John Adams®

8+

Rainbow ScienCe®

Magically colourful & fun rainbow science projects

WARNING!

NOT SUITABLE FOR CHILDREN UNDER 8 YEARS. FOR USE UNDER ADULT SUPERVISION.

READ THE INSTRUCTIONS BEFORE USE, FOLLOW THEM AND KEEP THEM FOR REFERENCE.

DO NOT ALLOW CHEMICALS TO COME INTO CONTACT WITH ANY PART OF THE BODY, PARTICULARLY THE MOUTH AND EYES.

KEEP SMALL CHILDREN AND ANIMALS AWAY FROM THESE EXPERIMENTS.

KEEP THE EXPERIMENTAL SET OUT OF REACH OF CHILDREN UNDER 8 YEARS OLD.

It may sound worrying, but this is the standard legal wording we must include in this leaflet:

ADVICE FOR SUPERVISING ADULTS

- Read and follow these instructions, the safety rules and the first aid information, and keep them for reference.
- The incorrect use of chemicals can cause injury and damage to health. Only carry out those experiments which are listed in the instructions.
- This experimental set is for use only by children over 8 years.
- Because children's abilities vary so much, even within age groups, supervising adults should exercise discretion as to which experiments are suitable and safe for them. The instructions should enable supervisors to assess any experiment to establish its suitability for a particular child.
- The supervising adult should discuss the warnings and safety information with the child or children before commencing the experiments.
- The area surrounding the experiment should be kept clear of any obstructions and away from the storage of food. It should be well lit and ventilated and close to a water supply. A solid table with a heat resistant top should be provided.
- If any experiment starts to grow mould, dispose of it immediately in household waste and wash your hands.
- Some items in the kit can stain clothing and furniture. Cover the activity area with newspaper to avoid damage.
- Undiluted/unmixed ingredients may irritate skin.

FIRST AID INFORMATION

- In case of eye contact: Wash out eye with plenty of water, holding eye open if necessary. Seek immediate medical advice.
- If swallowed: Wash out mouth with water, drink some fresh water. Do not induce vomiting. Seek immediate medical advice.
- In case of inhalation: Remove person to fresh air.
- In case of skin contact and burns: Wash affected area with plenty of water for at least 10 minutes.
- In case of doubt, seek medical advice without delay. Take the chemical, its container and this leaflet with you.
- In case of injury always seek medical advice.

SAFETY RULES

- Read these instructions before use, follow them and keep them for reference.
- Keep younger children under the specified age limit and animals away from the experimental area.
- Store this experimental set out of reach of children under 8 years of age.
- Clean all equipment after use.
- Make sure that all containers are fully closed and properly stored after use.
- Ensure that all empty containers are disposed of properly.
- Wash hands after carrying out experiments.
- Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.
- Do not eat or drink in the experimental area.
- Do not allow chemicals to come into contact with the eyes or mouth.
- Dispose of all components in household waste unless otherwise stated in the instructions.

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2. Bubble Blower Cap
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11. Felt Wicks
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13. Stickers
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16. Blue Powdered Colour 0.3g (E133)
17. Pipette
18. Scoop
19. AR Canvas
20. Leaflet

Welcome

Welcome to Rainbow Science, where you can have lots of fun being a scientist whilst exploring the magical world of colour.

All the components you need are included in the box apart from a few common household ingredients which you will have to ask a kind grown up to supply. Ask nicely, I'm sure they won't mind – after all you will be learning some important scientific principles.

Let's get started...

Preparing the bottles of colouring:

The yellow, red and blue colouring (14,15 & 16) is supplied in powdered form. Before it is used, remove the cap, pull out the dropper and fill the bottle to the line indicated with cold water. Replace the dropper, screw the cap back on and shake. Note: Colouring can stain so always wear old clothes and cover the work area with newspaper.

Safety first

These kits are completely safe when used in the way we describe in this instruction leaflet. Always read the instructions before starting and ask for adult help when requested.

If any of your projects start to look, feel or smell strange, grow mould, pink stuff, purple stuff, or any other "stuff", throw them away. When in doubt....throw it out!!

Some Rainbow Facts:

- Sunlight is made up of all the colours of a rainbow. When those colours are all mixed together it is called white light. White light is the light we see every day.
- When sunlight travels through the air in the same direction we see white light, but when the sunlight enters a raindrop, the colours separate causing us to see a rainbow.
- Each raindrop makes its own tiny rainbow, but it takes millions of raindrops to from the large rainbows we see in the sky.
- Sometimes sunlight is reflected twice inside a raindrop. When this occurs, we get a secondary rainbow or a double rainbow.
- The colours of a secondary or double rainbow are in the opposite order to the primary or first rainbow. You will see violet on top of the secondary rainbow instead of red.
- Did you know that no two people see the same rainbow? Why? Well, a person standing next to you is standing in a slightly different spot and sees the rainbow in a slightly different place. The rainbow may look the same but will be a little different because the person next to you sees different raindrops.
- When the sun is lower the rainbow will be higher in the sky.
- When the sun is higher the rainbow will be lower in the sky.
- Did you know you can never get to the end of a rainbow? When you move the rainbow moves too.

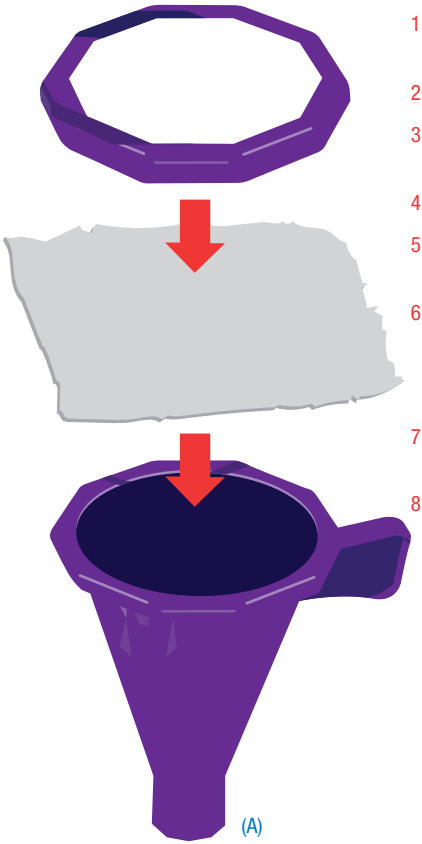
Rainbow Bubble Snake

Some Facts About Bubbles:

A bubble is simply air wrapped inside a soapy film. That soapy film is actually two layers with water in the middle. Think of it like a water sandwich with soap molecules for bread. The soap and water work together to hold the air inside and because bubbles like to enclose the maximum volume of air in the minimum amount of bubble solution, they always form round shapes. The surface tension of the water layer is what stops the bubble from bursting, but the surface tension is easily broken when bubbles are poked or land on something sharp. Bubbles also pop when the water between the soap film evaporates. Bubbles tend to cling together because to minimize surface area, they join together to share one common wall.

Let's Make a Rainbow Bubble Snake:

Items you will need which are not included in the kit: some washing up liquid and a saucer.



(A)

1. Place the Bubble Cloth (3) over the large end of the Bubble Blower Body (1). Make sure the entire Bubble Blower hole is covered.
2. Push the Bubble Blower Cap (2) into place as shown (A).
3. Pour cold tap water into a saucer so that it is a few millimetres deep.
4. Add a few drops of washing up liquid to the water and stir.
5. Now dip the large, Bubble Cloth covered end of the Bubble Blower into the water.
6. Remove the Bubble Blower from the water and squeeze several drops of the different Colourings ** (14, 15 and 16) onto the Bubble Cloth (B).
7. You are now all set. Put the small end of the Bubble Blower in your mouth.
8. Give a long, consistent pressure blow and see what happens.

** See page 3 for instructions describing how to prepare your bottles of colouring.

(B)

What's happening in this experiment? When you blow air through the Bubble Blower it squeezes through the soap-soaked Bubble Cloth, creating hundreds of tiny bubbles. Bubbles like to attach to each other, so when they come out of the fabric they form a long rainbow bubble snake coated with the colouring.

Rainbow Amulet

What Is Density?

In its simplest form, **density** can be thought of as the amount of "stuff" in a given space. Scientists use the equation

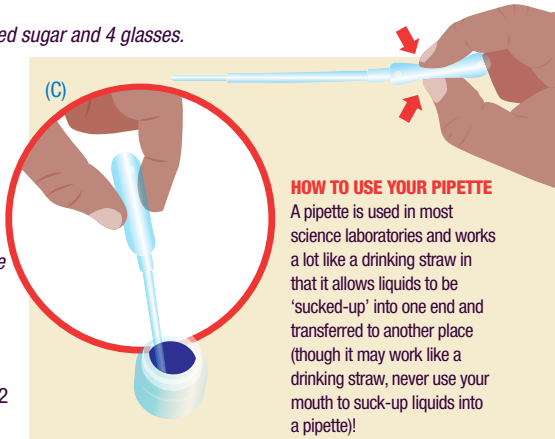
DENSITY = MASS (the stuff) ÷ VOLUME (the space)

Think about putting five gummy sweets into a Ziploc bag for your friend and 20 of the same sweets into the same size Ziploc bag for yourself. Whose bag of sweets is denser? A liquid with less molecules or smaller molecules is less dense than a liquid that has more molecules or larger molecules.

To Make Your Rainbow Amulet:

Items you will need which are not included in the kit: granulated sugar and 4 glasses.

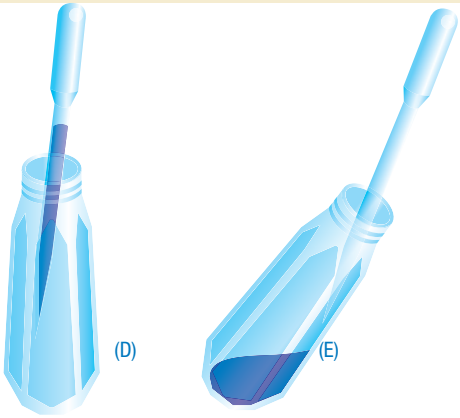
1. Place 4 glasses in a row.
2. Using the Scoop (18), add sugar to each glass as follows:
   - 1 full level Scoop into glass #1
   - 2 full level Scoops into glass #2
   - 3 full level Scoops into glass #3
   - 4 full level Scoops into glass #4
3. Now add 4 full Scoops of cold tap water to each glass.
4. Stir each glass until all the sugar has dissolved *(make sure you wipe your stirring spoon between each glass to make sure you don't transfer sugar water between them).*
5. Add several drops of:
   - the Yellow Colouring** (15) to glass #1
   - the Yellow and Blue Colouring** (15 & 16) to glass #2 (to make green)
   - the Red Colouring** (14) to glass #3
   - the Blue Colouring** (16) to glass #4
6. Starting with the blue solution, suck some of the solution into the Pipette (17) (C).
7. Gently squirt the blue liquid into the bottom of the Rainbow Amulet Jar (6) (D).
8. Repeat until the Amulet Jar is around a quarter full.
9. Flush out your Pipette with clean water.
10. Now repeat stages 6 to 9 with the red solution until the jar is half full. IMPORTANT: Hold the tip of the Pipette against the inside of the Amulet close to, but not touching the surface of the blue liquid. Squeeze the Pipette gently so the red water flows slowly down the side of the Amulet onto the top of the blue liquid. If you try to rush it, the layers will just mix together (E).
11. Now repeat with the green solution and then finally the yellow.
12. You should now have a four layer rainbow amulet. Screw on the lid (7) and use the Thread (9) and Suction Cup (8) to hang it on a window.



HOW TO USE YOUR PIPETTE

A pipette is used in most science laboratories and works a lot like a drinking straw in that it allows liquids to be 'sucked-up' into one end and transferred to another place (though it may work like a drinking straw, never use your mouth to suck-up liquids into a pipette)!

- Squeeze the bulb.
- Place the tip into the liquid.
- Keeping hold of the bulb, allow it to return its original shape.
- You should now have liquid inside the pipette.
- Squeeze the bulb gently to transfer the liquid.



** See page 3 for instructions describing how to prepare your bottles of colouring.
Please note that the colours will merge and fade over a few days.

What's Happening in This Experiment?

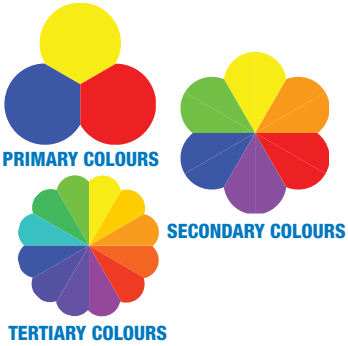
The amount of water in each of the 4 glasses was the same. The only difference was the amount of sugar you put in each before the water was added. By stirring the water, you dissolved the sugar (it filled the spaces between the water molecules). The blue water had the most sugar which made it the densest. The red, green and yellow water each had less sugar than the previous, so each liquid was less dense than the previous.

WALKING WATER RAINBOW FLOWER

Colour Theory.

Colour is an important part of our life. It can make us feel hot, cold, excited, happy or even sad. Undoubtedly you will have a favourite colour, but do you know what makes different colours?

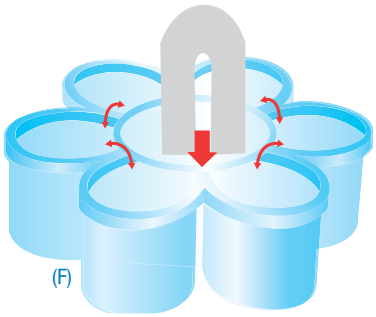
All colours originate from what are called the three primary colours; red, blue, and yellow. These colours are unique because they cannot be mixed or formed by any other combination of colours. By mixing primary colours together you get green, orange and purple, also known as secondary colours. Then, by mixing a primary with a secondary, you arrive at the six tertiary colours, yellow-orange, red-orange, red-purple, blue-purple, blue-green & yellow-green.

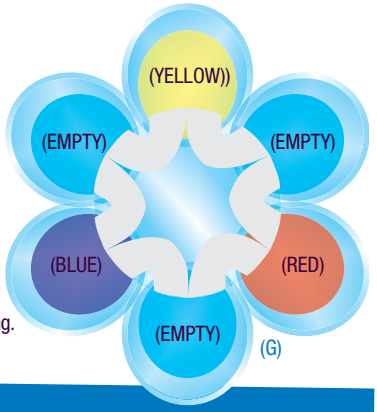


Making Your Rainbow Flower:

Items you will need which are not included in the kit: 3 glasses of water.

1. Slide the 6 Felt Wicks (11) into the slots of the compartments in the Walking Water Flower Container Base (10). Slide them in as shown so that each Felt Wick connects adjacent compartments (F).
2. Using the Scoop (18), add 4 scoops of cold tap water into each of 3 glasses.
3. Add several drops of:
   - the Red Colouring** (14) into glass #1
   - the Yellow Colouring** (15) into glass #2
   - the Blue Colouring** (16) into glass #3
4. Stir the water in each glass, wiping your spoon in between each glass so you don't mix the colours.
5. Pour the coloured water into separate compartments in the base of the Walking Water Flower Container as shown (G). **IMPORTANT: It is essential that you follow the exact positions shown.**
6. Just like in nature, you will need to wait for a while before the primary colours in the 3 "petals" form a 6 petal primary and secondary colour flower.


(F)



(G)

** See page 3 for instructions describing how to prepare your bottles of colouring. Please note that the colours will merge and fade over a few days.

WHAT'S HAPPENING IN THIS EXPERIMENT?

After a few minutes you will notice that the water has travelled up the felt and the empty parts of the container are starting to fill with water. These keep filling until there is an even amount of water in each compartment. How does this happen? It's all down to capillary action. There are two main components of **capillary action**: cohesion and adhesion. With cohesion, two similar molecules will be attracted to each other whereas with adhesion, two completely different molecules are attracted to each other. As an example:

1 water molecule + 1 felt piece molecule = adhesion
1 water molecule + 1 water molecule = cohesion

When the attraction between adhesive molecules is stronger than the attraction between cohesive molecules, capillary action will begin and the water will start to travel.

Augmented Reality Painting

Some facts about Augmented Reality:

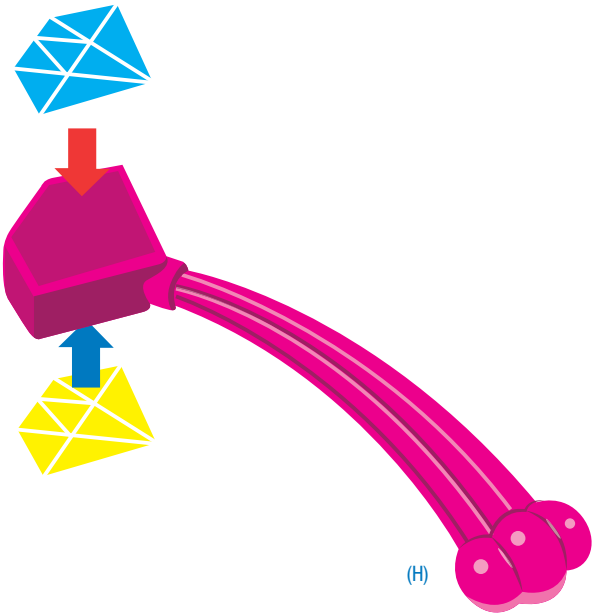
Augmented Reality (AR) is the name of the technology which combines (augments) real world images with computer-generated information or graphics. AR dates back as far as 1968 when American computer scientist, Ivan Sutherland created a head-mounted display system at Harvard University. It showed simple wireframe drawings and computer-generated graphics.

Maybe you have also heard of Virtual Reality (VR), which may seem similar to AR, but don't confuse the two. VR replaces the world around you with a simulated one, letting you experience a new, virtual, sometimes unreal world. AR, on the other hand, superimposes virtual objects on real elements to create computer-generated objects in your own world.

Let's Paint In Augmented Reality:

Items you will need which are not included in the kit: a smartphone with internet access to download our free app.

1. Attach the blue and green diamond Stickers (13) to either side of the Wand (12) (H).
2. Download the app we have created by visiting the Play Store (Android) or the Apple iTunes Store (IOS) and search for Rainbow Science FX.
3. Now simply open the app and follow the instructions.



(H)

What's happening in this experiment?

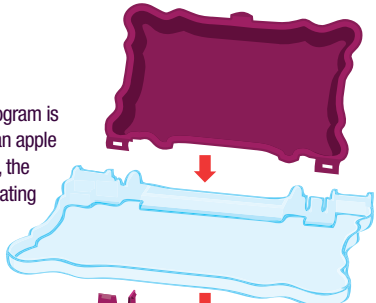
Your smartphone screen displays an image of whatever your camera is pointing at. In 2D mode, when the camera recognises the wand sticker design, it sends a signal to the app to draw the digital image on the screen. As you will see, when the app recognises the blue diamond sticker, it is programmed to behave differently from when it recognises the green one. The app and the sensors in the phone recognise movement, so it always adjusts the digital lines it "paints" to correspond with the position of the wand sticker. When you switch to 3D mode and add the AR canvas (19), it allows the app to reference points in 3 dimensions, so not only can the app recognise what you are drawing with the wand, but it allows you to move the phone around the wand and see behind what you have drawn.

HOLOGRAM VIEWER

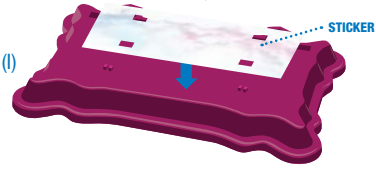
What Are Holograms?

The first hologram was made in 1947 by Hungarian-born scientist, Dennis Gabor. A hologram is a 3-dimensional picture made with a laser. Suppose you want to take a photograph of an apple with your phone. You hold a camera in front of it and when you press the shutter button, the camera lens opens briefly and allows light through, hitting a light-sensitive chip and creating a digital image. All the light travelling from the apple comes from a single direction and enters a single lens, so the camera can record only a 2-dimensional pattern of light, dark, and colour.

A hologram is a cross between what happens when you take a photograph and what happens when you look at something for real. Like a photograph, a hologram is a permanent record of the light reflected off an object, but a hologram uses a laser to reflect light off the object and every point in a hologram catches light waves that travel from every point of the object. That means wherever you look at a hologram you see exactly how light would have arrived at that point if you'd been looking at the real object. So, as you move your head around, the holographic image appears to change just as the image of a real object changes.

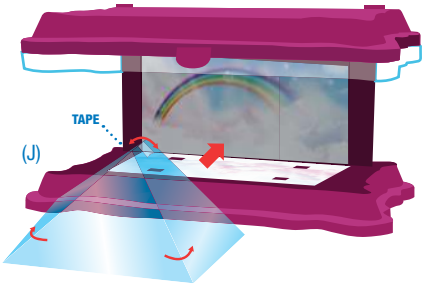


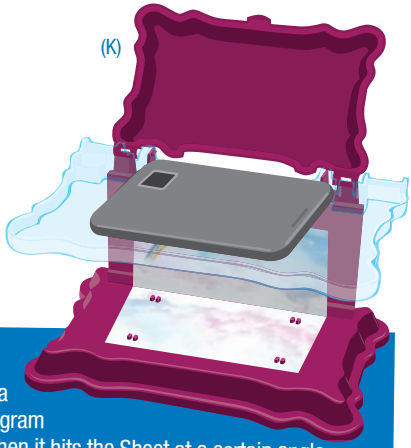
Making Your Hologram Stage:



Items you will need which are not included in the kit: a smartphone with internet access to download our free app.

1. Slot the 4 pieces of the Hologram Stage (4) together as shown. IMPORTANT: Please note the slightly raised section on the back panel. Make sure this is inserted into the base NOT the roof.
2. Add Stickers (13) (I).
3. Remove the protective cover film from each side of the Hologram Viewer Plastic Sheet (5) and fold it as shown, then secure it with a piece of tape (J).
4. Slide the Hologram Viewer Plastic Sheet into position inside the Hologram Stage.
5. Download the app we have created by visiting the Play Store (Android) or the Apple iTunes Store (IOS) and search for Rainbow Science FX.
6. Now simply open the app and follow the instructions to select your hologram.
7. Place your smartphone, screen side down into the clear lid of the Hologram Stage, making sure the large image on your screen will be towards the front of the Stage (K).
8. Shut the lid and view your hologram **





** For best results, view in a darkened room with your phone screen on maximum brightness and disable both the screensaver mode and the auto rotate screen functions. You may need to move the position of your phone to get the best results.

WHAT'S HAPPENING IN THIS EXPERIMENT?

As you may have realised, this isn't a true hologram. In fact it is a recreation of an old theatre trick called Pepper's Ghost. The Hologram Viewer Sheet is transparent but is also good at reflecting light when it hits the Sheet at a certain angle.

When the brighter parts of the phone screen's image screen hit the Hologram Viewer Sheet, they are reflected out towards the watcher, but the darker (background) parts of the phone's image do not get reflected and the watcher can see the sticker through the Hologram Viewer Sheet.

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