





### INTRODUCTION

Greetings fellow scientists! Welcome to the exciting exploration of the world around us...the world of science. This is a book full of fun & thought-provoking science projects and experiments that will teach you, step-by-step, how to create an exciting project that not only demonstrates good scientific practice but provides a safe and fun educational experience too! With this book you will discover that science is a part of every object in our daily lives. Who knows? Maybe someday you'll create your own fascinating inventions—or even grow up to be a rocket scientist!

You can read all the books on music and guitars in the world, but that won't make you a great guitar player. You have to actually practise with a guitar to get it right! It is easiest to figure things out by getting your hands 'dirty' by doing! Science works exactly the same way. Yes, you can learn a lot in science class or by doing homework, but there's nothing quite as much fun as learning by getting your hands dirty doing some science experiments.

Science can be real simple and is actually only about understanding the world you live in! Science certainly does not need to be complicated formulas, heavy text books and geeky guys in white lab coats with thick glasses. Doing science experiments are all about testing and getting results, even if you get a surprising result than you might not have expected. But remember, even if things don't work out as you would have hoped, a good scientist is constantly asking: Why? Science is in fact only an organized system created by people to gather and store information. We use it as a way to define and understand the world we live in!

Science experiments are an awesome part of science that allows you to engage in cool and exciting hands on learning experiences that you are sure to enjoy and remember! A short introduction to each project will help raise questions in your mind, followed by step-by-step instructions for creating your project. Finally, our conclusion and learn more sections will help you understand what your project demonstrates and how this information can answer broader questions about science.

Most of the items you will need for the experiments, such as jars, aluminium foil, scissors and sticky tape, you can find around your home. Others, such as magnets, lenses or a compass, you will be able to buy quite cheaply at a hobby shop or hardware store.

When you carry out experiments, always keep notes about the things you use (materials / apparatus), what you do (method), and what happens (observations, results and conclusion). All scientists do this. If an experiment does not work first time, don't be discouraged. Try again. You may find there is something simple you have not done. Surprisingly, by doing things wrong, you sometimes learn more than when you do things right!

## TAPE NOTICE

In many of the science projects, an item known as 'sticky tape' is required in the materials list. With sticky tape, we only recommend any kind of adhesive tape which you would find most suitable to the particular experiment.

Many types of adhesive tapes are available, from: masking tape which has a paper material making it easier to tear, stick and write on; Sellotape which is stronger and is manufactured from a plastic substance, Insulation tape is often used for insulating electrical wires and can be used effectively where a waterproof bond is required. Duct tape, familiar worldwide is the strongest and most versatile of all tape types.

Have fun experimenting!



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# FALLING TIME

Calculate the viscosity factor of various liquids

CHEMISTRY > ELEMENTS &  
COMPOUNDS  
RN: 11030803

SUITABLE GRADES

① ② ③ ④ ⑤ ⑥ ⑦ ⑧

DIFFICULTY

① ② ③

TIME REQUIRED

< 12 Hours



ADULT SUPERVISION  
ADVISED

## STUFF YOU WILL NEED (MATERIALS):



Glass bottle



Small ball bearing



Stopwatch



Cooking oil



Baby oil



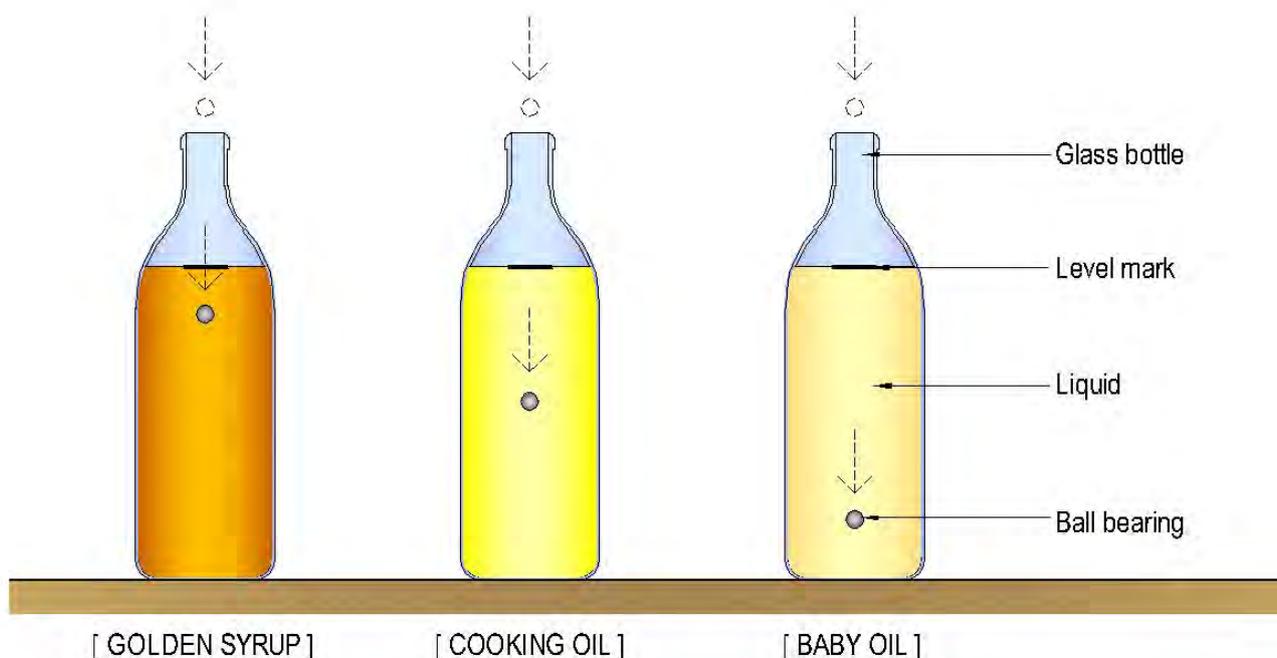
Golden syrup



Magic marker

## HOW TO PROCEED (METHOD):

All fluids, liquids and gases, show signs of 'viscosity' to some degree. Viscosity may be thought of as the friction within a fluid, similar to the friction between two solids that resists the motion of one over the other. Friction makes it possible for an object to acceleration relative to another object, such as the friction between the wheels of a car on a highway. Measure the viscosity of various liquids by calculating the average time a round solid object takes to fall through the liquid to the bottom of a bottle in the following science experiment:



1. Pour a small glass bottle about  $\frac{3}{4}$  full of 'cooking oil' and mark the level of the liquid with a magic marker. This mark will be used when testing the other liquids so that a constant level is used and the liquids can be properly compared.
2. Drop a small ball bearing (about 10mm diameter) into the liquid in the bottle and use a stopwatch to time the number of seconds it takes for the ball bearing to fall to the bottom of the bottle.
3. Do the procedure two more times, and each time record the results to obtain the average falling time for each of the liquids tested.
4. Repeat steps 1 to 3 for the 'baby oil', 'syrup' and other substances you might want to test.

5. Draw up a data chart to compare the viscosity of various liquid substances.

**WHY IT WORKS (CONCLUSION):**

‘Viscosity’ is the term used to describe the ability of a liquid to flow, in other words, the level of internal friction within a liquid affecting its rate of flow. The higher the viscosity factor of a fluid, the more resistance it will have against a solid trying to move through it. In this science experiment, the golden syrup has the highest viscosity and the ball bearing takes the longest time to fall to the bottom of the bottle, whereas the baby oil has the lowest viscosity and will fall to the bottom of the bottle a lot quicker.



**LEARN MORE:**

*Viscosity resists the motion of a solid, such as a ball bearing, through a fluid, such as oil. The viscosity of a fluid also makes it possible for a propeller or other device to accelerate the solid through the fluid. The propeller on a boat or an aeroplane uses the viscosity of water or air to move forward.*

**GLOSSARY:**

**Viscosity**

The resistance of a liquid to shear forces and hence its ability to flow. For example: Water or alcohol has a low viscosity while oil or honey has a high viscosity. Liquid hydrogen has the lowest viscosity at 20.28 K, of all liquid elements!

**Friction**

The resistance encountered when one body is moved in contact with another.

**NOTES:**

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# TIME FLIES WHEN YOU ARE HAVING FUN!

Make a sundial to tell the time

EARTH SCIENCE & ASTRONOMY  
> ASTRONOMY  
RN: 10110403

SUITABLE GRADES  
1 2 3 4 5 6 7 8

DIFFICULTY  
1 2 3

TIME REQUIRED  
< 2 Days



ADULT SUPERVISION ADVISED

## STUFF YOU WILL NEED (MATERIALS):



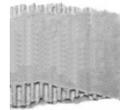
Protractor



Stiff card



Compass



Thick cardboard



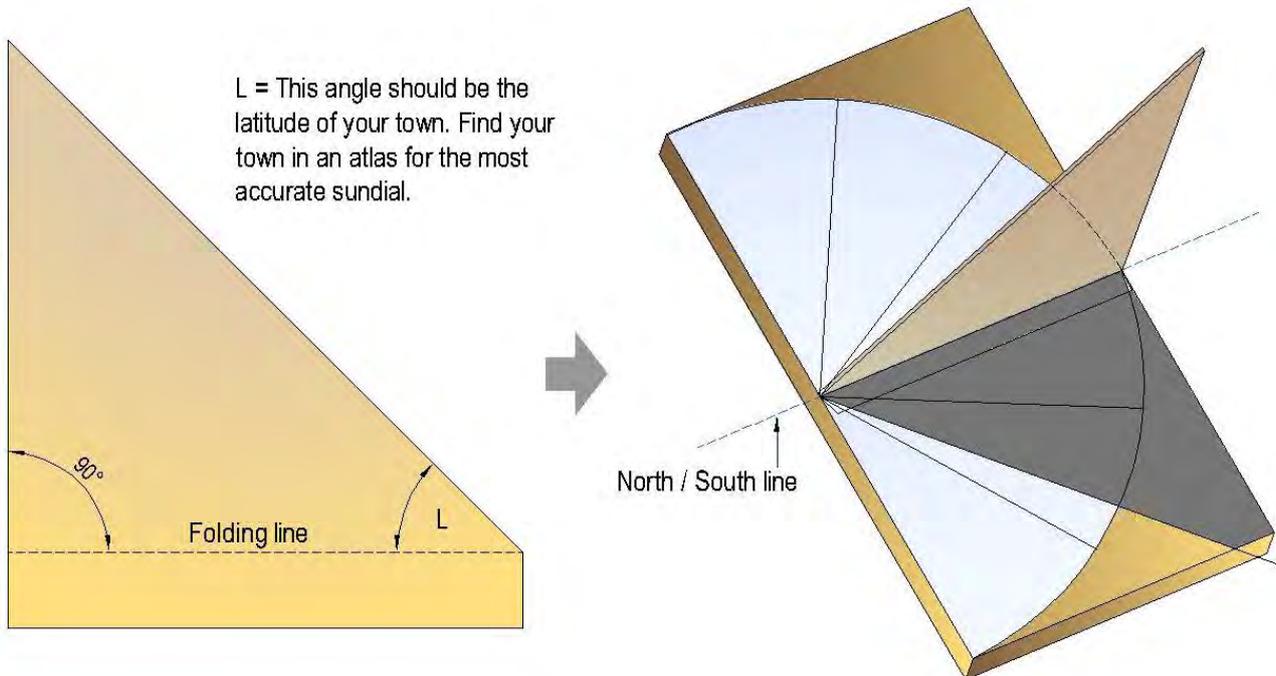
Glue



Scissors

## HOW TO PROCEED (METHOD):

At the same time the Egyptians invented the 'shadow clock', other cultures also developed a need to organize their time more efficiently. Amongst others, the Chinese, Greeks and the Romans developed another device for telling the time known as a 'sundial'. Sundials do not necessarily work better than shadow clocks, it is just a slight variation to the shadow clock. Make your own 'sundial' to tell the time in this science experiment:



1. On a stiff piece of cardboard, draw a right angled triangle as in the diagram above. The short sides of the triangle should be about 150mm long, whereas the long side will be about 200mm, depending on the longitudinal angle used for your town. Make sure that you also add the base, below the dotted line.
2. Cut out the triangle, and make a fold along the dotted line to form the base for the triangle to stand on.
3. Make a thick base for your sundial out of corrugated cardboard or wood of about 150x300mm in size. Draw a semi-circle on the base as shown in the diagram above.
4. Glue the folded part of the triangle firmly to the base and place the sundial on a flat surface outside so that the triangle points north / south.
5. Mark the position of the shadow that falls on the base every hour. Notice that the shadow travels the same distance along the semi-circle every hour. On a sunny day you will now be able to tell the time by looking at the position of the shadow on your sundial!

## WHY IT WORKS (CONCLUSION):

In the above science experiment we have built a time indicating device called a 'sundial'. This works because of the fact that shadows change direction, depending upon the time of day. The position of the sun in relation to a specific location on earth changes throughout the day as the earth rotates around its own axis every 24 hours. A 'sundial' like this one, uses a shadow's position to tell the time. The position of a shadow on the semi-circle depends on the time of day, but it also depends on the season of the year. That's because the sun's position at a certain time of day is different in different seasons.



### LEARN MORE:

*The obvious problem with 'sundials' and 'shadow clocks' is that they don't work during night time! The king of Egypt, was not satisfied having to check the position of the stars to know what the time is during the night, so one of his princes made him a water clock.*

*A water clock works by taking a big bucket of water, fills it with water up to a specific line and then cut a small hole in the bottom of the bucket and marked off lines on the bucket after each hour had passed. The problem with a water clock is that water flows more slowly or quickly when the temperature changes.*

*The same principle was used but the water was substituted with sand to make a sand clock. The inventor of the sand clock is unknown, but the sand clock or hourglass was commonly used in ancient times and is still used today.*

## GLOSSARY:

### Time

We think of time as the ways in which we measure the passing of time, such as a clock or watch, or perhaps a measured interval of time such as an hour or minute.

### Shadow clock

An ancient time telling device consisting of a straight base with a raised crosspiece at one end, which uses the length of the sun's shadows because of its position, in relation to a specific location on earth, to tell the time.

## NOTES:

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# I'M SINGING IN THE RAIN

Build your own rain alarm in this simple experiment

**ELECTRICITY & MAGNETISM >**  
**ELECTRICAL CURRENT**  
RN: 11020801

SUITABLE GRADES  
1 2 3 4 5 6 **7 8**

DIFFICULTY  
1 2 **3**

TIME REQUIRED  
< 1 Week

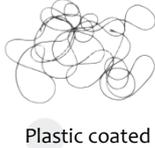


ADULT SUPERVISION ADVISED

## STUFF YOU WILL NEED (MATERIALS):



9-volt battery



Plastic coated copper wire



9-volt buzzer / Bell



Clothespin



Effervescent tablets



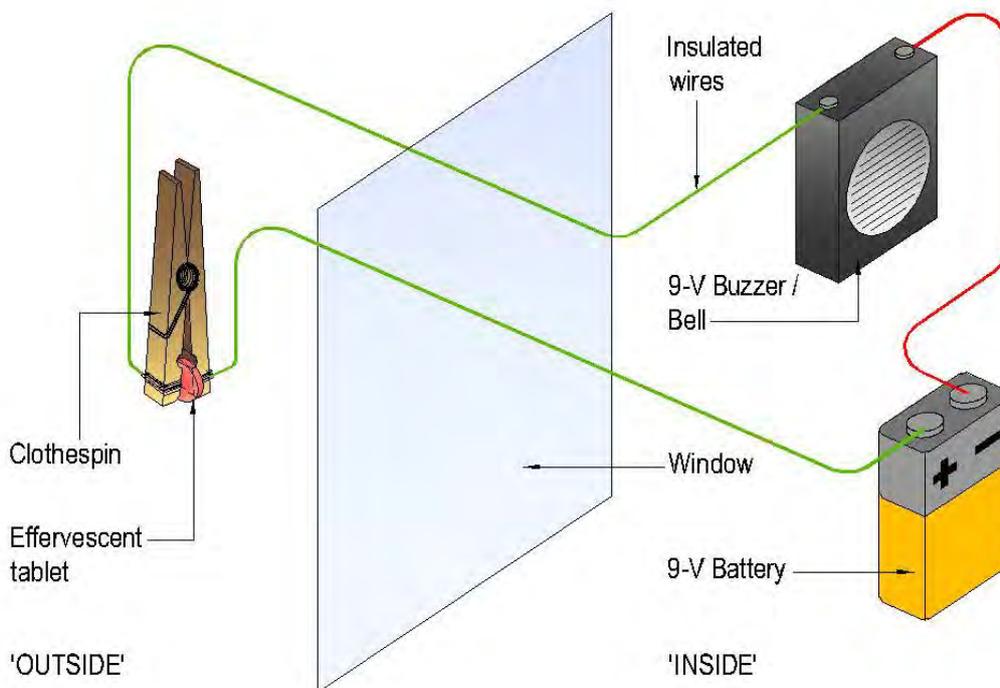
Wire cutters



Rubber cement

## HOW TO PROCEED (METHOD):

Many electrical devices are used as early warning systems such as burglar alarms, electric fencing systems and many more. Don't you think it will be useful to have an early warning system for rain to warn you to close the windows and bring in the clothes from the clothesline? In the following science experiment you will build a device that can detect rain as soon as the first drops start to fall:



1. Cut two pieces of thin plastic coated wire of about 2m - 3m each (or long enough to reach from the outside of your window to the inside of your bedroom where the buzzer and battery will be positioned). Use wire cutters to strip clean the ends of both wires. Make sure that one end of each wire has at least 30mm clean stripped, and the other side of each wire about 100mm clean stripped.
2. Push the 100mm stripped clean ends of both wires through a small opening in your bedroom window, and connect the other ends to the terminals of a 9-V battery, and an electrical buzzer or a bell. Use another shorter piece of wire to connect the battery and the bell to each other as in the diagram above.
3. On the outside of your window, connect a wooden or plastic clothespin to the other ends of the wires by winding it several times over each of the front ends of the clothespin. This will be your two contact

pieces to complete the electrical circuit.

4. Place a small effervescent-type of tablet in between the two prongs with the contact pieces of the clothespin to prevent them from touching. You may need to experiment with several types of tables to find the most suitable one, which degenerate the fastest when coming in contact with water or 'rain'.
5. Place the clothespin and tablet configuration on the sill of your window (you can use rubber cement to hold it in position).
6. When it starts to rain, the buzzer will go off and warn you that your clothes or curtains might get wet!

### WHY IT WORKS (CONCLUSION):

The power or 'electrical energy' stored in a battery can only be released and allowed to flow when a complete circuit is made out of wires or other 'conductors' that conduct electricity. In the above experiment, the electrical circuit is not complete until the prongs of the clothes pins with the wires wrapped around it are pressed together. When the rain drops degenerate and melt the effervescent tablet, the prongs with the wire contact pieces are pressed together, making a circular path between the battery and the bell. The current flows in a complete 'loop' from the battery through the 'rain detector' on the window sill to the buzzer and battery in your room. When the circuit is complete and the current is flowing, the buzzer sounds to warn you of the rain that started to fall!



### LEARN MORE:

*Did you know that your 'rain detector' can also be usefully applied to other situations where you might need to be warned, like the water level in a tank for instance?*

*Let's suppose we have to fill a water tank on a roof top with the help of a pump and we are unable to see the level of water in the tank. We can use the 'rain detector' to warn us of a possible overflow of the tank. The 'rain detector' can be placed inside the wall of the tank near the top so that water strikes the rain 'sensor' just before the overflow occurs. This is another practical application of your rain detector in everyday life.*

### GLOSSARY:

#### Electrical current

Electrical current is the flow of charged electrons through a circuit. Electrical current, which is electrons flowing in a wire, can be explained as cars driving along a road, where the road is the wire and the cars are the electrons. The current would be the number of cars passing a given point.

#### Buzzer

An electrical mechanism that produces an intermittent current and an audible buzzing sound, or series of sounds, when electrical current flows through it.



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# FLY BY NIGHT!

Make a box trap to capture nocturnal insects

LIFE SCIENCE > ENTOMOLOGY  
RN: 10112401

SUITABLE GRADES  
1 2 3 4 5 6 **7 8**

DIFFICULTY  
1 **2** 3

TIME REQUIRED  
< 2 Days



ADULT SUPERVISION ADVISED

## STUFF YOU WILL NEED (MATERIALS):



Flashlight



Carton box



Aluminium foil



Plastic jar



Rope



Sticky tape



Sock



White paint



Scissors



Ruler



Rubber band



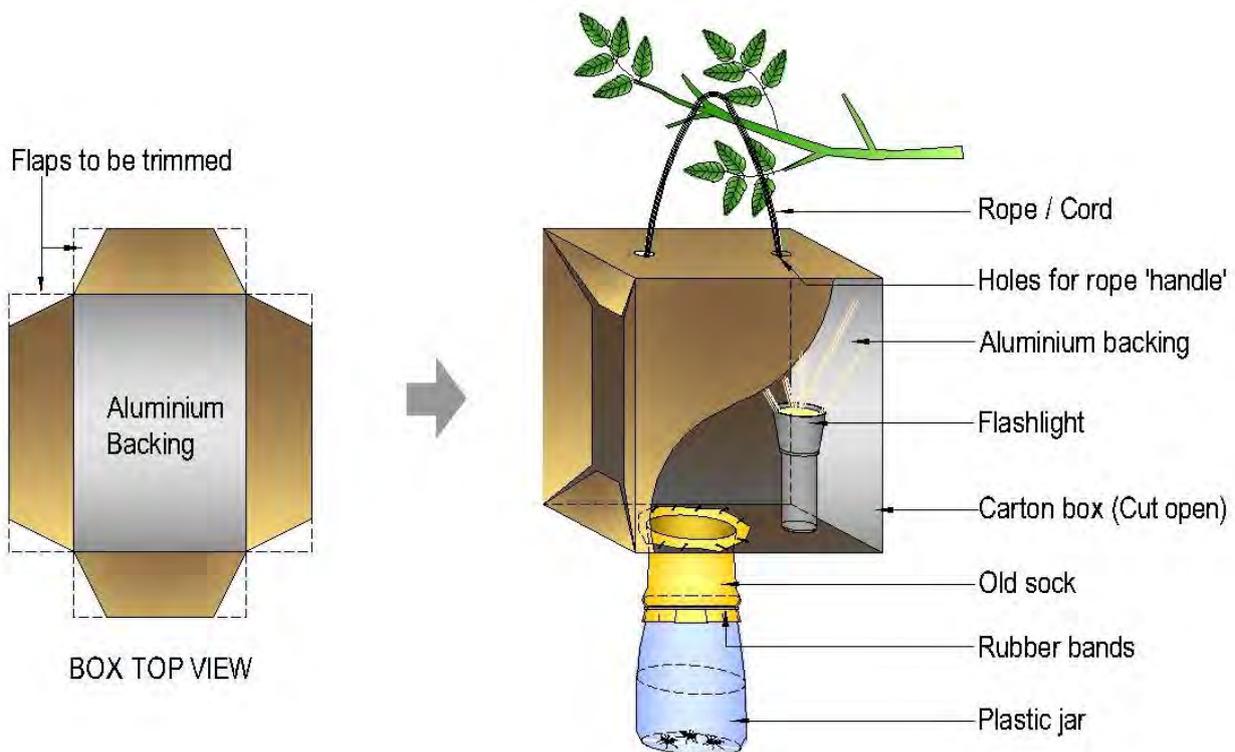
Glue



Stapler

## HOW TO PROCEED (METHOD):

As much as there is a place for all insects in the bigger scheme of things, some 'nocturnal' insects can be really annoying to people. Night insects like mosquitoes, moths and the like, buzzes your ears constantly, they bite you, or even takes up residence in your home. Use a box-trap to catch some of these 'nocturnal' insects in the following science experiment:



1. Find a medium sized carton box, about the size of a large shoebox but one with flaps. Use scissors to trim away the sides of each of the four flaps as in the diagram above.
2. Paint the whole box with white paint and use scissors to cut out a rectangular piece of aluminium foil that will fit fully inside the back wall of the box (the side opposite the opening with the flaps). Stick the piece of aluminium foil against the inside back wall using glue.
3. Push the flaps slightly towards the inside of the box, so that the wedges come together where it was trimmed away.

4. Put the box upright so that the side with the flaps are facing you, and you can see the aluminium backing behind the flaps. Now, cut out a circular shape in the floor of the box about 120mm in diameter.
5. Use the scissors to cut away the toe end of an old sock, and stretch the opening of the sock over the sides of the opening in the floor of the box. Use a stapler to secure the sock to the sides of the circular opening in the floor of the box, so that it forms a 'sock-tube' leading towards the bottom of the box.
6. Fix a transparent plastic jar to the other end of the 'sock-tube', with several rubber bands twisted tightly over the sock-end, which is placed over mouth of the jar.
7. Next, make two small holes in the roof of the box, and place the ends of a piece of rope into each hole. Make a large knot on each end of the rope to prevent the rope from sliding, out forming a rope 'handle' for the box.
8. At nightfall, suspend the box from a tree branch and place an electronic lantern or flashlight upright at the back of the box, next to the aluminium backing so that the light is reflected outward.
9. Leave your box-trap out all night and observe your assets in the morning. You will have caught a large variety of nocturnal insects – especially mosquitoes and moths, which are the most annoying!

#### WHY IT WORKS (CONCLUSION):

This science experiment works because nocturnal insects use the moon to navigate their surroundings. Nocturnal insects will hence be naturally attracted to any source of bright light, and will fly towards the light in the box being reflected off the shiny aluminium paper. Due to the clever flap design of the box which is folded slightly inwards, the insects find it hard to escape again. The insects become exhausted from flying around trying to escape, collapse, and fall through the sock into the jar below.



#### LEARN MORE:

*Similar to nocturnal insects that use the moon to navigate their way, bees, wasps and many other flying insects use the sun as their compass. These flying insects rely primarily on the Sun as a reference point for navigation, keeping track of their flight direction with respect to the Sun, and factoring out the effects of the winds that may be blowing them off course.*

*The Sun can be a difficult landmark to utilize for navigation because cloud cover can obscure it and it is always in motion from east to west. Insects use the patterns of ultraviolet polarized light in the sky to determine the Sun's location, and they are born with the ability to compensate for the sun's continuous motion.*

#### GLOSSARY:

##### Nocturnal

Animals or insects that is active during the night and sleep during the day.



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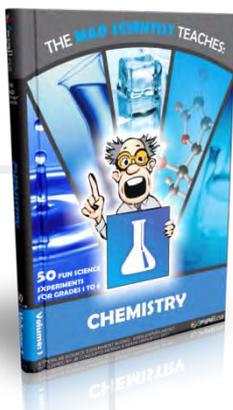
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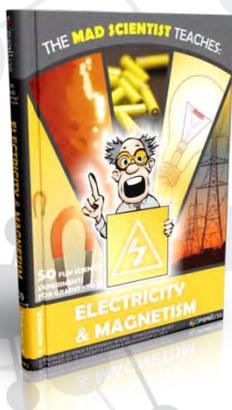
## OTHER SCIENCE E-BOOKS BY EXPERILAND:

### THE MAD SCIENTIST SERIES:

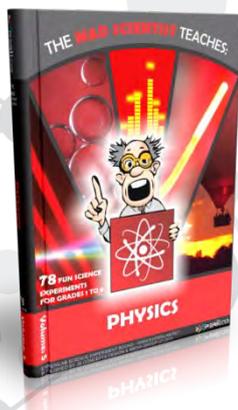
**Volume 1 – The Mad Scientist teaches:  
Chemistry [50 projects]**



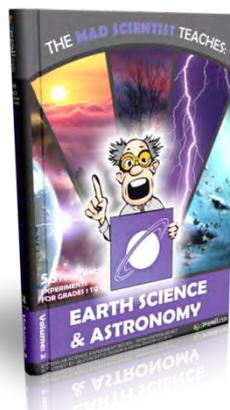
**Volume 3 – The Mad Scientist teaches:  
Electricity & Magnetism [50 projects]**



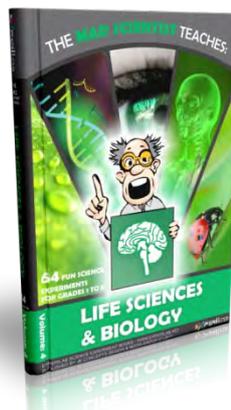
**Volume 5 – The Mad Scientist teaches:  
Physics [78 projects]**



**Volume 2 – The Mad Scientist teaches:  
Earth science & Astronomy [58 projects]**



**Volume 4 – The Mad Scientist teaches:  
Life sciences | Biology [64 projects]**



#### NOTE:

This e-book series are suitable for elementary & middle school science enthusiasts (grades 1 to 8) Projects take from only few hours, up to weeks to complete.



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## OTHER SCIENCE E-BOOKS BY EXPERILAND:

### **FUN & EASY SCIENCE PROJECT SERIES:**

#### **Volume 1 – Fun & Easy Science projects: Grades 1 & 2**



**SUBJECTS COVERED:**

Chemistry, Earth sciences, Electricity & Magnetism, Life sciences, Physics

**GRADES:**

Suitable for grades 1 & 2

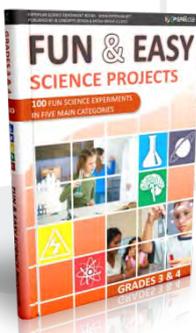
**PROJECTS:**

60 Fun science experiments [121 PAGES]

**TIME REQUIRED:**

From only few hours, up to weeks to complete.

#### **Volume 2 – Fun & Easy Science projects: Grades 3 & 4**



**SUBJECTS COVERED:**

Chemistry, Earth sciences, Electricity & Magnetism, Life sciences, Physics

**GRADES:**

Suitable for grades 3 & 4

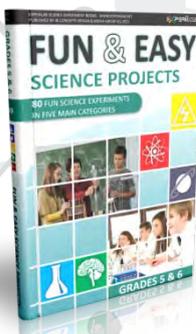
**PROJECTS:**

100 Fun science experiments [215 PAGES]

**TIME REQUIRED:**

From only few hours, up to weeks to complete.

#### **Volume 3 – Fun & Easy Science projects: Grades 5 & 6**



**SUBJECTS COVERED:**

Chemistry, Earth sciences, Electricity & Magnetism, Life sciences, Physics

**GRADES:**

Suitable for grades 5 & 6

**PROJECTS:**

80 Fun science experiments [186 PAGES]

**TIME REQUIRED:**

From only few hours, up to weeks to complete.

#### **Volume 4 – Fun & Easy Science projects: Grades 7 & 8**



**SUBJECTS COVERED:**

Chemistry, Earth sciences, Electricity & Magnetism, Life sciences, Physics

**GRADES:**

Suitable for grades 7 & 8

**PROJECTS:**

60 Fun science experiments [149 PAGES]

**TIME REQUIRED:**

From only few hours, up to weeks to complete.



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## OTHER SCIENCE E-BOOKS BY EXPERILAND:

### LAST MINUTE SCIENCE EXPERIMENT SERIES:

#### Volume 1 – Last Minute Science experiments: 12 Hours & Counting...



**SUBJECTS COVERED:**

Chemistry, Earth sciences, Electricity & Magnetism, Life sciences, Physics

**GRADES:**

Suitable for elementary & middle school science enthusiasts (grades 1 to 8)

**PROJECTS:**

150 Fun science experiments [300 PAGES]

**TIME REQUIRED:**

From only few hours, up to about 12 hours to complete.

#### Volume 2 – Last Minute Science experiments: A Day or Two Remains...



**SUBJECTS COVERED:**

Chemistry, Earth sciences, Electricity & Magnetism, Life sciences, Physics

**GRADES:**

Suitable for elementary & middle school science enthusiasts (grades 1 to 8)

**PROJECTS:**

100 Fun science experiments [220 PAGES]

**TIME REQUIRED:**

Science experiments take a few hours up to a day or two to complete.

#### Volume 3 – Last Minute Science experiments: Due in a Week or More...



**SUBJECTS COVERED:**

Chemistry, Earth sciences, Electricity & Magnetism, Life sciences, Physics

**GRADES:**

Suitable for elementary & middle school science enthusiasts (grades 1 to 8)

**PROJECTS:**

50 Fun science experiments [122 PAGES]

**TIME REQUIRED:**

Science experiments take a week or more to complete.



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