

Now that's cool, but why is it doing that?



Just like other living things, plants need food to survive. When light, water, carbon dioxide and nutrients combined, together they form a chemical reaction called **photosynthesis**, which produces the food for plants to survive! Most of the plants are green in colour because they contain lots of **chlorophyll**, which does the job of absorbing sunlight and activating photosynthesis.

Have you noticed in your experiment, that the plant exposed to green light is the smallest in size? That is mainly due to the fact that plants are green in colour! Because they are green, it means that most of the green light is reflected out for us to see and little of that energy is contributed to growing.



Sunlight or light coming from incandescent light bulbs are made up of a **spectrum** of colours, and together they form the white light that we see. In comparison, the LED's that we use in this experiment are very good at producing just a narrow band of light, so we could see which colour contributes best to the plant growth.

And it turns out, the colour red sits within the range that promotes the most active photosynthesis, that's why more energy gets converted into growth for the plant!

You may ask, do my plants grows faster if I only give it red light? Technically yes! But they may grow differently as they would in nature, which isn't always a good thing, and other colours also contribute to producing fruit and flowers in plants, so crops that grows under red light may not be as tasty and nutritious.

Acid and alkalis are two extremes that describe chemicals, just like hot and cold are two extremes that describe temperature. Many common household items can be acidic or alkaline. For example, lemon juice and vinegar are acids and they usually tastes sour. In contrast, chemicals used for cleaning are alkaline, such as detergent and baking soda (**Don't taste them!**).

Do you know when acid and alkalis are mixed together, their effects cancel out. This process is called neutralisation.

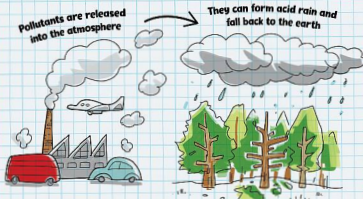
The included pH paper can tell us whether something is acidic or alkaline by changing its colour upon contact with these substances. By comparing the colour of the pH paper to the pH scale, you can determine the pH of the substance you are testing. Substances which have a pH lower than 7 are acids, and those above 7 are alkalis.

Do you know water has a pH of 7 and is considered "neutral"?



Acid and Alkalis in nature

Acid rain occurs when pollutants in the air falls back on earth's surface when it rains. When the rain becomes acidic it creates all sorts of problem to the plants. Not only the plants cells can be damaged by the acid, but the soil can also absorb the acidic rain, affecting the natural balance of nutrients in the soil and leaving long term effects to the ecosystem.



Biochemistry Collection PLANT GROWTH EXPERIMENT

Included Materials

- 1 Growing Stand
- 3 Ruler Inserts
- 3 Test Tubes
- 1 Test Tube Rack
- 1 Petri Dish
- 1 Plastic Cup
- 1 Pipette
- 1 Pair of Tweezers
- 1 pH Chart
- pH Test Papers
- 1 Magnifier
- 1 Battery Module
- 3 LED's (red, green and blue coloured)
- 1 Pack of Cotton Ball



Advice for Supervising Adults

This experiments kit is only intended for use by children over the age of 8 years. The instructions should enable adults to assess the experiment's suitability for the child concerned. Before starting the experiments, read through the instruction manual together with your child and discuss the safety information. Check to make sure the kit has been assembled correctly, and assist your children with the experiments.

Notes on Using Batteries in Experiments

Warning! Only for use by children aged 8 years and older. Instructions for parents or other supervising adults are included and have to be observed. Keep the packaging and instructions as they contain important information.

The wires are not to be inserted into socket-outlets. Only adults should install and replace batteries. Alkaline batteries are recommended. If the toy has not been used for a long time, remove the batteries. Non-rechargeable batteries are not to be recharged. Rechargeable batteries are to be removed from the toy before being charged. Rechargeable batteries are only to be charged under adult supervision. Do not mix old and new batteries. Do not mix alkaline, standard (carbon zinc) or rechargeable (nickel cadmium) batteries. Exhausted batteries are to be removed from the toy. The supply terminals are not to be short-circuited. Only batteries of the same or equivalent type as recommended are to be used. Batteries are to be inserted with the correct polarity.

You will need to prepare:

- Choose one type of plant seeds:
Green beans/ Tomato - These plants are quick to germinate and their daily growth is visible to the eye, allowing us to see the results clearly.
- Tap Water

Procedure

Germinating the seeds

Germination is like waking the seed up from a deep sleep, because each seed can wake up at a different time, we wanted to be sure that the seeds that we pick are growing at the same rate. **Just like in a running competition, all contestants start at the same position!**



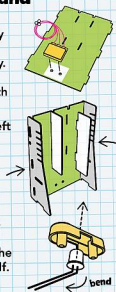
- 1 Pinch a small amount of cotton from the bag, with just enough to thinly cover the base of the petri dish.
- 2 Soak the cotton with tap water, pour out the excess water.
- 3 Place around 20 seeds or beans on the cotton and lay them out evenly.*
- 4 White roots will emerge from the seeds, this indicates that the seed is healthy and will grow. Pick 6 seeds with roots of similar sizes and length for the next step.



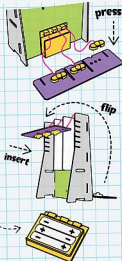
* In the coming days, check the dish occasionally and add some water to the cotton if it is dry.

Assembling the growth stand

- 1 Align the two studs on the battery module to the holes on the green cardboard, press until it fits snugly. Beware of the direction of the cardboard, there should be a notch on the top right corner.
- 2 Insert the two leg pieces on the left and right of the green piece. Beware that the battery module should face the back.
- 3 Insert the two dividers into the green piece.
- 4 Turn the stand around so you face the battery module. Insert the LED's into the holders and bend the legs of the LED away from yourself.



- 5 Align the studs of the LED connector to the purple piece and press until it fits snugly. Beware that the wires of each LED shall not cross each other.
- 6 After the LED's were installed, flip the entire purple piece to the front and insert it to the slots of the stand. The LED's should face down.
- 7 Insert three AAA batteries to the battery module (insert with the correct polarity) and the LED's should light up!



Preparing the growing module

- 1 Assemble the test tube rack accordingly and place three test tubes on the rack.
- 2 Fill each test tube with tap water up to the "28ml" marking.
- 3 Pinch 3 cotton balls with the size of the test tube neck and push it into the test tubes, position all three of them at similar levels.
- 4 With a pair of tweezers, pick 2 seeds that you have germinated and let them sit on top of the cotton balls.
- 5 Place the test tube rack to the growth stand and secure it to the left and right notches.
- 6 Slide in the ruler insert from the top. As the plant grows, adjust the height of the LED light by repositioning the purple piece. Mark the height of the plants on the ruler everyday.



Tips

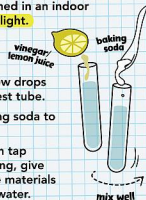
Place the setup in the indoors at a darker area away from sunlight, ensuring the plant is only receiving the LED as a light source.

Further Compare

For the this part of the experiment, take apart the purple piece from the growth stand and disconnect the wires from the battery module. Place the growth stand with test tube rack attached in an indoor environment with **plenty of sunlight**.

Acid and alkalis

- 1 Add 10ml of vinegar or a few drops of lemon juice to the first test tube.
- 2 Add one tea spoon of baking soda to the second test tube.
- 3 Fill all three test tubes* with tap water up to the 28ml marking, give the test tubes a swirl so the materials are well dissolved into the water.



* We leave out the third test tube with just tap water, acting as the **control** of the experiment

- 4 Take a piece of pH paper with your tweezers and cut it into three squares *
- 5 Fill the plastic cup with water, we will use it to rinse off the pipette later.
- 6 Add one drop of sample from each test tube to the pH paper using a pipette. In between samples, wash the outside of the pipette and pump it a few times in the water.
- 7 Wait a minute and compare the colours with the pH scale.
- 8 If the pH paper with the lemon juice or vinegar turned orange while the one with baking soda turned green, it means that you have successfully prepared an acidic and alkaline solution.



* Always hold the pH paper with the tweezers, because even the moisture of your fingers can make it change colour!

➔ Now you can follow the previous steps to prepare your seeds for growing comparison!