DEXT

Technology Limited

Bringing practical science education to Africa.

www.dext.tech

The Science Set

Executive Summary

Our Company

Dext Technology Limited is a company that develops and deploys innovative, user-friendly and affordable tools for the effective learning of basic Science Technology Engineering and Mathematics (STEM).

Our Product

The Science Set is an affordable science toolbox that contains 45 individual materials for over 26 experiments and is small enough to fit on a student's desk. There are currently over 11000 students in Ghana with access to our science sets.

Our Goal

Our goal is to increase performance and interest in science through access to hands-on teaching and learning materials.

Our Pricing

The retail price of the Science is $20.

Support Services

Dext has the capacity and resources including people and production workshops to provide the requisite technical support for all Science Sets that it will produce and distribute. Dext has a tall list of science and technology developers and contributors with an extensive range of expertise for all areas of interests in its portfolio.

Capacity Development

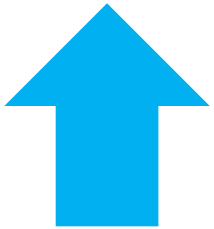
The design philosophy of the Science Set is to be intuitive by default. So very little training if any is required for teachers to use and administer the use of the science set. In addition, Dext has developed comprehensive user and instructor manuals to make the use of the Science Set easy and fun for teachers and students.

Notwithstanding, Dext has designed a comprehensive training programme for teachers to ensure that the Science Set is used to its full potential and correctly to last for a longer period than its designed for.

The problem

The lack of experiential hands-on science

Ratio of science students to other subjects. This ratio shows student's disinterest in science.



Rising demand for science and technology education by stakeholder

Science technology and engineering are the bedrock for development and as such the effective training of young students in science and technology is paramount to development. Unfortunately due to the lack of facilities, equipment and limited funds students in parts of Lagos lack a do not experience science beyond the black board. Students in these places miss the opportunity to get practical knowledge. Practical knowledge required to understand the technology of today and build the skills to be a part of those who create tomorrow's technology.

Addressing the Problem

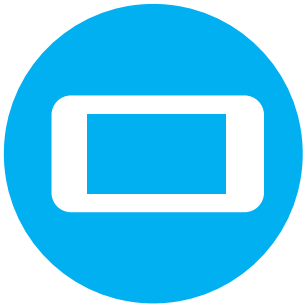
Our solution targets:

- **Affordability**
- **Effectiveness**
- **And ease of implementation**

Our solution does not require putting up new structures in schools. It is a solution that while affordable, enables practical, personalized and experiential teaching and learning of science.

How we designed our solution

We studied science syllabi across Africa and developed potable versions of materials needed for experiments.



We succeeded in packing over 45 components and materials in a container the size of an average textbook and developed manufacturing methods that will enable us produce affordably

We are providing access to practical education with this potable science laboratory that is small enough to fit in the bag of students and is affordable enough for every student to have one

Our Solution

The **Science Set**

45
Individual component and materials.

Small
Miniaturized to fit on a student's desk.

Affordable
Every student can have one.

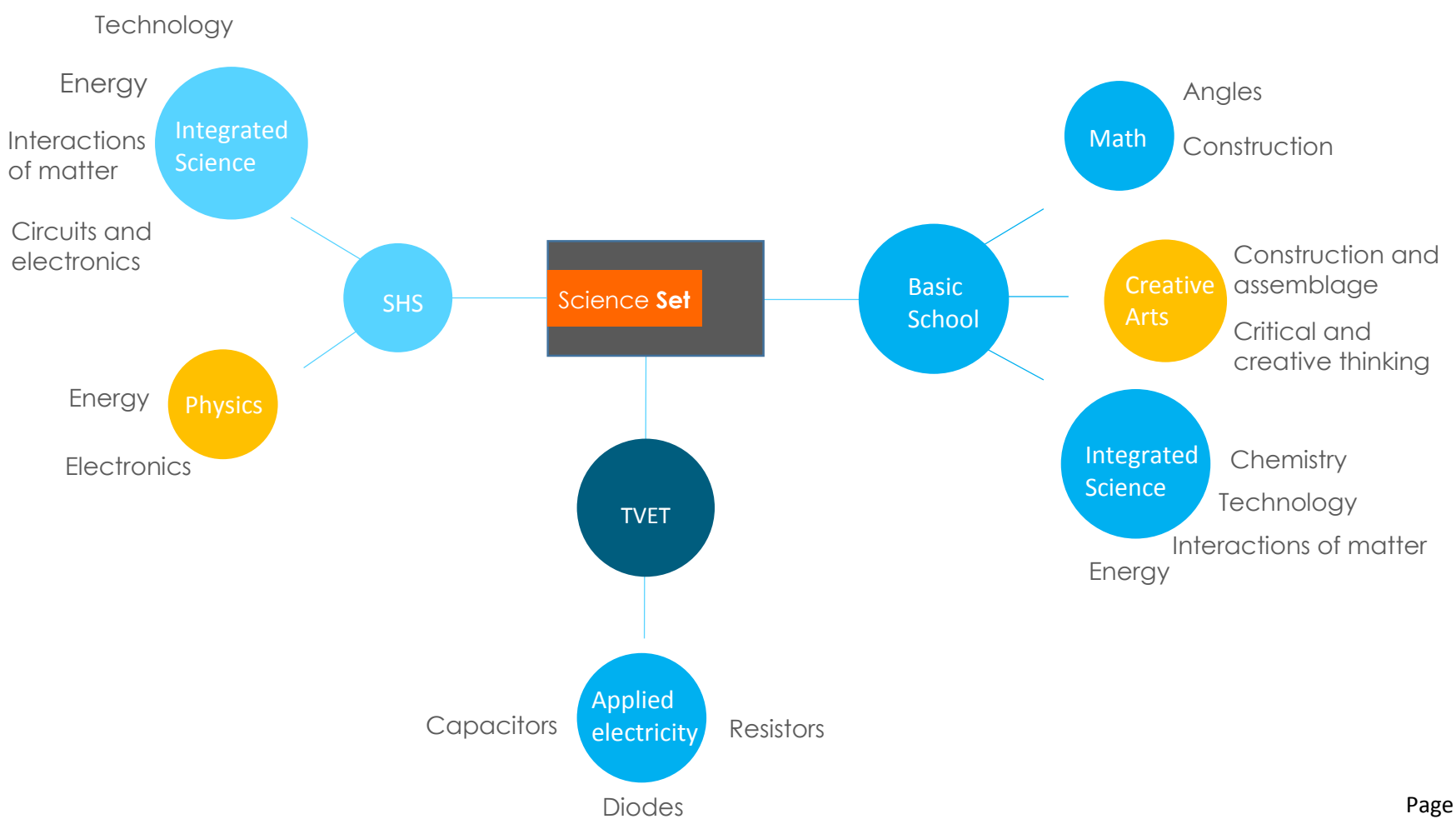
The Science Set is our solution to the lack of practical science education in Africa. It is an affordable mini science laboratory that contains materials and components needed for science activities and experiments.

The science set currently contains materials that can be used to perform activities at the basic school, junior high school, senior high school as well as technical school levels.

Practical
Simple
Effective

Benefits of the science set

Areas covered by the science set



Benefits of the science set

Section 4 Energy **Unit 3** Basic Electronics

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
LED **Connecting wires** **Battery**	Let pupils: Connect up a simple electronic series circuit using the following components: Battery, switch, LED(light emitting diode) and connecting insulated wires Close the switch and observe what happens to the LED. Open the switch and observe what happens Add one battery at a time to the same circuit to the LED. Tell what happens. Compare what happens with that of the 3V battery.	The pupil will be able to: 4.3.1 tell the uses of the parts of a simple electronic circuit.	Parts of an electronic circuit - Battery(two or more cells) - Switch - LED(light emitting diode) - Connecting insulated wires	What does an LED do in electronic circuit? What is the importance of a switch in an electronic circuit? How can you make the LED in an electronic circuit?

Energy **Unit 3** Basic Electronics

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
LED **Connecting wires** **Resistors** **Battery**	Observe different types of colour-coded resistors of various resistances (low and high). Connect up a simple circuit comprising a 3V battery, a switch and an LED. Close the switch and observe the effect on the LED. Open the switch. Connect a low resistor R (330 Ω) in between the switch and the LED. Close the switch and observe the effect on the LED. Replace the resistor with a high resistor R(2200 Ω). Close the switch. Observe the effect on the LED. Connect a 9V in series with the switch, a 330 Ω resistor and an LED. Close the switch and observe what happens to the LED. Open the switch and remove the resistor from circuit. Complete the circuit and close the switch. Observe what happens to the LED. Explain what the resistor does to the LED PROJECT Design and build a flash light using four or more LEDs	4.3.1 investigate the behavior of a resistor in an electronic circuit	Parts of an electronic circuit - Battery(two or more cells) - Switch - LED(light emitting diode) - Connecting insulated wires Resistors	What does a resistor do in an electronic circuit?

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
LED **Diode** **Connecting wires** **Resistors** **Battery**	Let pupils: Examine a P-N junction diode and identify the P (Positive) region and N (negative region). Connect a series circuit comprising a 3V battery, a switch, a diode, and an LED. Close the switch and observe what happens to the LED. Open the switch. Reverse the diode connection and close the switch again, Observe the effect on the LED Brainstorm to come out with the meaning of the terms, forward bias and reverse bias	The pupil will be able to: 4.2.1 describe the behavior of a P-N Junction diode in an electronic circuit.	P-N Junction semiconductor diode - Forward bias - Reverse bias.	What is the use of a P-N junction diode in an electronic circuit?

Energy **Unit 3** Light

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
LED **Connecting wires** **Resistors** **Battery** **Multiple slit beam splitter** **Mirror** **LED Light stand**	Let pupils: Demonstrate that light is a form of energy. Discuss natural and artificial sources of light. Demonstrate reflection of light using plane mirrors and polished surfaces. Project : Design and make a periscope. Demonstrate that white light can be broken up into many different colours. Discuss the terms Transparent, Translucent and Opaque materials Place different materials in the path of light and determine whether the materials are, translucent, transparent or opaque. Sort and group materials into transparent, translucent and opaque materials according to the degree to which they allow light to pass through them.	infer that light is a form of energy. 4.3.2 identify different sources of light. 4.3.3 explain that an object can be seen when it reflects light. 4.3.5 demonstrate that white light is made up of different colours. 4.3.7 explain the terms transparent, translucent and opaque. 4.3.8 distinguish among Transparent, translucent and opaque materials	Light as a form of energy Sources of light: - Natural - Artificial Reflection of light. Colours that make up white light Transparent, Translucent and Opaque materials Distinguishing among Transparent, translucent and opaque materials	Distinguish among transparent, translucent and opaque materials.

Section 4 Energy **Unit 6** Basic Electronics

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
LED **Diode** **Capacitor** **Connecting wires** **Resistors** **Battery**	Let pupils: Observe the negative mark on the (electrolytic) capacitor and identify the negative and positive leads of the capacitor. Construct a simple circuit made up of a 6V battery a switch, a 1000μF capacitor, a 1000 Ω resistor and an LED as shown Close the switch and quickly and carefully observe what happens to the LED. Open the switch. Remove the battery from the circuit. Carefully disconnect the capacitor, ensuring that the leads do not touch each other. Reconnect the capacitor in a reversed position and complete the circuit without the battery. Close the switch and carefully observe the effect on the LED. Repeat the above activity using a 9V battery and comment their observation.	The pupil will be able to: 4.6.1 investigate the behavior of a capacitor in a d.c circuit	P-N Junction semiconductor diode - Forward bias - Reverse bias.	Explain the function of the capacitor in a d.c electric circuit

Energy **Unit 4** Simple electrical circuit

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
LED **Connecting wires** **Buzzer** **Battery**	Let pupils: Construct a complete electrical circuit using a battery, switch, a bulb and connecting wire. Construct a simple electrical circuit from circuit diagrams involving bulbs and cells in series and in parallel. Investigate the brightness of the bulbs based on number of cells and bulbs. Discuss some examples of electrical conductors and insulators. Construct a simple electric circuit to produce light, heat and sound. Draw your arrangement and discuss. Project Construct a simple electrical circuit using a battery, a switch, and motor. Use the motor to power a miniature device like fan/ corn mill. Design and make a solenoid and use it to make a magnet	The pupil will be able to: 4.4.1 list the components and functions of a simple electrical circuit. 4.4.2 construct simple circuit from circuit diagrams. 4.4.3 identify electrical conductors and insulators. 4.4.4 construct simple electric circuit to produce light, heat and sound. 4.4.5 Construct a simple electric circuit to produce a magnet	Components of electrical circuit: Dry cell/battery Switch Bulb/lamp Connecting wires Constructing simple circuits from circuit diagrams Electrical conductors and insulators Circuit to produce light, heat and sound Electromagnets	State the importance of a battery, switch and connecting wire in an electrical circuit. Draw a simple electrical circuit and label the parts. Describe how you will use an electric current to produce a magnet

Section 5 Energy **Unit 3** Light Energy

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
LED **Connecting wires** **Battery** **Light stand** **Pin-hole boards**	Arrange three card boards, each with a hole in the centre so that their holes are aligned. Place a lighted candle behind the cards and observe the light through the holes. Move one of the cardboards slightly to misalign its hole to the others and observe again. Record and discuss their observations. Observe a model of the Pinhole camera and describe how it works to form an inverted image. Place an opaque object between a small source of light and a screen. Record and discuss their observation. Identify umbra and penumbra from the demonstration above Use the globe or tennis ball and LED in LED stand to demonstrate the formation of eclipse. Note: Discuss eclipse of the Sun and that of the Moon. Annular eclipse Excluded Let pupils:	5.3.1 demonstrate that light travels in a straight line. 5.3.3 describe the formation of shadows 5.3.4 demonstrate the formation of eclipse The pupil will be able to:	Rectilinear propagation of light Formation of shadows	Name three sources of Light. Draw a diagram to show that light travels in a straight line. In groups,

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
Multiple slit beam splitter, **single slit beam splitter** **Mirror**	Arrange a light source, plane mirror and screen to demonstrate reflection of light. Identify the incident and reflected rays and draw their paths. Discuss the characteristics of images formed by a plane mirror. NOTE: Discussion should include distinction between real and virtual images. Compare reflection of light from polished flat surfaces to rough surfaces. Demonstrate the change in path of light as it travels from one medium to another e.g. glass and water. State some uses of reflection and refraction in real life situations e.g. in periscopes, eye glasses, cameras and telescopes	5.3.5 demonstrate the reflection of light 5.3.6 demonstrate the refraction of light.	Formation of eclipse Reflection of light Refraction of light	demonstrate that the angle of incidence is equal to the angle of reflection.

Section 5 Energy **Unit 4** Basic Electronics

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
LED **Capacitor** **Connecting wires**	Discuss what electronics is. Examine various types of LEDs, P-N Junction diodes, colour code resistors and capacitors. Use pictures/video clip to observe various electronic components. Draw circuit symbols of the components as listed in the content. Identify the Positive (P) region and Negative (N) region of the P-N junction diode. Connect a simple electronic circuit comprising a 3V battery made of two dry cells in series with a switch and an LED as shown below. Close the switch and observe what happens to the LED. Open the switch and observe what happens Let pupils: Connect a 3V battery, a switch, P-N junction diode and an LED in series. Close the switch and observe what happens to the LED. Reverse the P-N junction	5.4.1 explain the term electronics. 5.4.2 demonstrate the behavior of discrete components in a d.c. electronic circuit	Electronics Components in an electronic circuit: LED P-N Junction diode Resistor Capacitor	What are the functions of the following components in an electronic circuit? 1. LED 2. P-N junction diode 3. Resistor 4. capacitor

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
Battery **Switch** **Diode**	diode connection. Close the switch and observe what happens. Explain the terms Forward Bias and Reverse Bias Connect a 330Ω resistor in place of the P-N junction diode in the series circuit above. Close the switch and observe what happens to the LED. Replace the 330 Ω resistor with a higher resistance of 3,300Ω Observe what happens to the brightness of the LED. Replace the 3,300Ω resistor with a capacitor. Close the switch and observe what happens to the LED. Open the switch. Let the terminals of the capacitor touch together and separate them. Close the switch again and observe what happens to the LED. Connect the circuit according to the schematic diagram shown below. Press the switch and observe what happens to the LED. Open the switch and observe what happens to the LED. Explain the charging and discharging action of the capacitor in the circuit. Discuss the application of the charging and discharging action of the capacitor, e.g. to slowly light and darken a room in a movie theatre.	The pupil will be able to: 5.4.3 demonstrate the charging and discharging action of a capacitor	Charging and Discharging action of a Capacitor.	Draw the circuit symbols of the following: 1. P-N junction diode 2. LED 3. Capacitor

Section 4 Energy **Unit 3** electrical energy

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
LED **Resistor** **Connecting wires** **Battery**	Discuss sources of electrical energy. Discuss the terms electric current, potential difference and resistance as applied to electric circuits and assign appropriate units. Use the relationship V=IR to perform simple calculations. Explain the term electrical circuit. Use batteries, switch, bulbs, resistors and connecting wires to set up simple electrical circuits. Observe the effect on the bulb when there is increase in the number of batteries or when the number of bulbs is increased. Investigate the effect of varying resistance on the current in the circuit by arranging resistors in series and in parallel. Draw circuit diagrams for series and parallel	4.3.1 describe ways of generating electrical energy. 4.3.2 explain the terms electric current, potential difference and resistance. 4.3.3 demonstrate the flow of current using a simple electrical circuit. The pupil will be able to: 4.3.4 wire an electric plug and explain the use of a fuse in electrical	Sources of electrical energy: Hydro-, windmills, solar cells, fuel cells, voltaic cells(dry cells and accumulators) and thermal power Electric current, potential difference (voltage) and resistance Simple electrical circuit Wiring a plug and uses of fuse Ways of conserving electrical energy	State four sources of electrical energy. Explain why parallel circuits are widely used in household while series circuits are not. Project: In groups, pupils design and build an alarm electrical circuit and display for class discussion What is the importance of fuse in electrical

	connections. Note: Calculations involving effective resistance of resistors in series and parallel is not required Demonstrate skills in the use of the instruments Let pupils: Discuss the use of fuses in electrical circuits. Discuss how electricity is wasted in the home and industry. Discuss ways of conserving electricity	appliances. 4.3.5 explain ways of conserving electrical energy		appliances?

Section 4 Energy **Unit 4** Basic Electronic

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
LED **Transistors** **Resistor**	Identify the two P-N junctions of a transistor. Identify also the Emitter lead (e), Base lead (b) and Collector lead(c). Identify the types of transistors Investigate how a transistor is turned on and off as a switch by carrying out the following activity. Connect the circuit as in Fig.1. Open switch S1 and close switch S2. Observe what happens to the LED in the Collector-emitter section of the circuit.	4.3.1 describe the composition and types of transistors.	Composition of transistors Emitters, Base and Collector Types of transistors: NPN, PNP. Characteristics of transistors Saturation region for switching action	Draw symbols for NPN and PNP transistors

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
Switch **Connecting wires** **Battery**	Close S1 and observe what happens to the two LEDs. Make inferences from their observation. Note: A small current must flow through the base to turn on the transistor Let pupils: Connect the circuit as in Fig 2 with Base -Emitter junction forward biased and base Collector junction reversed biased with a gap between wire1 and wire2. Close the switch and observe what happens to the LED. Use the left finger to hold the tip of wire1 with right fingers holding wire 2 to close the gap between the two wires and observe what happens to the LED. Repeat the activity by connecting a 100kΩ resistor in series with an LED in the gap between wire 1 and wire 2 Note that a small current (input signal) flowing through a very high resistor such as the human body in the emitter-base section can be amplified by the transistor to light an LED (output signal	4.3.2 describe the characteristics of transistors.	Active region for amplification action	

Section 4 Energy **Unit 2** Basic Electronic

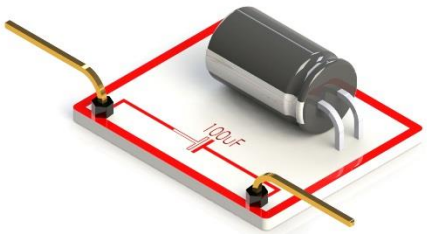
Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
LED **Transistors** **Capacitor** **Resistor** **Switch** **Connecting wires** **Battery**	Let pupils : Connect the circuit as shown. Close the switch and observe what happens to the LED. Open the switch and observe what happens to the LED. Discuss what happens to the capacitor when the switch is closed and when it is opened. Replace the 100KΩ resistor and the 470Ω resistor with different values and observe what happens to the charging and discharging rate of the capacitor. Discuss the application of a capacitor in an electronic circuit, e.g. in a camera flash.	The pupil will be able to: 4.2.1 Demonstrate the use of a transistor to slowly charge and discharge a capacitor	Using a transistor to slowly charge and discharge a capacitor	What is the importance of a capacitor in an electric circuit?

Section 5 Interaction of Matter **Unit 2** Magnetism

Materials in the science set	Teaching and learning activities	Specific objective	Content	Evaluation
Solenoid **Metal core** **Connecting wires** **Battery**	Let pupils : Review magnetic and non-magnetic materials from Upper Primary syllabus. Discuss the properties of magnets Brainstorm to come out with the meaning of the magnetic field Place a paper on top of a bar magnet and sprinkle iron filings on top of the paper. Tap the paper gently and record what happens. Draw the magnetic field of a bar magnet. Demonstrate methods of making magnets by induction, stroking, and use of electricity. Note: Mention that permanent magnets are made from steel and temporary magnets from iron Brainstorm to bring out the uses of magnet	The pupil will be able to: 5.1.1 describe the properties of magnets. 5.1.2 explain the term magnetic field. 5.1.3 demonstrate the magnetic field around a bar magnet. 5.1.4 demonstrate methods of making magnets. 5.1.5 outline the uses of magnets	Properties of magnets Magnetic field Demonstrating Magnetic Field Methods of making magnets; Induction, Stroking and Use of electricity. Uses of magnets	

Inside the science set

Electronic components



Electrolytic Capacitor

Ceramic Capacitor

330 Ohm Resistor

33 Ohm Resistor

1 Kilo Ohm Resistor

10 Kilo Ohm Resistor

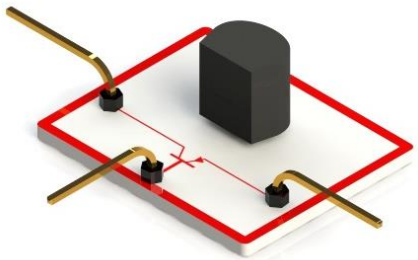
5 millimeter LED (5 of them in each science set

Simple Diode

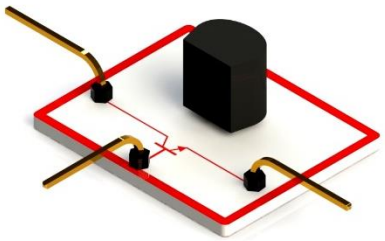
Switch Pad

Electronic components

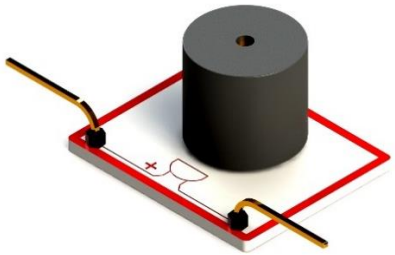
Light Dependent Resistor
(Light Sensor)



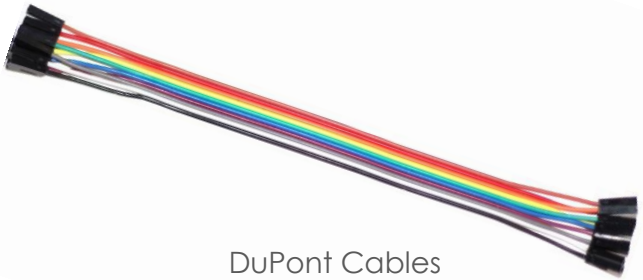
NPN Transistor



PNP Transistor



Buzzer

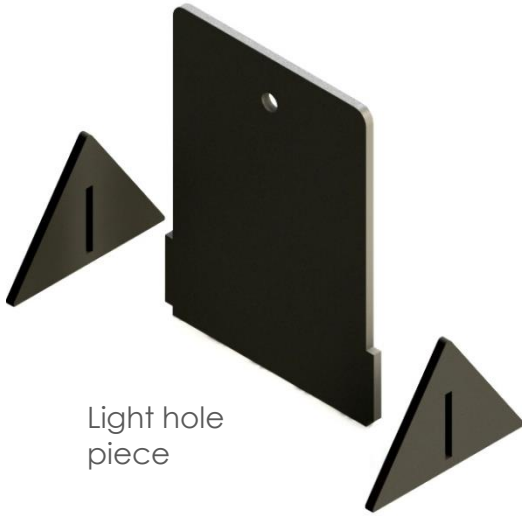


DuPont Cables

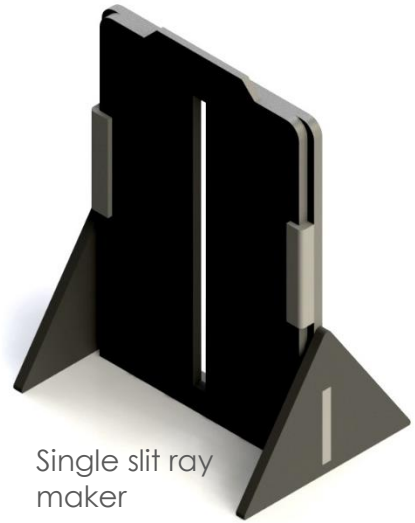
T Junction cables

Assorted simple
metal conductors

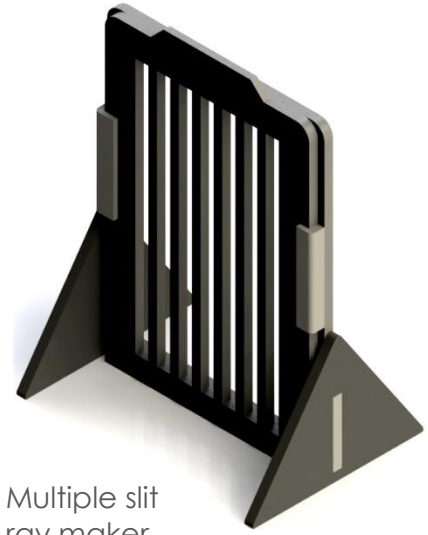
Electromagnetism and Light Components



Light hole piece



Single slit ray maker



Multiple slit ray maker

LED Stand

Iron core

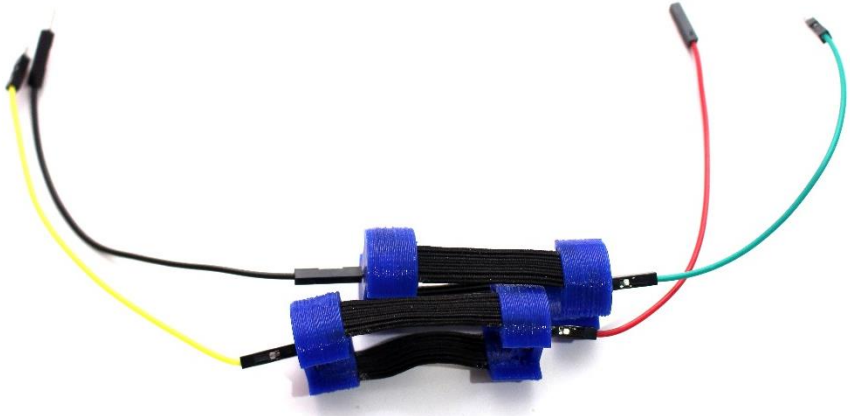
Solenoid

Other components

Iron fillings

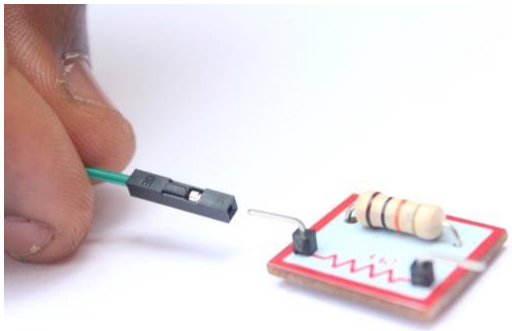
Mirror

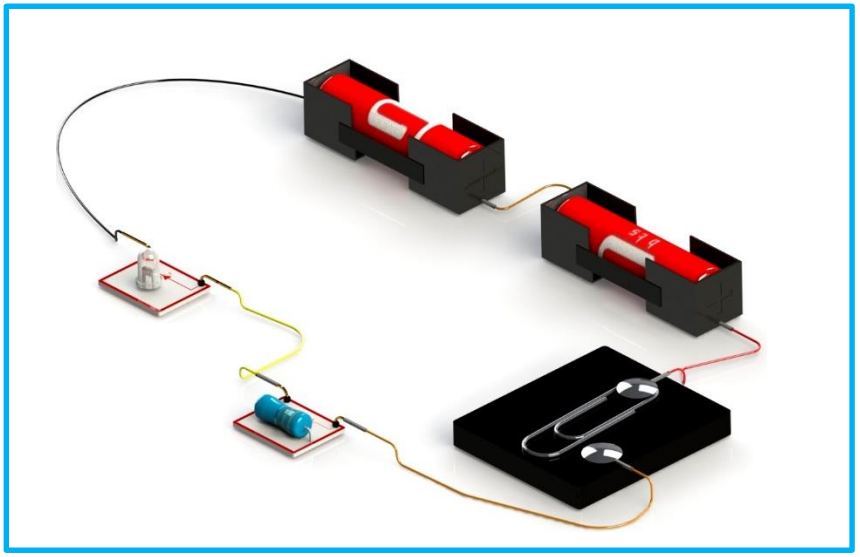
1.5 Volts Dry Cells

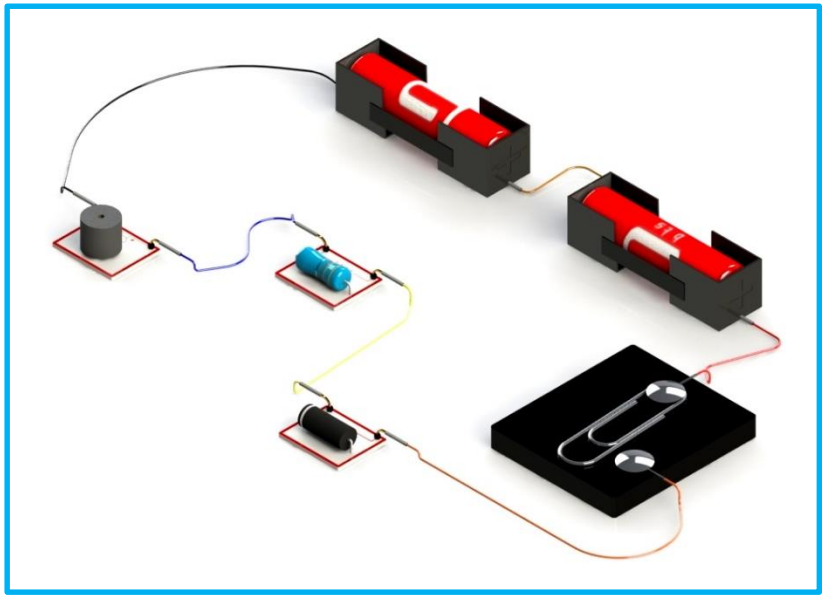


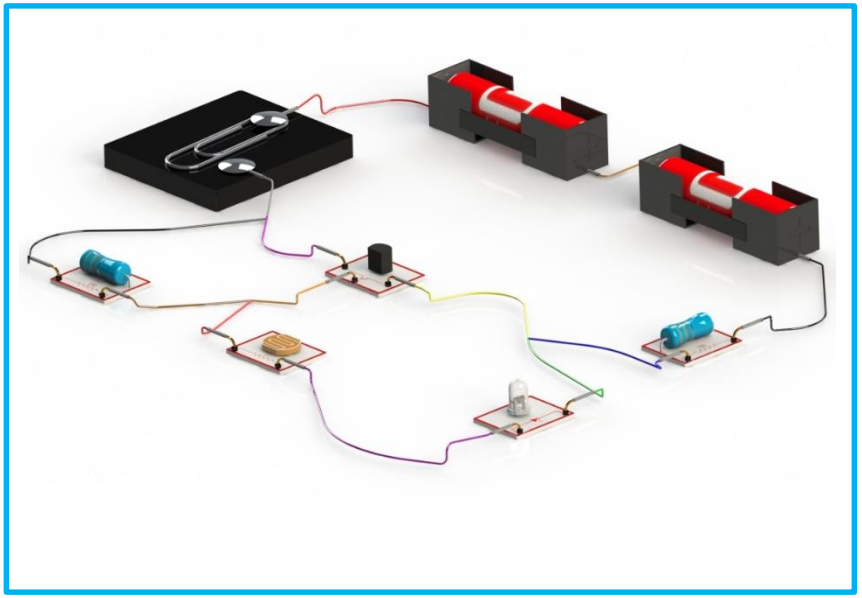
Clip-on Battery Holder

Basic Setups Examples

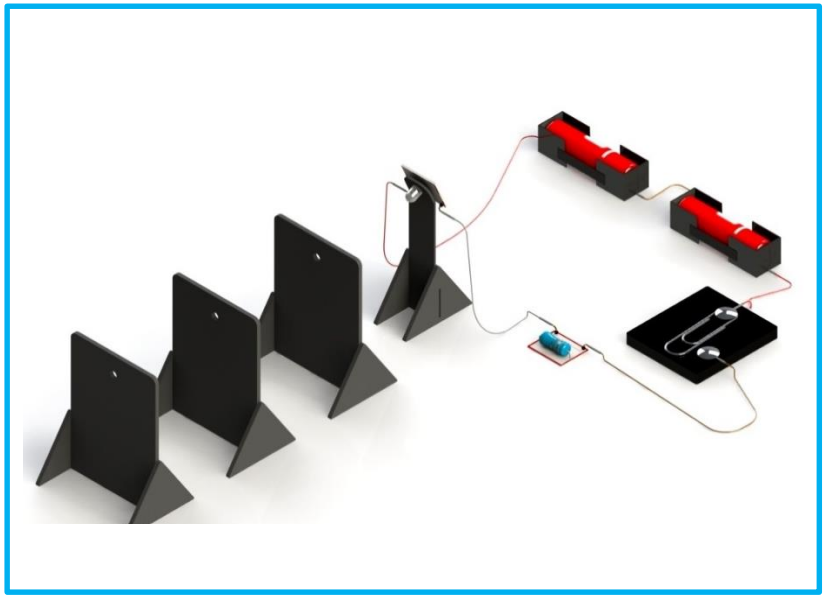


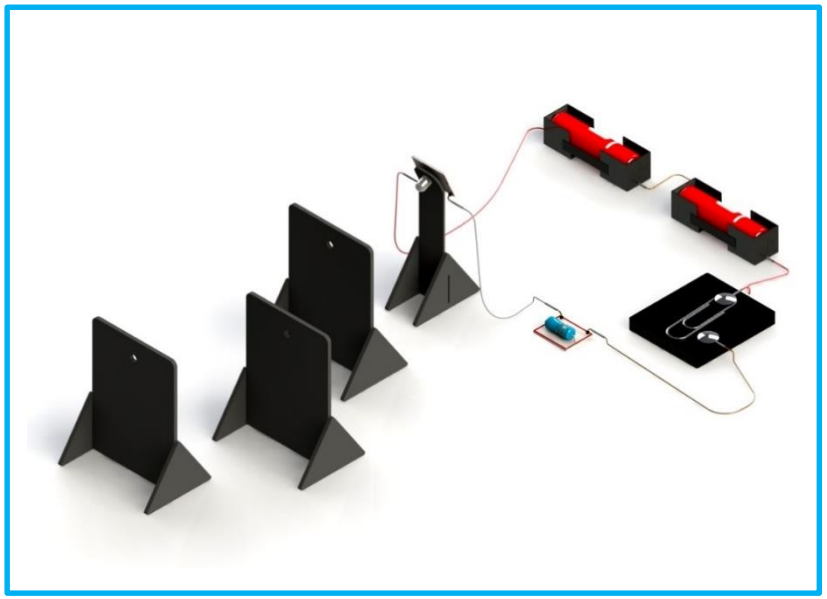


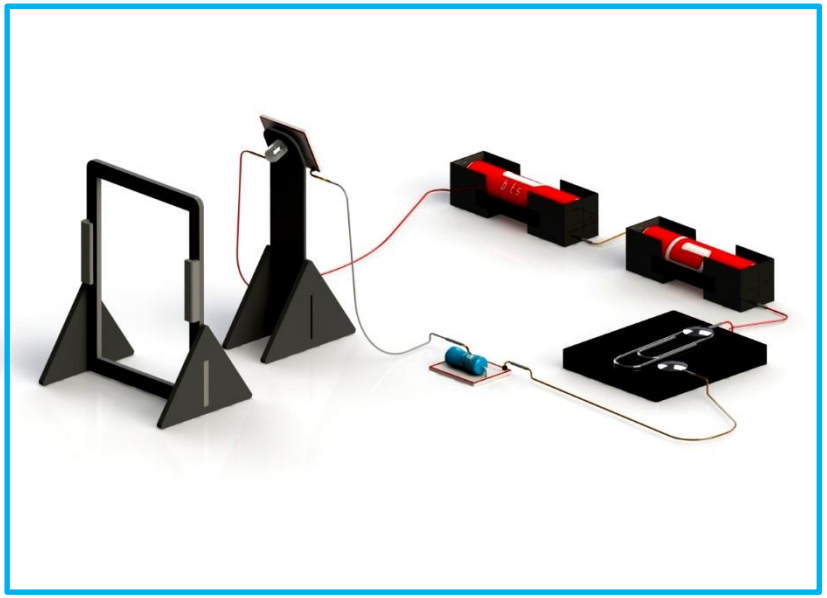


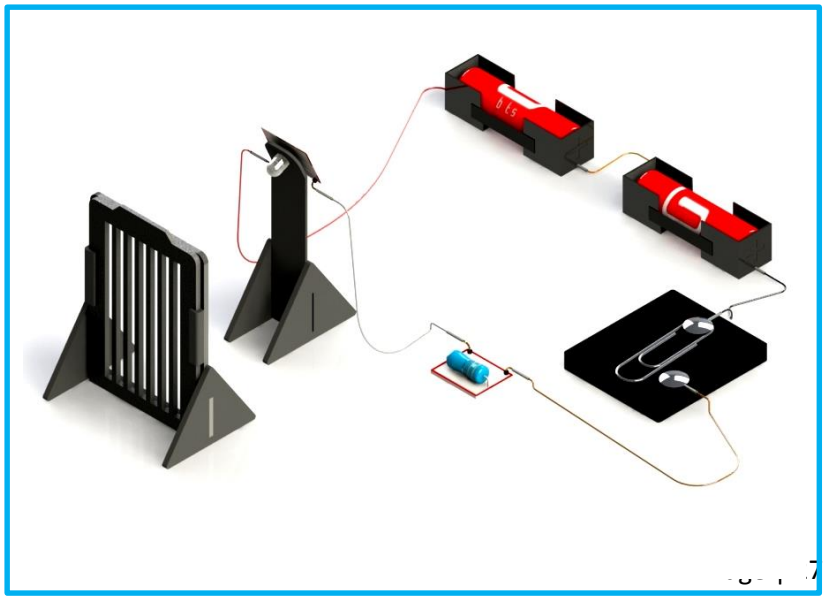


Basic Setups Examples

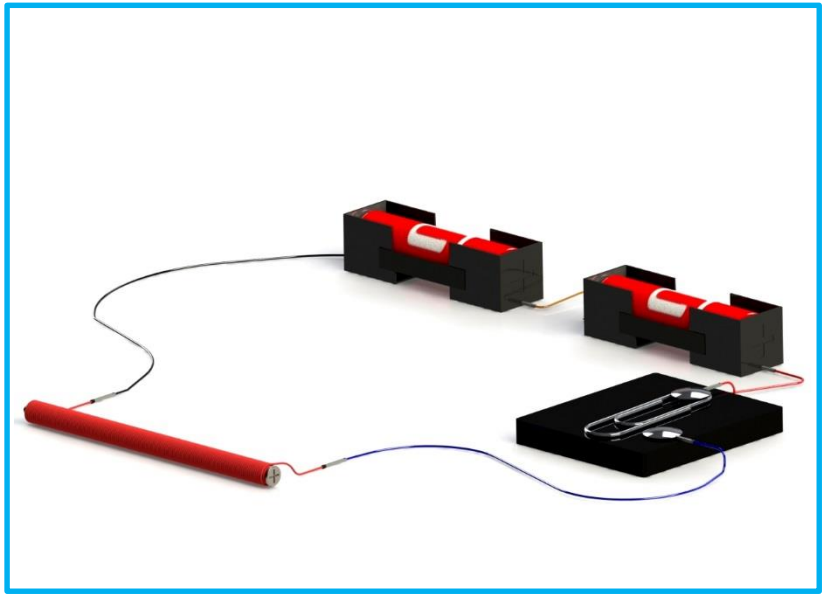


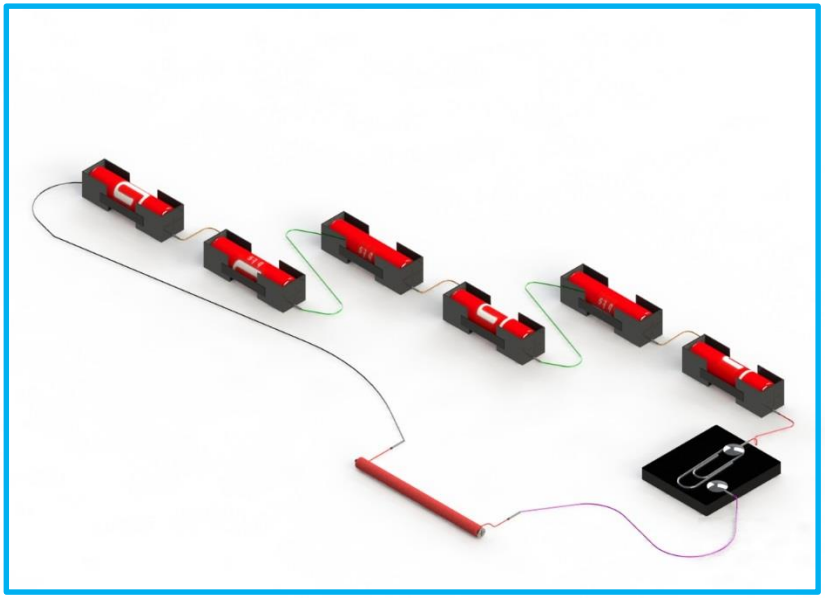


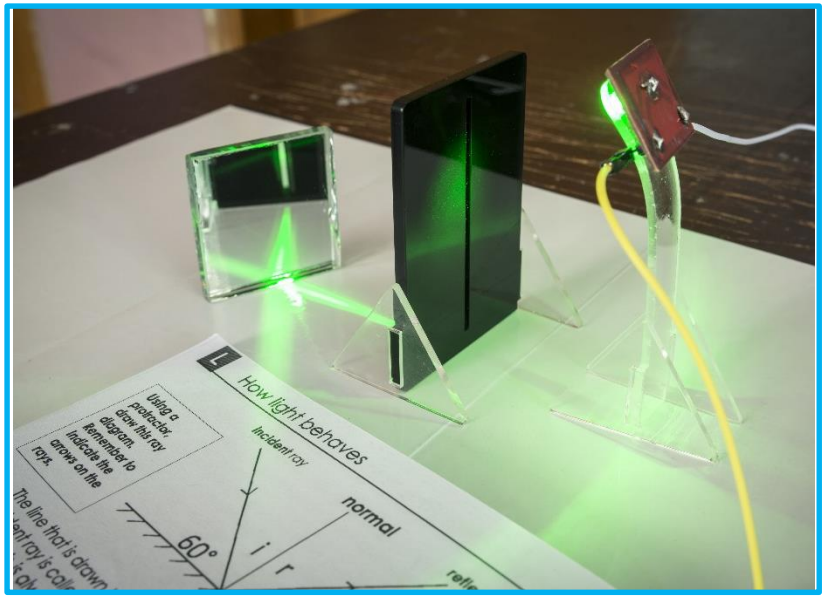




Basic Setups Examples







Deployment So Far

50

Schools

In Ghana and USA use the science set

11000

Students

currently have access to the science set

200

Teachers

have been trained and actively use the science set

20,000

Activities

have been performed using the science set in 200+ classrooms

2

International Awards

from the American Society of Mechanical Engineers and Royal Academy of Engineers

Implementation so Far

3000 science sets have been distributed to schools across Ghana and USA through direct sales and donations. These sets are used in over 200 classrooms by over 11000 students.

We received an award from the Ghana Institute of Engineers (GhIE) during their 2016 engineering excellence awards. We also received an award from the American Society of Mechanical Engineers (ASME) during their 2017 innovation show in Kenya. We have worked with MITs practical education network, Technology consultancy center (at Kwame Nkrumah University of Science and Technology) and Ghana Exploratory (with funding from Australian Aid).

Partner and recognition

Technology Consultancy Center KNUST

the exploratory
STEM+Love = A better world

With sponsorship from **Australian High Commission Ghana**

GhIE
Ghana Institution of Engineers

American Society of Mechanical Engineers
ASME

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Implementation so far

Some Teacher Training and Donation Events

Awards

The Ghana Institute of Engineers (GhIE) 2016 Engineering Excellence Awards

"For ingenuity and innovation in the development of the Science Set and in recognition of the potential of the Science Set to transform the future of science education in basic schools…"

American Society for Mechanical Engineers (Innovation Show Award)

"For socially innovative hardware-led solution which is pushing human collective knowledge frontier outward and solving problems to improve the lives of all people."

Royal Academy of Engineering (Short listed as top African innovation)

"For finding a way to keep learning in the classroom, supporting social, collaborative learning rooted in contact with the real world and real objects"

ROYAL ACADEMY OF ENGINEERING

We are committed to transform science education in Africa through collaboration with individuals and organization

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