Unit price:	6,95 **€**
Pack of 10 (5x black , 5x red)	Set price:	32,2**5 €**

Note the safety instructions (in the packaging)!

Additional single component parts available on request, request an offer!

Charging a smartphone, tablet, or powerbank with solar energy:

Smartphones, powerbanks or tablets are charged with 5V DC over a charging cable with USB plug. In each device, charging electronics are built in to regulate the charging current. At the beginning of the charging, usually a current of about 0,7A – 1A is flowing, it decreases in the course of the charging process.

For charging, we use a solar module with adequate power and a DC-DC converter to 5V (10W minimum, e.g. SUSE 4.50-10, optimally 20W, e.g. SUSE 4.42-20). In bright sunshine, 4.50-10 delivers a maximum current of ca. 1,2 A, so an adequate current. But under a clouded sky the maximum current decreases, e.g. to half or ¼ of the bright sunshine value, then the current (it is proportional to the light intensity!) is too low and the charging process respectively takes more time. So please pay attention to an adequate power of the connected solar module!

The powerful DC-DC converters SUSE 4.17M with a high efficiency of >92% amplify the output current, so for example an output current of 300mA can be amplified to an output current of 700 mA! With a USB measurement device the charging process can be measured and observed. Additional consultation by W.R. Schanz via info@sundidactics.de or by phone +49 (0)175 7660607.

SUNdidactics Wolf- Rüdeger Schanz, Schaperbleek 15, D-31139 Hildesheim, Germany
Phone: +49(0)5121 86 07 30 Fax: +49(0)3222 370 66 89 Mail: wr.schanz@t-online.de
Mobile: +49(0)175 766 06 07 Web: www.sundidactics.de Mail: info@sundidactics.de
cooperation www.nils-isfh.de

Suncatcher box Secondary School Class level 8-10 (For students aged 14-16)

2x 5 Learning stations for student-centered experiments for 30 students in groups of 3

The **suncatcher box SEKI** consists of the listed devices, basic information about solar energy, solar radiation, photovoltaics, measurement technology, supplemented by technical data, and info about the devices as well as extensive experimentation manuals, test exercises and solutions. On top of this an email consultation with SUNdidactics and NILS-ISFH as well as a further training for teachers after delivery in the laboratory of NILS in the ISFH or at the supplied school is included. For schools outside of Lower Saxony, Germany, the travel expenses for the consultant have to be borne.

The learning group of up to 30 students is divided into 10 groups of 3, with smaller learning group sizes there can also be groups of 2. The groups 1+2 start with SFSEK1, groups 3+4 with SFSEK2, groups 5+6 with SFSEK3, groups 7+8 with SFSEK4 and groups 9+10 with SFSEK5, the experiments take 2 lessons (1,5 hours) per station, subsequently they continue in a rotating fashion. If the learning group executes all learning stations, 5 double lessons are necessary. The learning stations are independent of each other, for lack of time not all 5 learning stations and not all experimental exercises of the stations have to be worked on. **All device files can be found at www.sundidactics.de/Download.**

Conduction of the experiments with the learning stations either outdoors in natural sunlight or inside the classroom with halogen lamps

Learning station	Experimental devices for 1 learning station	Measurement technology and accessories	Main topics of the experiments
Learning station 1 SFSEK1 Solar cell	2 solar modules SUSE CM4MBV 1 storage module SUSE 4.12 1 basic device SUSE 4.0 with halogen lamp 120 W From school: 1x overhead projector	1 dig. multimeter 8 lab wires, 50 cm each 1 switchable 3x desk power socket 1 folding rule	V,I,P of solar cells with different irradiations Efficiency factor, irradiance, series connection, motor as a generator, solar storage, determination of solar cell quality
Learning station 2 SFSEK2 Solar cell	1 solar module SUSE 4.33 6 solar motors SUSE 4.16 1 basic device SUSE 4.0 with halogen lamp 120 W From school: 1x overhead projector	1 Dig. multimeter 12 Lab wires 50 cm each 1 switchable 3x desk power socket	U,I,P of solar cells with different irradiations, series and parallel connection of solar cells and motors
Learning station 3 SFSEK3 Solar cell	1 solar module SUSE 4.3RB 1 basic device SUSE 4.0 with halogen lamp 120 W 2 LED modules SUSE 4.15 1 storage module SUSE 4.12 1 solar motor SUSE 4.16 1 solar radio SUSE 4.36	1 Dig. multimeter 6 Lab wires 50 cm each 1 switchable 3x desk power socket	U,I,P of solar cells with different irradiations, current density j, series connections, experiments with LEDs, solar storage, solar motors, solar radio
Learning station 4 SFSEK4 Solar electric mobility	1 SUSE solar vehicle 4 1 solar module solar filling station SUSE 4.34 1 basic device SUSE 4.0 with halogen lamp 120 W	1 Dig. Multimeter 4 Lab wires 50 cm each 1 switchable 3x desk power socket 1 Stop watch 1 Folding rule	Electric mobility, filling a solar vehicle at the solar module with different voltages, charging and discharging a GoldCap, driving experiment with the solar vehicle
Learning station 5 SFSEK5 Solar modules	2 10W solar modules SUSE 4.52 1 20W solar module SUSE 4.42 1 LED module SUSE 4.15-24 rainbow 1 smartphone charging device SUSE 4.17 with USB cable (USB to micro USB) 1 powerbank battery pack	1 Dig. multimeter 1 switchable 3x desk power socket 4 Lab wires 50 cm each 1 Stop watch 1 Folding rule	Solar module technology with a professional solar module (4.52 with 18 solar cells, 4.42 with 36 solar cells), solar charging of smartphones and powerbank battery packs

In case of interest in solar thermal experiments the learning station 5 can also be switched to learning station 6 with the solar thermal collector ES.

Suncatcher box SEKI = Each learning station SFSEK 1-5 twice: 1599,00 € net plus shipping and taxes

SUNdidactics
SolarEnergyDidactics
SolarEducation
SolarEngineering

innovative Solarsysteme für Schule und Ausbildung
innovative solar- systems for school, college, technical education

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- Solarzellen
- Solarmodule
- Photovoltaik- Experimentiergeräte
- Photovoltaik- Gerätentwicklung
- Experimentieranleitungen didaktische Konzepte
- Solarberatung
- Solar- Workshops
- Solar- Fortbildung für Lehrkräfte
- solare Aus- und Weiterbildung
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Phone: +49(0)5121 86 07 30 Fax: +49(0)3222 370 66 89 Mail: wr.schanz@t-online.de
Mobile: +49(0)175 766 06 07 Web: www.sundidactics.de Mail: info@sundidactics.de

cooperation www.nils-isfh.de

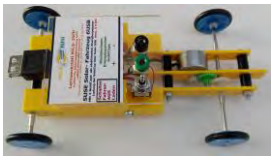
Experimental learning stations on solar energy

Photovoltaics, solar radiation, solar heat, optoelectronics

Experiments from the learning workshop NILS-ISFH for classes, training, workshops, project days, labs
Execution in sunlight/daylight outdoors or with halogen spot lamps indoors
www.nils-isfh.de Field of application (FA): Secondary schools, Difficulty levels: 1 (easy), 2(medium), 3(advanced)

Experimental learning stations

Group	Field of application; level	Time requirement ca. min	Age group ca. years
A	ISCED 2; 1,2	30 min	11 - 14
B	ISCED 2; 2,3	45 min	12- 15
C	ISCED 2; 2,3 Selection of experiments	> 45 min	14- 16
D	ISCED 3	60 min	16- >18
E	Self-assembly Solar modules, solar vehicles solar boats	**≥60 min**	>12
F	For students aged 8- 11 years: 30 learning stations for primary school with the suncatcher box GS		
G	Short learning stations ca. 20 min for ISCED levels 2 and 3 for fairs, exhibitions, workshops		
H	Learning stations for groups ca. 30 min.		



Experimental learning stations on solar energy

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Execution in sunlight/daylight outdoors or with halogen spot lamps indoors
www.nils-isfh.de Field of application (FA): Secondary schools, Levels: 1 (easy), 2(medium), 3(advanced)
www.sundidactics.de

Each learning station includes an extensive experimentation manual with a bill of materials, setup instructions, experiments, basic information, and assignments. Info and offers can be obtained from nils@isfh.de or info@sundidactics.de

Overview of the learning stations A Age group 11-14 years

Group	No.	Topic	Time ca. min	Levels Notes
A	1	Connection of solar motors to a solar module with SUSE CM6MS or SUSE 4.2, SUSE 4.16	30	1,2
A	2	Measuring voltage, current, power of a solar cell with SUSE 4.33	30-45	1,2
A	3	SUSE 4.12 as solar energy storage with SUSE 4.3 RB, 4.12, 4.15, 4.16	30-45	1,2
A	4	Radio operation with solar module and solar storage with SUSE 4.3RB, 4.36, 4.12	30-45	1,2
A	5	Experiments with solar motors and generators with SUSE 4.3RB, 4.16	30-45	1,2
A	6	Series connection of solar cells with 2x SUSE 4.33	30-45	1,2
A	7	Series connection of solar cells with 6x SUSE CM6B	30-45	1,2
A	8	Parallel connection of solar cells with SUSE 4.33	30-45	1,2
A	9	Parallel connection of solar cells with 6x SUSE CM6B	30-45	1,2
A	10	Simple experiments with solar cell fragments	30-45	1,2
A	11	Charging a smartphone on a 10W solar module with SUSE 4.52, DC-DC converter SUSE 4.17	30-45	1,2
A	12	Experiments on solar radiation and light radiation with SUSE 4.24 and SUSE 5.23	30-45	1,2
A	13	Experiments with the solar vehicle 4 with solar vehicle 4 and solar filling station SUSE 4.34	30-45	1,2
A	14	Experiments with the solar vehicle 1.2 and solar filling station with SUSE 4.3 RB, 4.35, solar vehicle 1.2	30-45	1,2
A	15	Simple experiments with the solar vehicle 3	30-45	1,2
A	16	Experiments with the solar thermal collector (stagnation collector) with the stagnation collector GS	30-45	1,2
A	17	Experiments with solar toys with solar boat, solar cricket, solar racer, solar helicopter...	30-45	1,2
A	18	Experiments with a 10W solar module with SUSE 4.52	30-45	1,2
A	19	Experiments with the solar construction kit 6-in-1 with 6in1	30-45	1,2
A	20	Experiments with the SUSE solar vehicle 6USB and the solar filling station SUSE 4.50-10	30-45	1,2

Overview of the learning stations B Age group 12-15 years

Group	No.	Topic	Time ca. min	Levels Notes
B	1	Experiments with the solar module SUSE 4.33 with SUSE 4.33	45	2,3
B	2	Experiments with the solar module SUSE 4.3 with SUSE 4.3	45	2,3
B	3	Experiments with the solar module SUSE 4.3RB with SUSE 4.3 RB	45	2,3
B	4	Experiments with the 10W solar module SUSE 4.52 with SUSE 4.52, charge controller SUSE 4.17, LED reading lamp, solar vehicle SF6USB	45	2,3
B	5	Experiments with the 10W solar module SUSE 4.41 with SUSE 4.41, charge controller SUSE 4.17, LED reading lamp, solar vehicle SF6USB	45	2,3
B	6	Determination of the light intensity = irradiance with SUSE 5.22	45	2,3
B	7	Experiments with the solar vehicle 1.2 with SUSE 4.36,4.35, solar vehicle 1.2	45	2,3
B	8	Experiments with the solar thermal collector with the thermosiphon solar collector	45	2,3
B	9	Quality determination of solar cells with SUSE 5.22, solar cell fragments	45	2,3
B	10	Dependence of V,I,P from the solar cell area with SUSE CM6MS	45	2,3
B	11	Solar module as charging station for a smartphone + powerbank with SUSE 4.52, 4.17, powerbank battery pack	45	2,3
B	12	Experiments with the 20W solar module SUSE 4.42 with SUSE 4.42, charge controller SUSE 4.17, LED reading lamp, solar vehicle SF6USB	45	2,3
B	13	LEDs as solar cells with SUSE 4.20IRRB, SUSE 5.16	45	2,3
B	14	Angle dependence of V,I,P of a solar cell with SUSE 5.22alpha, SUSE 5.16	45	2,3
B	15	Efficiency factor determination of solar cells with SUSE 5.22, solar cell fragments, raw solar cells	45	2,3
B	16	Reduced output of solar modules: clouding/shadowing with SUSE 5.22	45	2,3
B	17	Experiments with the solar vehicle 3 with solar vehicle 3	45	2,3
B	18	Experiments on solar radiation/light radiation with SUSE 5.23/4.24A	45	2,3
B	19	Experiments with the LED module SUSE 4.20IRRB with SUSE 4.20IRRB, 4.3RB	45	2,3
B	20	Intensity measurements with solar cells on an overhead projector with SUSE CM6B or CM6MS	45	2,3
B	21	Experiments with a vacuum tube solar thermal collector and with a heat pipe solar collector	45	2,3
B	22	Experiments with the solar boat 4	45	2

Overview of the learning stations C Age group 14-16 years

Group	No.	Topic	Time ca. mi	Levels Notes
C	1	Experiments with the solar module SUSE CM4MBV with SUSE CM4MBV, 4.16, 4.15, 4.36, 4.12	≥45 Selection possible	2,3
C	2	Experiments with the solar module SUSE CM6MS with SUSE CM6MS, 4.16, 4.15, 4.36	≥45 Selection possible	2,3
C	3	Experiments with the solar module SUSE 4.3RB with 4x SUSE 4.3RB, 4.15, 4.16, 4.17, 4.19, solar vehicle 1.2	≥45 Selection possible	2,3
C	4	Experiments with the solar thermal collector GS Taking temperature curves	≥45 Selection possible	2,3
C	5	Experiments with the solar module SUSE 4.3 with SUSE 4.3, solar motor SUSE 4.16, LED module SUSE 4.15, radio SUSE 4.36	≥45 Selection possible	2,3
C	6	Experiments with 2 solar modules by comparison 5 W- 10W with 2 solar modules SUSE 4.51-5W and 4.41-10W, charge controller SUSE 4.17, powerbank battery pack	≥45	2,3
C	7	Experiments with 2 solar modules by comparison 5W- 20W with solar modules 5W (SUSE 4.51), 20W (SUSE 4.42), charge controller SUSE 4.17, powerbank battery pack	≥45	2,3
C	8	Experiments with 2 solar modules by comparison 5W- 5W with 2 solar modules 5W (SUSE 4.43 and 4.51), charge controller SUSE 4.17, powerbank battery pack	≥45	2,3
C	9	Experiments with 3 solar modules by comparison 5W- 10W- 20W with solar modules SUSE 4.51 (5W), SUSE 4.41 (10W), SUSE 4.42 (20W), charge controller SUSE 4.17, powerbank battery pack	≥45	2,3
C	10	Experiments with a solar module 125 W with solar module 125 W	≥45	2,3
C	11	Experiments with the solar measurement module SUSE 5.23 with SUSE 5.23	≥45	2,3
C	12	Experiments with the solar vehicle 3 with solar vehicle 3 + PC interface	≥45	2,3
C	13	Taking I-V and P-V characteristic curves with SUSE 5.15 + PC interface	≥45	2,3
C	14	Experiments with the solar module SUSE 4.41 10W	≥45	2,3
C	15	Experiments with the solar module SUSE CM312 with SUSE CM312, 4.36, 4.16	≥45 Selection possible	2,3
C	16	Experiments with the solar module SUSE CM315 with SUSE CM315, 4.36, 4.16	≥45 Selection possible	2,3
C	17	Experiments on the decrease of V,I,P from shadowing with SUSE 5.22, PC interface	≥45	2,3
C	18	Experiments with the 5W solar module SUSE 4.51 with 2x SUSE 4.51	≥45	2,3
C	19	Experiments with the 10W solar module SUSE 4.41 with 2x SUSE 4.41	≥45	2,3
C	20	Experiments with the 20W solar module SUSE 4.42 with 2x SUSE 4.42	≥45	2,3
C	21	Mini USB off-grid system with SUSE 4.52, reading lamp 4.15USB, powerbank battery pack, USB measurement technology, radio SUSE 4.36USB, short-time storage 4.12 USB, solar motor 4.16 USB	≥45	2,3
C	22	Experiments with the 2 solar cell solar module SUSE CM318 with switch to toggle parallel and series connection	≥45	2,3
C	23	Experiments with the solar module SUSE 4.2	≥45	2,3
C	24	Experiments with the 10W solar module SUSE 4.52	≥45	2,3

Overview of the learning stations
D - ISCED 3 College

Age group 16->18 years with key subjects

Group	No.	Topic	Time ca. min	FA Notes
D	1	Experiments with the characteristic curves module SUSE 5. with SUSE 5.15, PC interface Taking of characteristic curves and efficiency factor determination Radiation, semiconductor physics, el. fields, energy conversion	90	ISCED 3
D	2	Experiments with the solar vehicle 3 with capacitor charging and discharging El. fields, energy conversion, radiation	60	ISCED 3
D	3	Experiments with the solar vehicle 1 with capacitor charging and discharging El. fields, energy conversion, radiation	60	ISCED 3
D	4	Experiments with the solar vehicle 1.2 with capacitor charging and discharging El. fields, energy conversion, radiation	60	ISCED 3
D	5	Experiments with the LED module SUSE 5.9-6 with SUSE 5.9-6 Radiation, semiconductor physics, el. fields, quantum physics, wave physics	60	ISCED 3
D	6	Spectral analysis with the LED module SUSE 5.9-6 Quantum physical effects on LEDs Radiation, semiconductor physics, el. fields, quantum physics, wave physics	60	ISCED 3
D	7	Collector cooling and capacitor in comparison with solar collector and GoldCap capacitors Thermodynamics, el. fields, energy conversion, radiation	60	ISCED 3
D	8	Capacitor charging on a solar module with SUSE 4.3RB, 4.12 El. fields, radiation	60	ISCED 3
D	9	Capacitor discharging on a solar module with SUSE 4.3RB, 4.12, 4.16 El. fields , energy conversion, radiation	60	ISCED 3
D	10	Angle dependence of V,I,P of a solar cell with SUSE 5.22alpha, 5.16 Semiconductor physics, radiation	30	ISCED 3
D	11	Heating and cooling a solar thermal collector Measurement and calculation of stagnation temperature, efficiency factor determination Thermodynamics	60	ISCED 3
D	12	PV experiments with the solar module SUSE CM6MS Semiconductor physics, radiation	90	ISCED 3
D	13	Experiments with the SUSE solar vehicle 4 and solar filling station SUSE 4.34, energy conversion processes, capacitor charging and discharging Energy conversion, Mechanics, el. fields	90	ISCED 3
D	14	Efficiency factor determination at 2 solar cells in compariso through MPP measurements with 2x SUSE 5.15 (1 monocrystalline cell from 2017 and 1 multicrystalline cell from 2011) with the measurement value acquisition system CassyLab El. fields	45-60	ISCED 3
D	15	Shadowing experiments with SUSE 5.22, CassyLab, SUSE 5.16, Display of exponential absorption	45	ISCED 3

Overview of the learning stations E

Age from 12 years Self-assembly of solar modules

For the self-assembly of solar devices material expenses are incurred.

Group	No.	Topic	Time ca. mi	Levels Notes
E	1	Self-assembly of the solar module SUSE CM312 Experiments with the solar module SUSE CM312 and additional devices	>60	Self-assembly + experiments
E	2	Self-assembly of the solar module SUSE CM315 Experiments with the solar module SUSE CM315 and additional devices	>60	Self-assembly + experiments
E	3	Self-assembly of the solar module SUSE CM4MBV Experiments with the solar module SUSE CM4MBV and additional devices	>60	Self-assembly + experiments
E	4	Self-assembly of the solar module SUSE CM6MS Experiments with the solar module SUSE CM6MS and additional devices	>60	Self-assembly + experiments
E	5	Self-assembly of a solar module from solar cell fragments Experiments with the solar module and additional devices	>60	Self-assembly + experiments
E	6	Self-assembly of the solar boat 4 Experiments with the solar boat	>60	Self-assembly + experiments
E	7	Self-assembly of the solar vehicle 1	ca.60	Self-assembly + experiments
E	8	Self-assembly of the solar vehicle 1.2	>60	Self-assembly + experiments
E	9	Self-assembly of the solar vehicle 3B	>60	Self-assembly + experiments
E	10	Self-assembly of the solar vehicle 4	>60	Self-assembly + experiments
E	11	Self-assembly of the solar vehicle 5	ca. 60	Self-assembly + experiments
E	12	Self-assembly of the solar module 4.34 (Solar charging station for SF1,SF4)	ca. 45	Self-assembly + experiments
E	13	Self-assembly of the solar vehicle solar racer	ca.30	Self-assembly + experiments
E	14	Self-assembly of the solar module 4.35 (Solar charging station for SF1.2)	ca. 45	Self-assembly + experiments
E	15	Self-assembly of the beginner's solar module SUSE CM310	ca.45	Self-assembly + experiments
E	16	Self-assembly of the solar module SUSE CM318	> 60	Self-assembly + experiments
E	17	Self-assembly and calibration of the solar radiation measurement module SUSE 4.24A	> 60	Self-assembly + calibration
E	18	Self-assembly of the solar module SUSE CM316	ca.60	Self-assembly + experiments
E	19	Self-assembly of the solar module SUSE CM319	ca.45	Self-assembly

Overview of the learning stations F - Primary school

For Primary Schools, NILS-ISFH developed Hamelin's suncatcher box with 30 experimental learning stations and an extensive teacher's manual with solutions, as well as a students' booklet.

The 30 learning stations of the suncatcher box GS

No.	Experiment	Required devices plus indoors: halogen lamp 120 W
1	Experiments with the solar vehicle solar racer	Solar racer, folding rule, stopwatch
2	How does a solar cell perform best?	Solar module SUSE CM6MS, multimeter, lab wires
3	Who measures the highest current?	Solar module SUSE CM6MS, multimeter, lab wires
4	Comparison solar cell vs. battery	Solar module SUSE CM6MS, multimeter, mignon battery, lab wires
5	Series connection of batteries	Multimeter, mignon batteries, lab wires
6	Series connection of solar cells	Solar module SUSE CM6B, multimeter, lab wires
7	Operation of a radio with solar modules in series connection	Solar module SUSE CM6B, solar radio SUSE 4.36, lab wires
8	Operation of a radio with the solar module SUSE 4.3RB	Solar module SUSE 4.3RB, solar radio SUSE 4.36 multimeter
9	Storage of solar current, LED module	Solar module SUSE CM6B, lab wires, solar storage SUSE 4.12, LED module SUSE 4.15 rainbow
10	Storage of solar current, solar motor	Solar module SUSE CM6B, solar storage SUSE 4.12, solar motor SUSE 4.16, lab wires
11	Solar car with solar charging station	Solar module SUSE 4.3RB, SUSE solar vehicle 1.2, lab wires
12	When does the rainbow LED glow?	Solar module SUSE 4.3RB, LED module SUSE 4.15 rainbow, lab wires, multimeter
13	Which air screw rotates the fastest?	Solar module SUSE 4.3RB, solar motors SUSE 4.16, lab wires, multimeter
14	How many solar motors can a solar cell fuel?	Solar module SUSE CM6B, solar motors SUSE 4.16, lab wires, multimeter
15	Changing the solar cell area by covering	Solar module SUSE CM6B, multimeter, lab wires
16	Positioning of a solar cell in different cardinal directions	Solar module SUSE CM6B, multimeter, compass, lab wires
17	Experiments with the solar radiation meter	Solar radiation meter SUSE 4.24, compass
18	Experiments with solar cell fragments	Solar cell fragments, solar motor SUSE 4.16, lab wires, multimeter
19	Who measures the highest current with a solar cell fragment?	Solar cell fragments, multimeter, lab wires
20	The solar motor as a wind power plant	Solar motors SUSE 4.16, multimeter, lab wires
21	Wind power lets the LED glow	Solar motor SUSE 4.16, LED module SUSE 4.15, lab wires
22	Solar toys	Solar toys 6in1, solar butterfly, solar helicopter
23	Experiments with the thermometer	Digital thermometer
24	Experiments with the solar thermal collectors	Digital thermometers, solar thermal collectors
25	Heating of water in the solar thermal collector	Digital thermometers, solar thermal collector, test tube, water
26	Charging a phone with solar energy at the solar module SUSE 4.50-10GS and charging powerbank battery packs	Solar module SUSE 4.50-10, smartphone with USB charging cable, powerbank battery pack
27	Solar module SUSE 4.50-10 as a solar charging station	Solar module SUSE 4.50-10, solar vehicle SF6USB, USB cable (2x plug USB A)
28	Operating a radio and LED lamp at the solar module SUSE 4.50-10	Solar module SUSE 4.50-10, solar radio SUSE 4.36 USB, LED lamp with USB plug

29	Comparative experiments with big and small solar cells	Solar module SUSE CM6MS, solar module SUSE CM315, multimeter, 2 lab wires
30	Discover your own experiments with the solar module SUSE CM400	Solar module SUSE CM400

Overview of the short learning stations G – ISCED 2 and 3

ISCED 2: Age group 12->16 years ISCED 3: Age group >16 years Time: ca. 20 min

If there is only a limited amount of time available for experiments with learning stations, for example at fairs, exhibitions, workshops, the short learning stations, that only require ca. 20 min. to be conducted, fit perfectly. The experimental set up is usually already done previously. For each learning station there is a short, illustrated manual.

Short learning stations for ISCED level 2 Difficulty level 2		
No. <20	Description of the experiment	Required devices
G1	Measuring voltage, current, power of a solar module with 1 solar cell at different light intensities	Solar module SUSE 4.2/CM6MS/CM6B,1 multimeter, 2 lab wires red/black, 1 basic device SUSE 4.0, 1 switchable desk power socket , poss. overhead projector
G2 .	6 solar cells in series connection with solar module SUSE 4.3RB, connection to an LED module SUSE 4.15 or solar motor SUSE 4.16	Solar module SUSE 4.3RB, 1 multimeter, 4 lab wires 2x red/2x black, LED module SUSE 4.15, solar motor SUSE 4.16, 1 basic device SUSE 4.0, 1 switchable desk power socket
G3 .	Outdoor experiments with SUSE 4.3RB, multimeter and radio	Solar module SUSE 4.3RB, multimeter, 2 lab wires red/black, solar radio SUSE 4.36, 1 basic device SUSE 4.0, 1 switchable desk power socket
G4	Series connection with single modules SUSE CM6B, Connection to an LED module SUSE 4.15 or solar motor SUSE 4.16	6 solar modules SUSE CM6B, 5 metal filing strips or 5 short lab wires, 1 multimeter, 4 lab wires red/black, 1 LED module SUSE 4.15, 1 solar motor 4.16, 1 basic device SUSE 4.0, 1 switchable desk power socket
G5 .	Experiments with the solar electric car SF1.2, solar module SUSE 4.3RB or solar charging station SUSE 4.34	1 solar electric car SF1.2, 1 multimeter, 4 lab wires red/black, 1 solar module SUSE 4.3RB, 1 solar charging station SUSE 4.34, 1 basic device SUSE 4.0
G6 .	Experiments with solar modules SUSE 4.51 (5W) and SUSE 4.52(10W) in comparison: voltage-current-power	1 5W solar module SUSE 4.51 and 10W module SUSE 4.52, 1 multimeter, 2 lab wires red/black Indoors: spot light 400W + switchable desk power socket
G7 .	Experiments with the solar vehicle SF6USB and the solar module SUSE 4.51 (5W) or 4.52 (10W)	1 solar module SUSE 4.51 or 4.52, 1 multimeter, 2 lab wires red/black, 1 DC-DC converter SUSE 4.17, 1 solar vehicle SF6USB, 1 USB cable A-A, 1 USB measurement device, Indoors: spot light 400W + switchable desk power socket
G8	Outdoor experiments with SUSE 5.23 or SUSE 4.24A: Measuring the light intensity = irradiance S of the light	1 radiation meter SUSE 5.23 (digital) or 4.24A (analog), compass
G9	Solar thermal experiments with the solar thermal collector GS	1 solar thermal collector GS, 1 thermometer, 1 halogen lamp 120 W with handle
G10 .	Outdoor photovoltaic experiments with the 20W solar module SUSE 4.42 with solar smartphone charger SUSE 4.17	1 20W solar module SUSE 4.42, 1 multimeter, 2 lab wires red/black, 1 charging device SUSE 4.17, 1 USB measurement device, personal smartphone, halogen lamp 400W
G10A	Outdoor photovoltaic experiments with the 10W solar module SUSE 4.52 with solar smartphone charger SUSE 4.17	1 10W solar module SUSE 4.52, 1 multimeter, 2 lab wires red/black, 1 charging device SUSE 4.17, 1 USB measurement device, personal smartphone Indoors halogen lamp 400W
G11 .	Photovoltaic experiments with the solar module SUSE CM312/CM315/CM316 Short manual	Solar module SUSE CM312/315/316, multimeter with 2 lab wires red/black, 6 additional lab wires, 1 LED module SUSE 4.15, 3 solar motors SUSE 4.16, 1 solar radio SUSE 4.36
G12 .	Photovoltaic experiments with the solar module SUSE CM6MS Short manual	Solar module SUSE CM6MS, 1 multimeter with 2 lab wires red/black, 6 additional lab wires,1 LED module SUSE 4.15, 4 solar motors SUSE 4.16, 1 solar radio SUSE 4.36
G13 .	Storing solar current I with a solar module with 1 solar cell with SUSE CM312 or CM315/CM316/CM6MS/CM6B	Solar module SUSE CM312(or CM315, CM6MS, CM6B),1 multimeter with 2 lab wires red/black, 2 additional lab wires, 1 storage module SUSE 4.12, 1 solar motor SUSE 4.16, basic device SUSE 4.0 + switchable desk power socket
G14 .	Storing solar current II with a solar module with 6-8 solar cells in series connection with SUSE 4.3RB (6 cells) or 4.35 (8 cells)	Solar module SUSE 4.3RB or solar module SUSE 4.35, 1 multimeter with 2 lab wires red/black, 4 additional lab wires, 1 storage module SUSE 4.12, 1 solar motor SUSE 4.16, 1 LED module SUSE 4.15, 1 radio SUSE 4.36 Indoor: basic device SUSE 4.0 + switchable desk power socket
G15 .	Storing solar current III with solar module SUSE 4.51 (5W, 18 solar cells) or 4.52 (10 Watt, 18 solar cells) with GoldCap storage SUSE 4.12-USB, Powerbank battery pack, LED lamp SUSE 4.15USB + charging module SUSE 4.17 + radio SUSE 4.36USB, solar motor SUSE 4.16USB and USB measuring device	Solar module SUSE 4.51 or 4.52, 1 USB measurement device, 1 Powerbank battery pack, 1 USB cable 2x plug A, 1 charging device SUSE 4.17, 1 LED lamp, multimeter with 2 lab wires red/black 1 solar radio SUSE 4.36 USB, 1 solar motor SUSE 4.16USB. Indoor: spot light 400 W + switchable desk power socket
G16 .	Solar motor as a generator or wind power plant with SUSE 4.16 or SUSE CM316	2x solar motor SUSE 4.16 or 2x SUSE CM316 1x multimeter, 4 lab wires 2x red + 2x black, 1 LED module red SUSE 4.15, 1x storage module SUSE 4.12

G17	**Experiments with solar modules 5W….40W** Power and quality analysis with SUSE 4.41/4.42/4.43/4.51/4.50…	1-2 solar modules of own choice, multimeter with 2x lab wires red/black, folding rule, ruler, calculator or calculator app on the smartphone
G18	Experiments with solar cell fragments Are solar cell fragments usable?	Raw solar cells 52x52 mm Solar cell fragments, cell connectors, multimeter, crocodile clips, set square, mm paper, soldering station with tin solder, overhead projector
G19 .	Experiments with the solar module SUSE CM319 Experiments on series connections (short version)	2-3 solar modules SUSE CM319, multimeter, 4x lab wires, 3x red, 1x black, 1 solar motor SUSE 4.16, 1 LED module SUSE 4.15
ISCED level 3 Difficulty level 3		
No. >20	Description of the experiment	Required devices
G21 .	Voltage, current, irradiance measurements with the solar module SUSE CM6MS, comparison to characteristic curves	Solar module SUSE CM6MS, basic device SUSE 4.0, 1 multimeter, overhead projector, 2 lab wires
G22 .	Determination of the efficiency factor and power with the solar module SUSE CM6MS and measuring system CassyLab, recording of the I(V) and P(V) characteristic curves	Solar module SUSE CM6MS, basic device SUSE 4.0, load module SUSE 4.55-1, measuring system CassyLab, laptop
G23	Operation of the solar vehicle SF4 with solar module SUSE 4.34 (4 cells in series connection), observation and measurement of the charging and discharging of the GoldCap capacitor	1 solar module SUSE 4.34, 1 basic device SUSE 4.0, 1 SUSE solar vehicle 4, 1 multimeter, 8 lab wires poss. CassyLab with laptop
G24	Outdoor experiments with the 5W solar module SUSE 4.51 or 10W module SUSE 4.52, determination of V,I,P,S, comparison to characteristic curves and manufacturer data	1 solar module SUSE 4.51, 1 multimeter, 1 compass
G25	Shadowing experiments with SUSE 5.22 and CassyLab	1 optical bank SUSE 5.0alu, 1 halogen spotlight SUSE 5.16 with power supply 12V, 2 pipe collars, 6 lab wires (red, black, 2x yellow, green, blue) Cassylab with power supply, USB cable, PC or laptop
G26	Recording the I(V) characteristic curve on a solar cell with SUSE 5.15 and CassyLab, determination of MPP, efficiency factor, filling factor	1 optical bank SUSE 5.0alu, 1 halogen spotlight SUSE 5.16 with power supply 12V, 2 pipe collars, 6 lab wires (red, black, 2x yellow, green, blue) Cassylab with power supply, USB cable, PC or laptop

Overview of the learning stations H

for groups of up to 15 participants

These learning stations are applied with students groups at the ISFH for partial groups that don't work in the NILS lab.

No.	Description of the experiment	Required devices
H1	Experiments on energy conversion and voltage measurements on solar cells and solar modules with various solar cells, solar modules, Peltier element, solar motor SUSE 4.16, LED module SUSE 4.15	Experiments outdoors or indoors 8 different solar cells + solar modules, 1 Peltier element, 1 x SUSE 4.16, 1x SUSE 4.15, 1 halogen spotlight 120W, 1 halogen spotlight 400W, 1 red light lamp, 5 multimeters
H2	Experiments on energy conversion, reversibility, and voltage, current, and power measurement on solar cells, LEDs, and on a Peltier element	Experiments outdoors or indoors 4 different solar cells (twice each), LED module SUSE 5.9-6 (twice each), power supply 5V, battery 9V, 1 Peltier element , halogen spotlight 400W, 1 overhead projector, 5 multimeters, lab wires

Mini USB off-grid system complete solar energy supply

With 10 W solar module SUSE 4.52, USB DC-DC converter SUSE 4.17, USB powerbank battery pack, USB radio SUSE 4.36, USB lighting with 8 white LEDs, USB measurement device for measuring the voltage, current, charge, electric vehicle SUSE SF6USB, short-time storage module SUSE 4.12 USB, solar motor SUSE 4.16USB and 2 USB cables

Off-grid systems are photovoltaic units for an energy supply of buildings and technical units, that are not connected to the public power supply system. In Germany these off-grid systems are found for example in parking meters or on the highway for display panels or speed monitoring systems, in community gardens or on caravans. In many regions of Africa or Latin America, there are areas without a power supply grid, here PV off-grid systems are used as an energy supply for buildings, villages, facilities (e.g. cell phone towers).
Technically these systems usually are based on a 12V DC system, they consist of solar modules, charge controllers, 12V rechargeable batteries; we use the 5V DC system on a USB basis.

The mini USB off-grid system used by NILS-ISFH or SUNdidactics is based on the 5V/3,7V DC system and uses the USB - micro USB charging technology applied internationally for smartphones and tablet PCs. All used devices use the well-known USB-A plugs and micro-USB plugs. These inexpensive installations can be used directly in practice, but they also conduce to the photovoltaic education of students and teachers with additional experimental exercises.

The mini USB photovoltaic off-grid system consists of a 10W solar module SUSE 4.52, the charge controller with USB output SUSE 4.17, the powerbank battery pack, the radio SUSE 4.36 USB, a USB reading lamp with 8 white LEDs, the solar vehicle SF6USB, the USB measuring device, a short-time storage module SUSE 4.12USB, a solar motor with propeller SUSE 4.16USB, as well as 2 USB cables (1x USB-A to micro USB, 1x cable with 2x USB-A plugs). A cell phone, smartphone or tablet PC can be charged by solar power with this system. The powerbank battery pack or the smartphone have integrated charge controlling technology, so that the 3.7 V rechargeable battery is charged correctly. With this system, cell phones, smartphones, tablet PCs, and powerbank battery packs can be charged in the daytime in remote areas, at night the electric energy from the powerbank battery pack conduces to the electric power supply. Several systems are already in use in Africa.
With the solar module SUSE 4.52 and the accessory devices, photovoltaic experiments for the solar education of students and teachers can be conducted with the help of extensive manuals.

The components of the mini USB photovoltaic off-grid system:

Top: USB charge controller SUSE 4.17

Bottom: USB radio SUSE 4.36USB

10W solar module SUSE 4.52
With LED + desk/ground positioner

Powerbank battery pack
(picture similar)

Solar motor
SUSE 4.16USB

Short-time storage device SUSE 4.12USB

Reading lamp SUSE 4.15USB

Solar vehicle SF6USB

USB measurement technology to measure voltage, current, charge

Scope of delivery: 10W solar module SUSE 4.52, 1 powerbank battery pack 3,7 V/ 5V>5000 mAh, 1 USB reading lamp with 8 LEDs, 1 DC-DC converter SUSE 4.17M, 2 USB cables (USB to micro USB and USB-A to USB-A), 1 solar radio SUSE 4.36 USB, 1 USB measurement device, 1 solar vehicle SUSE SF6USB, 1 short-time storage device SUSE 4.12USB, 1 solar motor SUSE 4.16USB, extensive experimentation manuals and technical, solar didatic consultation service. Set price ready-to-**use devices** **199,95 €**

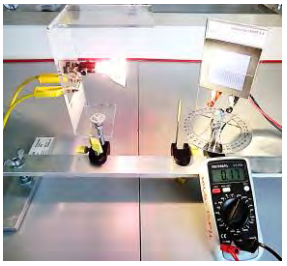
SUSE 5.0Alu Optical bench made of aluminum

Solid aluminum profile 30 x 10 x 600mm, length 600mm, width 200mm (feet), height 70mm, for the use with clamp holders commonly used in schools. For all devices of the SUSE 5.xx series (the 2 clamp holders visible in the picture are not included in delivery).
Very robust! With mounting screw (included in delivery) also applicable without feet on stand systems or tripods. Clamp holders not included in delivery!
They can optionally be delivered on request.
Ready-to-use device **31,95 €**

SUSE 5.1 High power solar cell with jack pair

V_{oc} = 0,64 V I_{sc} = 1020 mA on plexiglass support 155 x 80 x 4 mm with monopod rod M8, for operation on school stand systems or opt. Bench SUSE 5.0, with characteristic curves file
The multimeter displays the cell voltage in the winter sunlight: 0,59 V.
With detailed, extensive experimentation manual
Ready-to-use device **19,98 €**
Technical and operation manual at sundidactics.de/Download

SUSE 5.1alpha High power solar cell with angle scale for measuring the angle dependency of voltage/current/power



On the right-hand side in the picture: SUSE 5.1alpha on optical bench SUSE 4.0 with the 360° angle disc (Aristo full circle angle).
On the left-hand side the halogen spotlight SUSE 5.16
On plexiglass support 155 x 80 x 4 mm with monopod rod M8
With detailed, extensive experimentation manual
Ready-to-use device **29,98 €**
Technical and operation manual at sundidactics.de/Download

SUSE 5.33 Solar module with 3 solar cells in pluggable series connection, analog to SUSE 4.33

With 6 jacks + 2 connector plugs
On plexiglass support 310 x 80 x 4 mm with monopod rod M8, in series connection: V_{oc} = 1,89 V, I_{sc} = 1020 mA, P = 1,4 W
With detailed, extensive experimentation manual
New: Connector plug with measurement jack
Sleeve not included in delivery
Ready-to-use device **51,49 €**
Technical and operation manual at sundidactics.de/Download

SUSE 5.9-6 Module with 6 vertically mounted LEDs for electronic, quantum and wave optical experiments, operating voltage 5V DC.

IR 950 nm red 626 nm yellow 590 nm green 528 nm blue 470 nm UV 400 nm
High-quality, monochromatic LEDs, individually switchable with a switch, V_D individually measurable at 6 measurement jacks
On plexiglass support 220x 100x 5 mm
With detailed, extensive technical and experimentation manual
Ready-to-use device **58,95 €**
Technical and operation manual at sundidactics.de/Download

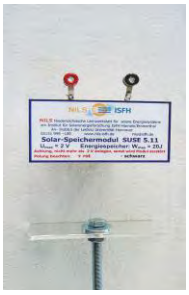
B System 5.xx- Photovoltaic devices and accessories for ISCED level 3 Upper secondary education + job training

SUSE CM594

Module with 4 vertically mounted LEDs
for electronic, quantum and wave optical experiments, IR 950 nm, red 626 nm, green 528 nm blue 470 nm. High quality, nearly monochromatic LEDs, individually switchable with a switch, V_D individually measurable at 4 measurement jacks
On plexiglass support 330 x 80 x 3 mm, bent roof-shaped
With detailed, extensive technical and experimentation manual
Ready-to-use device **51,95 €**
Technical and operation manual at sundidactics.de/Download

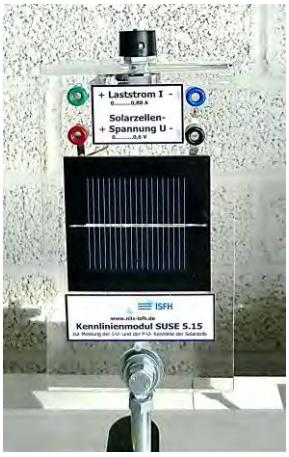
SUSE 5.11

Storage module with supercapacitor 5,0F /3 V
for experiments on the storing of electric energy. The photovoltaically gained electric energy is stored in the capacitor, a solar motor runs about 15 more minutes with a full charge! Storage capacity: 22,5 J.
On plexiglass support 220 x 100 x 5 mm
With detailed, extensive technical and experimentation manual
Ready-to-use device **18,95 €**
Technical and operation manual at sundidactics.de/Download



SUSE 5.12

do., but with 2 supercapacitors in series connection
V_{max} = 6 V, Storage capacity: 45 J
On plexiglass support 220 x 100 x 5mm
With detailed, extensive technical and experimentation manual
Ready-to-use device **23,98 €**
Technical and operation manual at sundidactics.de/Download

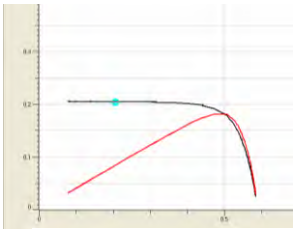


SUSE 5.15

Solar module with potentiometer for recording characteristic curves I(V) and P(U) of a solar cell, as well as the maximum power point MPP, with 2 jack pairs for V and I measurements, with high power solar cell 0,64 V/1020 mA.
On plexiglass support 220 x 100 x 5 mm

With detailed, extensive technical and experimentation manual
Ready-to-use device **54,25 €**
Technical and operation manual at sundidactics.de/Download

I(V) and P(U) characteristic curves recorded with SUSE 5.15 and PC interface



SUSE 5.16

Halogen spotlight for experiments 12 V, 35 W
For PV experiments on an optical bench with 2 jacks on plexiglass support (with 35W illuminant, halogen reflector), power supply 12V/ 3 A required.
On plexiglass support 330 x 80 x 4 mm
With detailed, extensive technical and experimentation manual
Ready-to-use device **33,95 €**
Technical and operation manual at sundidactics.de/Download

SUSE 5.21

Holder for diffraction grating for the wavelength determination of light (without diffraction grating) – Delivery of a diffraction grating o request
With detailed, extensive technical and experimentation manual
On plexiglass support 220x 100x 5 mm
Ready-to-use device 23,95 €
Technical and operation manual at sundidactics.de/Download

B System 5.xx- Photovoltaic devices and accessories for ISCED level 3 Upper secondary education + job training

SUSE 5.22

Solar module with 2 solar cells and connector plug in series connection

for experiments with a single cell or a series connection, especially suited for recording characteristic curves:

V_{oc} (S) Open circuit voltage as a function of the irradiance S (light intensity)

I_{sc} (S) Short-circuit current as a function of the irradiance S (light intensity)

P(S) Power as a function of the irradiance S (light intensity)

In the experiment seen in the photo, V_{oc} = 586 mV and I_{sc} = 0,65 A are measured simultaneously on a cloudy day. From I_{sc} the irradiance of the sunlight can be calculated to be S = 739 W/m².

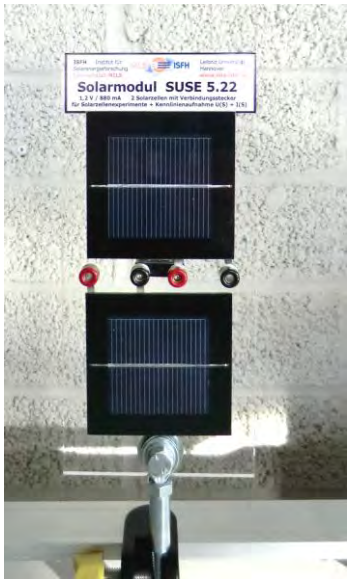
New: Connector plug with measurement jack

With detailed, extensive technical and experimentation manual

On plexiglass support 220x 100x 5 mm

Ready-to-use device **59,95 €**

Technical and operation manual at sundidactics.de/Download



SUSE 5.23

Digital measurement device for measuring the irradiance S of the sunlight in W/m² (or the light of artificial light sources) 0 – 2000 W/m², 4-digit display incl. 9V battery. The measurement device can be calibrated with the help of instructions!

At the red-black jack pair a measurement voltage for further data processing is available: 100 mV = 1000 W/m²

With detailed, extensive technical and experimentation manual

In synthetic casing 150 x 80 x 40 mm

Ready-to-use device **65,98 €**

Technical and operation manual at sundidactics.de/Download

Display of the solar irradiance S = 674 W/m² on a slightly cloudy day

SUSE 5.24

Analog measurement device for measuring the irradiance (intensity) of sunlight or the light of light sources (halogen spotlight or the like) respectively

Calibrated in W/m², no batteries required

On plexiglass support 220x 100x 5 mm

With detailed, extensive technical and experimentation manual

Ready-to-use device **49,95 €**

Technical and operation manual at sundidactics.de/Download

SUSE 5.100

Vertical joint for vertical rotation of SUSE 5.xx devices on optical benches or stand mounts

With this vertical joint the module SUSE 5.xx can be rotated 90° in the vertical plane to adjust it perfectly towards the sun in azimuth and elevation.

Ready-to-use device 13**,95 €**

Photovoltaic learning stations/ class sets for ISCED level 3

Class sets and learning stations

From the high number of different experimentation devices, a precisely fitting combination of devices/ experiments can be created for the specific needs of a school, a training center, or a learning group. We are happy to consult you on this in our learning workshop at the ISFH, via email, or by phone. Below you can find some examples of possible combinations:

Learning station ISCED3 - Basic

for up to 3 students, for solitary experiment work or small groups
With extensive device files, technical data, experimentation manuals: 1x printed out and on DVD

1x optical bench SUSE 5.0
1x halogen spotlight SUSE 5.16
1x solar cell characteristic curves module SUSE 5.15
1x solar module SUSE 5.22 (2 solar cells)
1x solar module (angle module) SUSE 5.1alpha
1x solar storage module SUSE 5.11
1x multimeter
4x lab wires, 1m in length, 2x black + 2x red
Tested ready-to-use devices **229,95 €**

Not included: sleeves for optical bench commonly used in schools, power supply unit 12 V >3A for halogen spotlight, can be supplemented optionally!

Learning station ISCED3 - Professional

for up to 6 students, for solitary experiment work or small groups
With extensive device files, technical data, experimentation manuals: 1x printed out and on DVD

2x optical bench SUSE 5.0Alu
2x halogen spotlight SUSE 5.16
1x solar cell characteristic curves module SUSE 5.15
1x solar module SUSE 5.22 (2 solar cells)
1x solar module (angle module) SUSE 5.1alpha
1x solar storage module SUSE 5.11-2
1x solar module SUSE 4.41 with mount for stand systems
1x phone charging module SUSE 4.17
1x solar vehicle 1.2 with 2 GoldCap capacitors
1x LED module SUSE 5.9-6
1x digital solar radiation measurement device SUSE 5.23
3x multimeter
10x lab wires, 1m in length, 5x black + 5x red
1 x NILS-ISFH photovoltaics DVD
1x half day advanced training for teachers at the NILS lab of the ISFH or at our school/facility
(For trainings outside of the ISFH (at the school/facility) the travel expenses for the consultant have to be borne (according to BRKG), starting from Hamelin.)

Not included in delivery: sleeves for optical bench commonly used in schools, 2 power supply units 12 V >3A for halogen spotlight, can be supplemented optionally!
Photo of the optical bench with devices and sleeves on the following page
Tested ready-to-use devices **499,95 €**

Additions or changes to the learning stations are possible without any difficulty, suggestions/offers can gladly be obtained on request.

B System 5.xx- Photovoltaic devices and accessories for ISCED level 3 Upper secondary education + job training

Left to right
on the optical bench
SUSE 5.0Alu:

1. The LED module SUSE 5.9-6

2. The 2 solar cell module SUSE 5.22

3. The characteristic curves module SUSE 5.15

4. The solar module SUSE 5.1

The devices are mounted on the optical bench with robust M8 stand rods and can be variably adjusted in height and distance, as well as rotation.

The configuration of devices can be changed at will using the PV device list, please request an offer via www.sundidactics.de, consultation by phone is possible anytime and free of charge. The device systems and experimental setups can be viewed at the ISFH after scheduling an appointment.

Secondary education student group experimenting on learning stations with solar modules

C System 4.xx Photovoltaic devices and accessories for primary schools

In science and project classes in primary school, the SUSE photovoltaic devices can be applied outstandingly. Also devices for ISCED level 2 are – with appropriate manuals – well-suited for primary schools.

SUSE CM310

Simple beginner's solar module for grades 1-4
Without measurement jacks/switch. Available as a construction kit or a ready-to-use device
Construction kit version
Pre-drilled and bent plexiglass support with built-in motor, simple assembly and soldering work
Construction kit premium 6**,99 €**
Tested ready-to-use device 8**,99 €**
With detailed, extensive technical and experimentation manual
Technical and operation manual at sundidactics.de/Download

SUSE CM4MSB

Robust solar module for grades 3-8
SUSE PV module 2 (0,64 V /1020 mA)+ solar motor + switch+ propeller + jack pair (binding posts) for measuring the voltage and the short-circuit current, electric motor disengageable
On plexiglass support 330 x 80 x 4 mm
With detailed, extensive technical and experimentation manuals
Ready-to-use device 19,95 **€**
Technical and operation manual at sundidactics.de/Download

SUSE CM7MSB

Solar module with 3 solar cells in internal series connection, with solar motor and switch to switch on/off the solar motor, 1,8 V / 600 mA
On plexiglass support 310 x 80 x 4mm
Suitable for grades 3-8
With detailed, extensive technical and experimentation manuals
Ready-to-use device 24**,95 €**
Technical and operation manual at sundidactics.de/Download

SUSE CM7MSB²

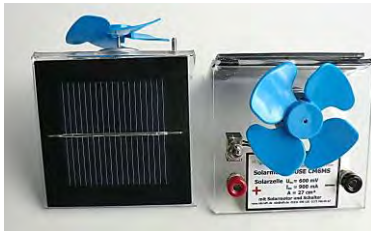
Like SUSE CM7MSB, but additional measurement jack for the solar motor
With detailed, extensive technical and experimentation manual
Ready-to-use device 27**,95 €**
Technical and operation manual at sundidactics.de/Download

SUSE CM6B

Solar module with solar cell SUSEMod215
0,64 V /1020 mA, with 2 jacks or binding posts red/black
On plexiglass support 330 x 80 x 4mm Fig. similar
With detailed, extensive technical and experimentation manual
Ready-to-use device 17**,95 €**
Technical and operation manual at sundidactics.de/Download

SUSE CM6MS

Solar module 0,64 V/1020 mA
with solar motor, propeller, measurement jacks, switch; also included in the suncatcher box GS
With detailed, extensive construction and experimentation manual
Construction kit **18,95 €**
Ready-to-use device **22,95 €**
Technical and operation manual at sundidactics.de/Download



SUSE 4.15

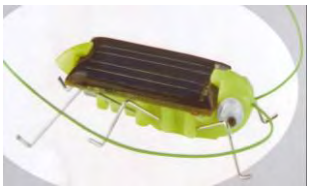
LED module
Light source to be connected to solar modules (at least 3 solar cells in series connection) or usable as a solar cell with V> 1,4 V
With series resistance
Available in 5 versions:
LED red, green, yellow, blue, white or with rainbow LED,
that constantly and fluently changes colors
With detailed, extensive technical and experimentation manual
Ready-to-use device **15,49 €**
Technical and operation manual at sundidactics.de/Download

Solar mini racer 704

Small, steerable solar car, drives quickly on smooth surfaces when illuminated by the sun or another light
With detailed technical manual
Ready-to-use device **8,95 €**

Solar cricket 713

Jumps and vibrates when illuminated by the sun
With detailed technical manual
Ready-to-use device **9,95 €**



Solar butterfly 730

Jumps and vibrates when illuminated by the sun
With detailed technical manual
Ready-to-use device 9,95 **€**

Solar house 720

Complete functional photovoltaic unit on a house, consisting of solar module, rechargeable battery, switch, yellow LED. In the light the battery is charged by the solar module, in the dark a yellow LED can be switched on, so that the interior of the house is brightly illuminated.
Scale 1:87, dimensions: 8 x 6 x 5,5 cm
With detailed technical manual
Ready-to-use device 13,95

Solar racer 703

Solar car construction kit
Mini solar car with solar cell, mini electric motor, gear
With detailed technical manual
Kit **7,95 €**

Solar carousel

Height 20 cm, diameter 15 cm
Rotates under intensive illumination with light from above.
Reference number: 719
Ready-to-use device **22,95 €**

Additional solar toys are in section D „Solar toys"

Solar car SF2

Powerful solar car
with the solar module SUSEmod 6 (2,4V-630 mA), drives in bright sunshine and under a clouded sky on smooth surfaces or indoors under illumination with light from bulbs or halogen lamps
With detailed technical manual
Ready-to-use device **24,95 €**
Technical and operation manual at sundidactics.de/Download

SUSE Solar thermal collector (stagnation collector)

Full version, plexiglass
For the generation of thermal energy from solar radiation, with reversible absorber sheet selective black and aluminum silver
With digital thermometer and test tube to heat water
With detailed, extensive technical and experimentation manual
Ready-to-use device **64,95 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.12

Storage module with GoldCap capacitor (2x 3,3F/2,5 V) on plexiglass support, supplementing SUSE PV modules. The electric energy of the solar cells is stored, a solar motor runs for several more minutes! Storage capacity 20 J of el. energy
With detailed, extensive technical and experimentation manual
Ready-to-use device 15**,98 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.16

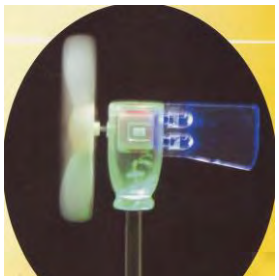
Solar motor on plexiglass support with propeller and binding posts for a connection to solar modules. For voltages of 0,3 – 5V DC

With detailed, extensive technical and experimentation manual
Ready-to-use device 15**,98 €**

SUSE 4.16 can also be used as a generator.
If 2 devices SUSE 4.16 are connected to each other with wires and one propeller is put into rotation, the motor 1 acts as a generator (main principle of a wind power plant), the 2nd motor then rotates with the generated el. Energy of the 1st motor – an interesting effect!
Technical and operation manual at sundidactics.de/Download

C System 4.xx Photovoltaic devices and accessories for primary schools

Regenerative electric energy with wind 716



Wind power plant with built-in current generator and 3 LEDs, that glow blue + green, when the propeller rotates in the wind (blowing on it or natural wind)
With detailed description and technical manual
Ready-to-use device **11,95 €**

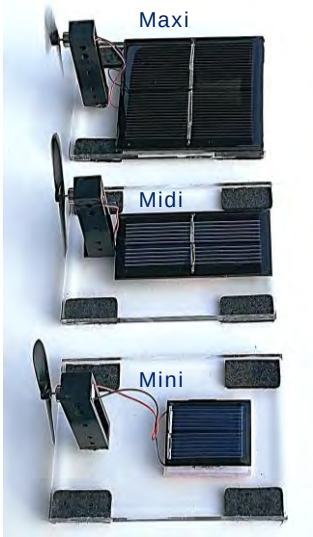
SUSE 4.24A

Analog measurement device for measuring the irradiance (intensity) of the sunlight or light of light sources (halogen spotlights or similar)
Calibrated in W/m², no batteries required
Especially suited for experiments in primary school and lower secondary school, on plexiglass support 220 x 100 x 5 mm, bent roof-shaped
With detailed, extensive construction and experimentation manual
Ready-to-use device 33**,95 €**
Technical and operation manual at sundidactics.de/Download

SUSE 4.36

SUSE radio VHF/MW to be connected to solar modules with 6 solar cells in series connection
e.g. 6 x SUSE CM4 or 6x SUSE 4.2 or 2x SUSE 4.33 or 2x SUSE CM7MSB
With 1 m cable with 2 banana plugs red/black, For a connection to solar modules
With graphic description and operation manual
Ready-to-use device **25,98 €**
Technical and operation manual at sundidactics.de/Download

SUSE CM307



Basic solar module in 3 modifications mini- midi- maxi
Solar module + solar motor + propeller on plexiglass plate, Dimensions plexiglass plate 80 x 60 x 3 mm
Solar module with 2 solar cells 1,2 V in internal series connection
mini solar module 1 I sc 80 mA for bright sunshine
midi solar module 2 I sc 160 mA for slightly clouded sky
maxi solar module 3 I sc 480 mA for clouded sky
Construction kit:
mini 3,95 € / midi 4,95 € /maxi 6,55 €
Tested ready-to-use device:
mini 4,95 € / midi 5,95 € / maxi 7,55 €
With detailed, extensive construction and experimentation manual
Technical and operating manual at www.sundidactics.de/Download

SUSE CM400

Simple photovoltaic experimentation device
Especially suited for class levels 3-6
Thin layer solar cell 3V/20mA with LED optionally red, orange, green, yellow, blue, pink
On plexiglass support 160x80mm bent to 75°
With detailed and extensive experimentation and construction manual
Construction kit 4,20 €
Pre-drilled and bent plexiglass support, solar cell with soldered hookup wires, LED, type plate sticker, manual
Ready-to-use device 5,50 €

NILS Niedersächsische Lernwerkstatt für solare Energiesysteme
am Institut für Solarenergieforschung ISFH Hameln Geschäftsführer Prof. Dr. R. Brendel
An- Institut der Leibniz Universität Hannover
Dr. R. Goslich + M.L. Klinghammer + V. Napp + W.R. Schanz + F. Tittel
Am Ohrberg 1 – D-31860 Emmerthal Tel.: 05151 999 100 Fax: 05151 999 400
email: nils@isfh.de web: www.nils-isfh.de www.isfh.de mobil: 0175 766 06 07 (W

Niedersachsen

Photovoltaik-System SUSE

Solarthermiesystem
Wärme von der Sonne

innovative Solarsysteme für Schule und Ausbildung

Leibniz Universität Hannover

MINT Begabungsförderung in Hannover und Region www.mint-hannover-region.de

BNE Bildung für Nachhaltige Entwicklung

The NILS-ISFH suncatcher box for elementary schools

Complete experimentation system on photovoltaics, solar heat, and wind energy
Class set for experiments on 30 learning stations
Especially suitable for student-centered experimental classes for grades 3-6

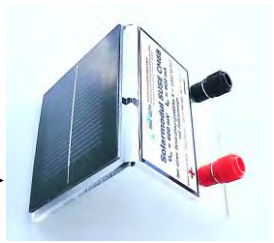
Hamelin's suncatcher box ES was developed at the learning workshop NILS of the institute for solar energy research ISFH. It contains a complete student-centered experimentation system on solar energy in a classroom set of learning stations.
With the solar didactic concept developed by NILS-ISFH with complete experimentation manuals the suncatcher box can be used for classroom experiments and school projects. With the acquisition of the suncatcher box an advanced training for teachers (4 hrs.) at the school or at the ISFH is included.

The experiments can be conducted outside in the sunlight or in the classroom with halogen lamps or red light lamps.

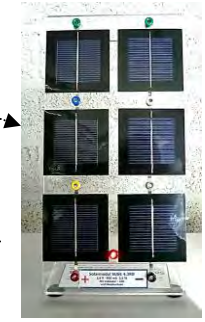
Contents of a suncatcher box:

8 solar modules SUSE CM6MS

8 solar modules CM6B



1 solar module SUSE 4.3 RB
with 6 solar cells in pluggable series connection



2 solar thermal collector GS
with 2 selective absorbers, black+silver

2 digital thermometers

8 digital multimeters with 2 measurement cables

Modell kann variieren

2 solar radiation meters SUSE 4.24A

2 solar- radios SUSE 4.36 to be connected to solar modules in series connection
1x mit SUSE 4.36 mit Büschelstecker, 1x SUSE 4.36 USB mit USB-A-Stecker für Solarmodul SUSE 4.50-10

2 LED modules (1x red, 1x rainbow)

2 solar cars (solar racer construction kits)

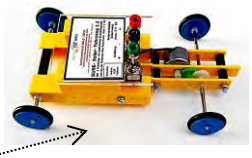
1 solar cricket

1 solar energy storage module SUSE 4.12

8 solar motors with propeller SUSE 4.16

3 batteries 1,5 V

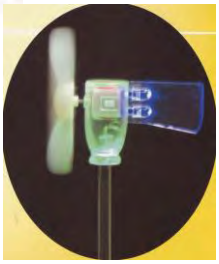
1 solar helicopter (connector system)



2 solar vehicles: SUSE SF1.2 for operation with the solar modules SUSE 4.3RB/CM6 and SUSE SF6USB for operation with the solar module SUSE 4.50-10

28 lab wires mit 2x 4mm- bunch plugs (14x red, 14x black, 0,5 m in length)

1 wind energy installation mit 3 LEDs



1 solar butterfly- set

2 test tubes for collector experiments
100mm x 10mm

1 experimentation set 6in1
6 models with 1 solar cell

1 10W- solar module SUSE 4.50-10GS with USB output +2 USB cables

1 LED lamp with USB plug

2 compasses

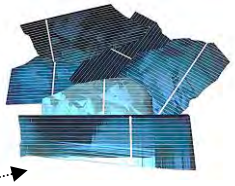
2 stopwatches
modell can vary

2 folding rules 2m

10 metal connectors for series connection with SUSE CM6B

1 solar module SUSE CM315

2 solar modules SUSE CM400, LED red + green



1 solar didactic handbook > 100 pages
on the suncatcherbox GS with complete manuals and solutions for 30 learning stationes, print out in spiral binding and on DVD

1 box of functioning solar cell fragments for experiments

1 training voucher for schools/institutions outside of lower saxony the travel expenses fort he consultat have tob e borne

For experiments in the classroom, 8 white glowing 120W halogen spot lamps with handles (from the hardware store) ore redlight lamps and 8 desk power sockets with switch are required.
Not included in delivery!

White LED spot lights **are not suitable because of the "wrong" lig** spectrum. As an alternative, 100-150W red light lamps are also suitabl because solar cells are especially sensitive to red light.

Suncatcherbox GS 1079,00 € plus shipping + VAT

The 30 learning stations of the suncatcher box GS

For each learning station there is an extensive manual in the handbook/on the DVD for the students as well as for the teachers with didactic/methodical notes and solutions.

No.	Experiment	Required devices plus indoors: halogen spot light
1	Experiments with the solar vehicle solar racer	Solar racer, folding rule, stopwatch
2	How does a solar cell perform best?	Solar module SUSE CM6MS, multimeter, lab wires
3	Who measures the highest current?	Solar module SUSE CM6MS, multimeter, lab wires
4	Comparison solar cell vs. battery	Solar module SUSE CM6MS, multimeter, mignon battery, lab wires
5	Series connection of batteries	Multimeter, mignon batteries, lab wires
6	Series connection of solar cells	Solar module SUSE CM6B, multimeter, lab wires
7	Operation of a radio with solar modules in series connection	Solar module SUSE CM6B, solar radio SUSE 4.36, lab wires
8	Operation of a radio with the solar module SUSE 4.3RB	Solar module SUSE 4.3RB, solar radio SUSE 4.36 multimeter
9	Storage of solar current, LED module	Solar module SUSE CM6B, lab wires, solar storage SUSE 4.12, LED module SUSE 4.15 rainbow
10	Storage of solar current, solar motor	Solar module SUSE CM6B, solar storage SUSE 4.12, solar motor SUSE 4.16, lab wires
11	Solar car with solar charging station	Solar module SUSE 4.3RB, SUSE solar vehicle 1.2, lab wires
12	When does the rainbow LED glow?	Solar module SUSE 4.3RB, LED module SUSE 4.15 rainbow, lab wires, multimeter
13	Which air screw rotates the fastest?	Solar module SUSE 4.3RB, solar motors SUSE 4.16, lab wires, multimeter
14	How many solar motors can a solar cell fuel?	Solar module SUSE CM6B, solar motors SUSE 4.16, lab wires, multimeter
15	Changing the solar cell area by covering	Solar module SUSE CM6B, multimeter, lab wires
16	Positioning of a solar cell in different cardinal directions	Solar module SUSE CM6B, multimeter, compass, lab wires
17	Experiments with the solar radiation meter	Solar radiation meter SUSE 4.24, compass
18	Experiments with solar cell fragments	Solar cell fragments, solar motor SUSE 4.16, lab wires, multimeter
19	Who measures the highest current with a solar cell fragment?	Solar cell fragments, multimeter, lab wires
20	The solar motor as a wind power plant	Solar motors SUSE 4.16, multimeter, lab wires
21	Wind power lets the LED glow	Solar motor SUSE 4.16, LED module SUSE 4.15, lab wires
22	Solar toys	Solar toys 6in1, solar butterfly, solar helicopter
23	Experiments with the thermometer	Digital thermometer
24	Experiments with the solar thermal collectors	Digital thermometers, solar thermal collectors

25	Heating of water in the solar thermal collector	Digital thermometers, solar thermal collector, test tube, water
26	Charging a phone with solar energy at the solar module SUSE 4.50-10GS and charging powerbank battery packs	Solar module SUSE 4.50-10, smartphone with USB charging cable, powerbank battery pack
27	Solar module SUSE 4.50-10 as a solar charging station	Solar module SUSE 4.50-10, solar vehicle SF6USB, USB cable (2x plug USB A)
28	Operating a radio and LED lamp at the solar module SUSE 4.50-10	Solar module SUSE 4.50-10, solar radio SUSE 4.36 USB, LED lamp with USB plug
29	Comparative experiments with big and small solar cells	Solar module SUSE CM6MS, solar module SUSE CM315, multimeter, 2 lab wires
30	Discover your own experiments with the solar module SUSE CM400	Solar module SUSE CM400 red/green

If there is no need for the whole suncatcher box, we can also prepare offers for single learning stations, please request an offer via info@sundidactics.de .

Among the scope of delivery there is an advanced training course for teachers with a duration of approx. 4 periods at the ISFH or at the school, at which the suncatcher box is to be used.
A voucher for an advanced training of 4 hours is part of the suncatcher box.

The topics of the advanced training for teachers at elementary schools:

- Solar energy as part of the energy revolution globally, in Europe, and Germany
- The sun as a sustainable and infinite energy source for humankind
- Basics of solar energy, photovoltaics, solar heat
- Current from solar radiation: composition and function of solar cells
- Current from solar radiation: composition and function of solar modules
- Heat energy from solar radiation: composition and function of solar thermal collectors
- Presentation and explanation of the experimentation devices in the suncatcher box
- Electric mobility with experiments of the suncatcher box
- Conduction of the experiments of the 30 learning stations by participants of the course
- Didactic concept of the suncatcher box GS in regards to STEM and ESD
- Didactic/methodical planning of the use of the suncatcher box at the school

The teachers' training is part of the suncatcher box and is free of fees.
Travel expenses in the state of Lower Saxony are borne by the state/the ISFH.

Teacher's trainings outside of the state of Lower Saxony require the absorption of travel expenses for the NILS-ISFH consultant according to BRKG.

Optimal is the conduction of the experiments outdoors in natural sunlight/daylight in bright sunshine or with a clouded sky.
Good light sources for experiments indoors/in the classroom are:
Halogen spot light 120W (portable floodlight) with pipe foot and handle with switchable desk power socket
Red light lamps 100- 150 W (as used in curing a common cold)
Overhead projectors, on the glass plate experiments can be conducted outstandingly

Shipping and billing services are handled by our vendor Sundidactics.
www.sundidactics.de info@sundidactics.de +49 (0)175 7660607 (mobile, W.R. Schanz)

For preschool, primary school, secondary school, and playful adults

NILS solar toys 2020

Toys of high educational value for a playful hands-on discovery of solar energy
For kindergarten, preschool, primary school, children's projects on renewable energy, for environmental projects, or as solar gift idea for children, teens, and adults
Every device comes with an extensive technical/didactical description

Solar firefighters helicopter construction kit with big, active solar rotor
Can be complemented with interlocking bricks and rebuilt corresponding to personal imagination at will. Solar cell rotor + encapsulated electric motor
Reference no. 701 **18,98 €**
Dimensions: 16,5 x 6,5 x 6,5 cm

Wooden solar helicopter with active solar rotor
Colorfully glazed, appealing wooden casing,
available in the colors:
natural, red, yellow, green, blue
Reference no. 702 **16,98 €**

Wooden helicopter
702

Solar cars

Solar mini racer
The smallest solar car in the world, steerable by a rotatable front axle! Metal design with rubber tires (Ready-to-use device, no construction kit)
Reference no. 704 **8,95 €**
Dimensions: 3,3 x 2,2 x 1,4 cm

Solar racer 703 Construction kit
Small solar car with solar cell, mini solar motor, gear
Reference no. 703 **7,95 €**
Dimensions: 4 x 5,5 x 1,4 cm

Every device comes with an extensive technical/didactical description

7 in 1 vehicle set

(construction kit)
with solar charging station
(solar module with
GoldCap energy storage)

Reference no. 707
23,95 €

707

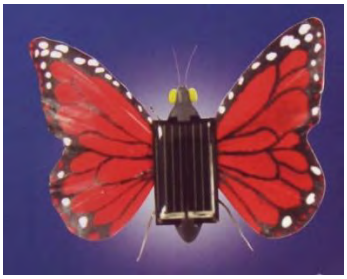
Reference no. 707

6 models with 1 solar module!

Solar boat – solar sleigh – solar car – solar rotorcraft – solar dog – solar wind power plant
Construction kit Reference no. 706 **16,95 €**

Motion models

To be operated outdoors in bright sunshine or indoors under illumination with light bulbs or light of halogen or red light lamps. The light of LED lamps is not suitable due to the unnatural light spectrum.



Solar butterfly set

Reference no. 711 **9,95 €**
Vibrates when illuminated by light and dances across plane, smooth surfaces through solar cell and solar motor with imbalance.

Solar cricket

Reference no. 713 **9,95 €**
Vibrates when illuminated by light and dances across plane, smooth surfaces through solar cell and solar motor with imbalance.

Regenerative energy with wind

Wind power plant with built-in current generator and 3 LEDs, that glow blue + green, when the propeller rotates in the wind (blowing on it or natural wind)
Reference no. 716 **11,95 €**

SUSE solar runabout

An inexpensive, simple solar vehicle to be operated in bright sunshine or indoors with halogen or red light lamps. Robust chassis with 2 solar cell solar module, micro motor, gear. Suitable for primary school from grade 3/4 on or lower secondary school.
Dimensions: 80mm x 70mm x 35mm.

With detailed technical description and experimentation manuals
Construction kit **5,50 €**
Ready-to-use device 6**,99 €**
Technical and operation manual at sundidactics.de/Download