# Astronomy Activities


The activities in this booklet have been collated from various sources. The activities are designed to be used to teach the optional BTEC Applied Science Unit 16: Astronomy and Space but are applicable to any astronomy course. Corresponding risk assessments for most activities can be found in the Risk Assessment folder on my GitHub within the Practicals directory.

If you have activities to add email astrodimitrios@gmail.com. You can find all my resources on my GitHub: github.com/astrodimitrios/Astronomy.

# Contents



**Main Cover Image:** Hubble image of LH 95 in the Large Magellanic Cloud, Credit: ESA/HUBBLE & NASA.
**Small Cover Images:** Left to right - copper rod in a bunsen, Newtonian telescope with solar filter, and Hydrogen spectra through a diffraction grating, Credit: Dimitrios Theodorakis.

# Solar System Scroll

Easy

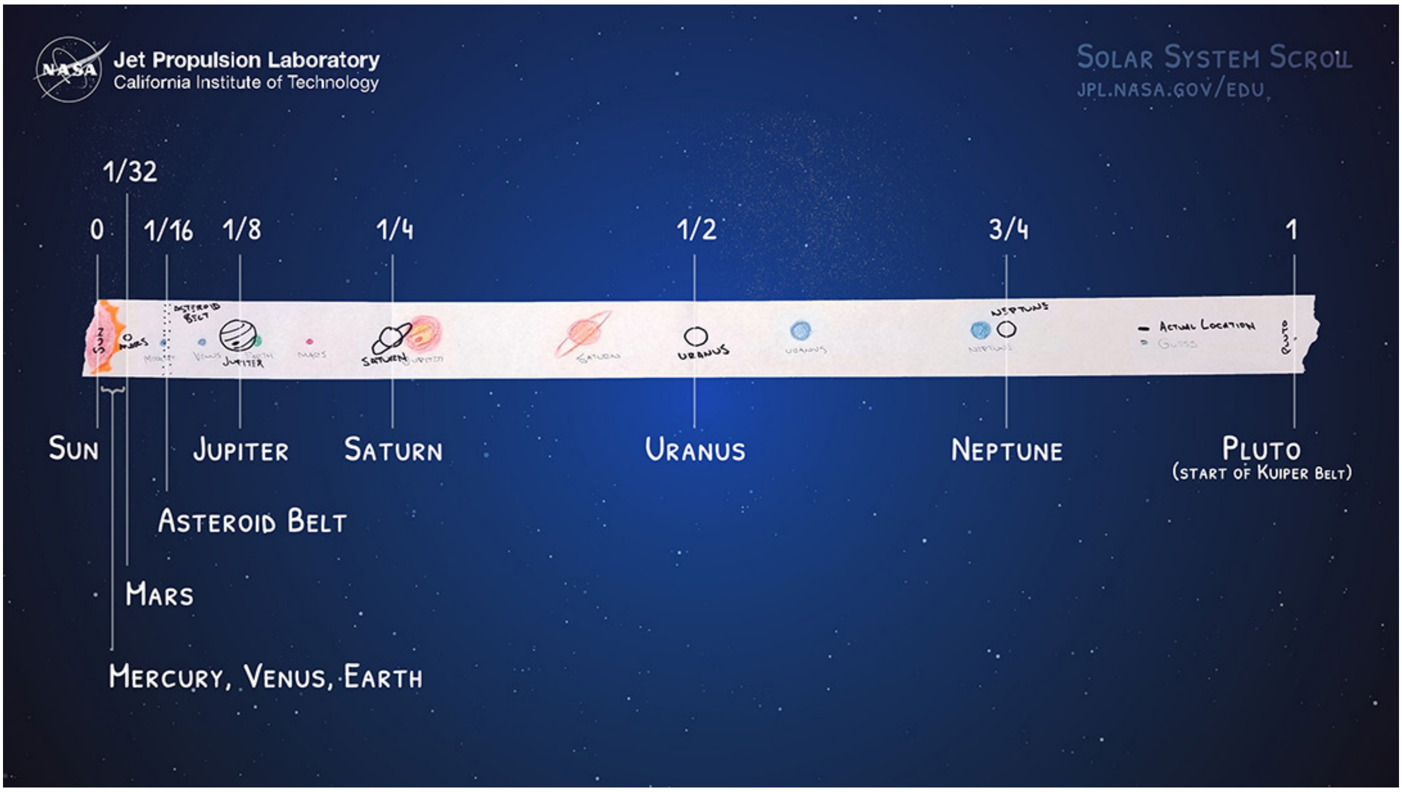
Solar System + Planets + Scale

**AIM:** Predict the scale of the solar system and the distance between planets.

In this activity students predict the distances between planets to dispel misconceptions about scale which are introduced by common pictures of all the planets next to each other.

**Materials**

- markers
- accounting paper




Final scroll image showing the fractions where the paper is folded. Credit: NASA/JPL.

## Method

1. Start by getting the students to place the sun at the left end of the roll and pluto at the other end.
2. Students then draw on where they think the planets and the asteroid belt lie in between the Sun and Pluto.
3. Fold the paper in half. This will give you the position of Uranus. Get students to use a different colour marker for the actual locations.
4. Fold the Sun end to the Uranus mark to get the 1/4 mark. This is the position of Saturn.
5. Fold the Pluto end to the Uranus mark to get the 3/4 mark. This is the position of Neptune.
6. Fold the Sun end to Saturn to find the position of Jupiter.
7. Fold the Sun end to Jupiter to find the position of the asteroid belt.
8. Fold the Sun end to the asteroid belt to find the position of Mars.

★
Easy

# Impact Craters

Planets + Craters + Impacts

**AIM:** Investigate how impacts shape planetary surfaces

A classic and easy experiment to show how impact craters are formed. This can be adapted to be more mathematical by getting students to calculate the energy of the impact or solely qualitative looking at the crater shapes and ejecta patterns.

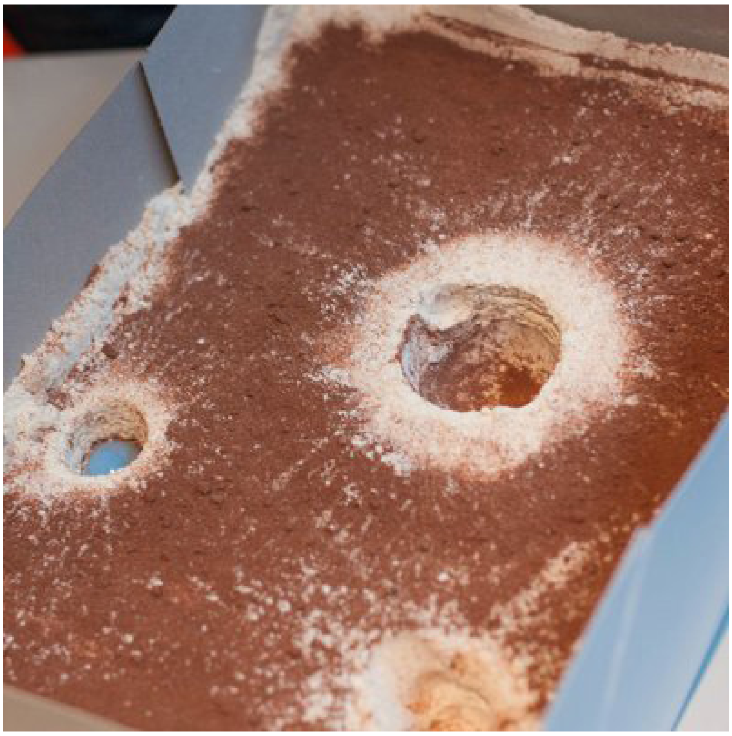
The layer of cocoa on the top helps to reveal the ejecta patterns. Different coloured sand layers can be used to achieve a similar effect.

### Materials

- sand/rice/sugar
- different sized balls/marbles
- cocoa
- a deep tray

If performing calculations:

- meter stick
- stopwatch



Tray with flour and cocoa showing impact craters. Credit: LCO.

## Method

1. Fill a tray with sand.
2. Cover the sand with a layer of cocoa powder.
3. Drop the balls from the same height and observe the craters that they make.

If students are going to calculate the energy of the impact they will need to know the height dropped or the time the ball took to fall so they can calculate GPE or KE.

Remember to ask students to vary ONE variable only for a fair comparison. The easiest to drop different sized balls from the same height.

Questions for students:

1. What happens to the crater size when a larger ball is used?
2. What happens to the crater size when the ball falls from higher up?
3. What patterns form around the craters?
4. What happens if the ball hits at an angle?

This activity was taken from the Las Cumbres Observatory (LCO) which has a version in which students calculate the kinetic energy of the impactors. You can find it here: [https://lco.global/education/activities/craters-in-the-classroom/](https://lco.global/education/activities/craters-in-the-classroom/)

# Inflatable Planets

Easy

Solar System + Planets + Scale

**AIM:** Visualise the planets and the Earth - Moon system

Not only great visual aides inflatable planets and a torch can be used to model day/night, seasons, and eclipses.

Inflating these can take a while and always have duck tape handy to fix holes.

**Materials**

- inflatable planets
- pump
- duck tape
- torch

Inflatable Planet set with pump. Credit: Learning Resources.

## Method

**Day/Night:**
Get one student to hold the Earth and rotate it slowly. Another should hold the sun with the torch next to it shining onto the Earth.

**Seasons:**
Get one student to hold the Sun in the centre of the room and shine the torch at the Earth. Another can hold the Earth at an angle (around 24 degrees if possible) and rotate it. The Earth can then orbit the sun and you can discuss the amount of light hitting each hemisphere due to the tilt each season.

**Eclipses:**
You will need three or four students to hold the Earth, the Sun, the Moon, and the torch. Get them to have a go arranging themselves in the correct positions to get a Lunar eclipse and then a solar eclipse.

★ Easy

# Elliptical Orbits

Planets + Orbits + Kepler

**AIM:** Draw an ellipse and visualise Kepler's Laws

Students learn that most objects have elliptical orbits and draw and ellipse in their notes. Then using a demo model explore Kepler's 2nd law - A line joining the Sun and a planet sweeps out equal areas in equal times.

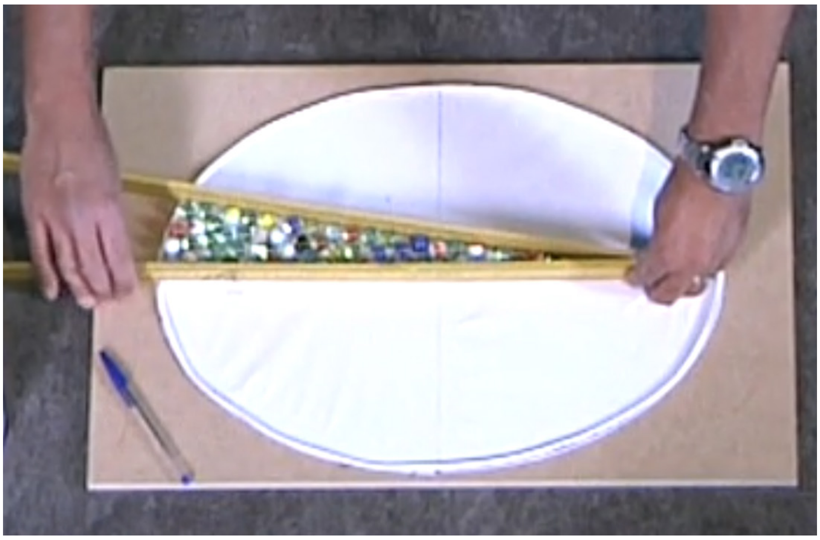
To make the demo ellipse trace out a large ellipse onto a piece of cardboard (A3 or bigger is best). Glue rope over your trace marking to form a raised ellipse. Your set up should look similar to the image below.

### Materials

- string
- 2 split pins per student

Demo:

- large piece of carboard
- super glue
- thick string/rope
- marbles (lots)
- 2 metre rulers



Demostrating Kepler's 2nd Law using marbles. Credit: ESA.

## Method

How to draw an ellipse:

1. Get your students to locate the center of their A4 paper.
2. Place one split pin about 5 cm above the center and one below.
3. Tie a piece of string approximately 15 cm in length to the pins connecting them.
4. Take a pencil and using the nib pull the string taught.
5. Keeping the string taught trace out an ellipse.

How to demonstrate Kepler's 2nd Law:

1. Place your marbles inside your raised demo ellipse as shown in the image above.
2. Place the ends of the two metre rulers on one focus of the ellipse.
3. Trap the marbles inside the two rulers and the edge of the ellipse.
4. Now you can sweep your rulers around the ellipse. The marbles show you have the same area inbetween the rulers each time but the segment of the ellipse travelled will change.

This is hard to explain in words. The European Space Agency has produced a nice video of this demo for reference at: https://www.esa.int/ESA_Multimedia/Videos/2014/07/Marble-ous_ellipses_-_classroom_demonstration_video_VP02

Don't forget to link this to orbital velocity. The object has to travel a greater distance in the same time nearer to the sun so it must travel faster.

# Surface of the Galilean Moons

★ Easy

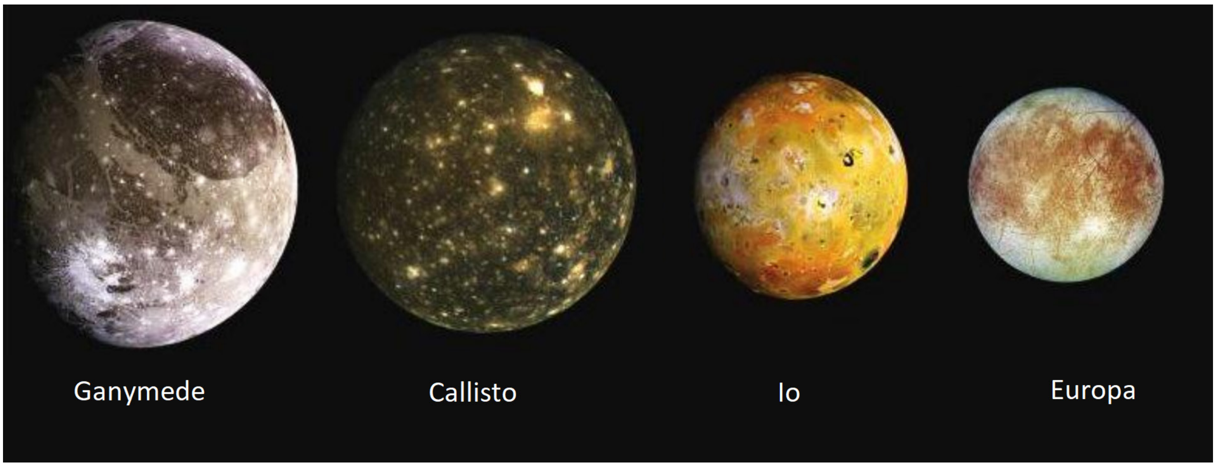
Jupiter + Moons + Surfaces

**AIM:** Compare the surfaces of the Galilean Moons

In this activity students look at images of the four Galilean Moons and compare their surfaces. They then relate their observations to the positions of the moons and their relative ages.

**Materials**

- worksheet
- activity ppt slides (AS005)




The four Galilean Moons. Credit: NASA/CESAR/ESA.

## Method

1. Get your students to make their sketch for Part 1. The radius of the moons/Jupiter cannot be drawn perfectly to scale alongside the radii on an A4 sheet of paper. I suggest students attempt to draw the orbital radii to scale using 1cm = 6 orbital radii. Then they can label the moons with their name and the relative radius.
2. Students can then answer the the questions in Part 2 with the images provided. They can also be displayed on the board. The activity powerpoint AS005 has larger versions of the images on the worksheet.

This activity was taken from: [https://web.pa.msu.edu/courses/1999fall/ISP205/sec-3/galilean-moon_act.html](https://web.pa.msu.edu/courses/1999fall/ISP205/sec-3/galilean-moon_act.html) by Bob Stein, Michigan State University.

Print the next two pages to get the full double sided worksheet (best in colour).

# Surface of the Galilean Moons

**AIM:** Compare the surfaces of the Galilean Moons

In this activity you will be looking at images of the four Galilean Moons and compare their surface features!

**Part 1**

The table on the right shows the radii of Jupiter and the Galilean Moons scaled to Jupiter's Radius, and the orbital radii of the moons also scaled using Jupiter's radius.

Use the blank space below to sketch the orbits of the moons around Jupiter.

You can use the scale 6 Orbital Radii = 1cm if it helps. Assume the orbits are circular and use a compass!

| | Radius | Orbital Radius |
|---|---|---|
| Jupiter | 1 | N/A |
| Io | 0.03 | 6 |
| Europa | 0.02 | 10 |
| Ganymede | 0.04 | 15 |
| Callisto | 0.03 | 27 |

Table showing the radius and orbital radius of Jupiter and the four Galilean Moons. All values are scaled in terms of Jupiter radii. Credit: Bob Stein.

## Part 2

1. Rank the four moons in order of most heavily impact cratered to least impact cratered.

2. Rank the four moons in order of largest to smallest impact craters.

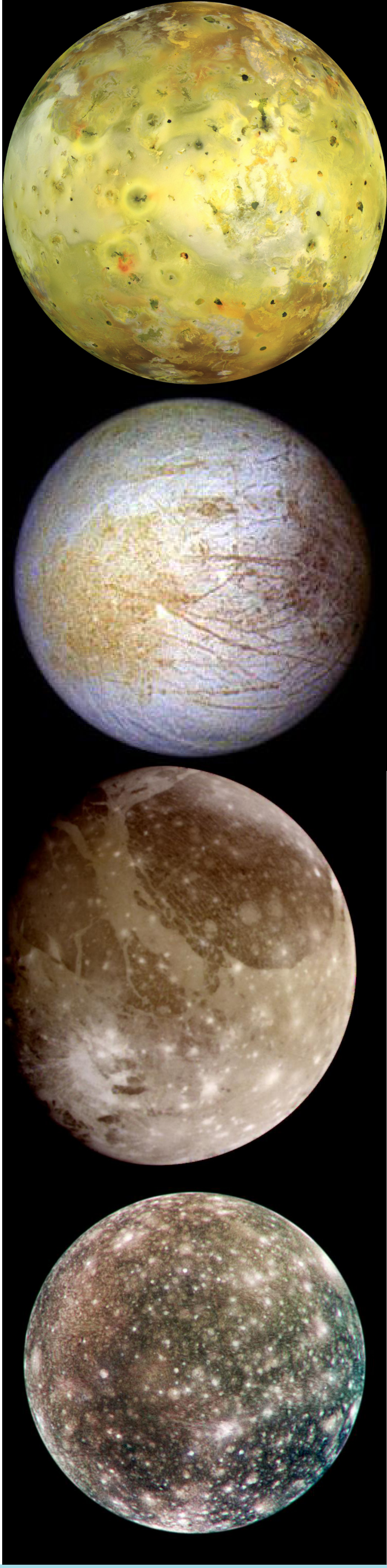
3. Which moon currently has active volcanoes.

4. Which moons show surface grooves and cracks indicative of surface motion after impact cratering?

5. Given your answers above, rank the moons' surfaces from oldest surface to youngest surface.

6. Using your sketch from Part 1, why do you think the ages of the surfaces are ranked this way?

7. What evidence on the surface of Europa makes us think it has a subsurface ocean?



**From top to bottom:**
**Io** true colour PIA02308 NASA/JPL/University of Arizona,
**Europa** enhanced colour PIA01295 NASA/JPL/University of Arizona,
**Ganymede** true colour PIA00716 NASA/JPL,
**Callisto** true colour PIA03456 NASA/JPL/DLR.
All images were taken by the Galileo Orbiter.

Hard

# Dry Ice Comets

Comets + Small Bodies + Solar System

**AIM:** Model a comet using dry ice

This can either be done as a demo or as a practical with supervision. Wear goggles and gloves when handling the dry ice.

Half of the dry ice should be crushed with the hammer before the practical.

**Materials**

- 2.5 Kg dry ice
- 1 litre water
- 1 cup of soil
- tbsp syrup
- eye protection
- thick gloves
- plastic bowl
- two bin bags
- hammer/mallet
- flat tray
- flashlight
- hairdyer with cool setting

Optional:

- ammonia
- alcohol

Image of a model comet by ???.

## Method

Making the comet:

1. Put on safety goggles and gloves. Line your plastic bowl with the two bin bags. You will be making your comet inside the bags. Place the bowl in the tray.
2. Add half of the water to the bag. Pour the rest of the liquid ingredients into the bag followed by the soil.
3. Add half of the crushed dry ice and knead the ingredients together by touching the outside of the bin bags.
4. Add the rest of the ice and then the water and knead again.
5. Close the bag around the comet and squeeze so it forms a solid ball.
6. If it does not stick together and falls apart try adding some more water.
7. Remove the comet and place it in the tray.

This activity was taken from the Lunar and Planetary Institute activity here:
https://www.lpi.usra.edu/education/space_days/activities/comets/dryIceComet.pdf

The next page details how to use the comet you just made to model comet tails.

### Method

Demonstrating comet tails:

1. Hold the flashlight and the hairdryer together and point them towards the comet.
2. The flashlight is the Sun and the hairdryer is the solar wind (which is made of particles!). Turn the lights out to see the tail better. Ask your students to predict what will happen to the tail when the comet is closer to the Sun.
3. Get your students to predict whether rotating the comet affects the tail.
4. Comet orbits are not circular. Make the comet travel around the room in an ellipse with the sun and the hairdryer still pointing towards it. Ask your students if the direction of the tail is changing?

This activity is rated hard because dry ice is used and is difficult to get in some places. Try asking your local university for some.

There is an associated risk assessment RA-AA006 which you should read before attempting this as a demo or a practical.

After you have finished with the comets they can be left to melt in a sink.

Image of the comet tail demonstration. Credit ???

# Magnetic Reconnection

★ Easy

Sun + Flares + Magnetism

**AIM:** Model magnetic reconnection

In this activity students model what happens when when magnetic field lines on the surface of the Sun reconnect with each other. This requires two people per group.

**Materials**

- 1 rubber band
- 2 binder clips
- marker
- scissors

Images showing step ? left and step ? right. Credit ???

## Method

1. Get one person to stretch the rubber band into a rectangle using their thumbs and index fingers.
2. The other person can then use the marker to draw arrows on the rubber band. One on each side of the square and all head to tail so that they form a closed path.
3. Choose two opposing sides and pinch them together. Place binder clips to hold the pinched sides together with a gap inbetween them. This simulates distortion of the magnetic field.
4. Take the scissors and cut inbetween the clips. This is the reconnection.
5. The rubber band will now be in two triangular loops.

Students should notice that the rubber bands snap back and this is modelling the release of energy during reconnection. There are great videos from the Solar Dyanmics Observatory online showing magnetic reconnection events where one loop collapses back into the surface of the Sun and the other escapes into space with some energy from the reconnection.

Reconnection is thought to cause flares and coronal mass ejections (CME's). It may also provide energy to heat up the solar corona.

This activity was taken from the Stanford Solar Center here:
[http://solar-center.stanford.edu/magnetism/magnetismsun.html](http://solar-center.stanford.edu/magnetism/magnetismsun.html)

# Atomic Spectra

★ Easy

Spectra + Light + Atoms

**AIM:** Identify gases based off their emission spectra

In this activity students observe the emission spectra of different gases and attempt to identify them by looking at the emission spectrum of the gas in a discharge tube through a spectroscope or a diffraction grating.

### Materials

- gas discharge tubes
- spectroscopes
- diffraction gratings

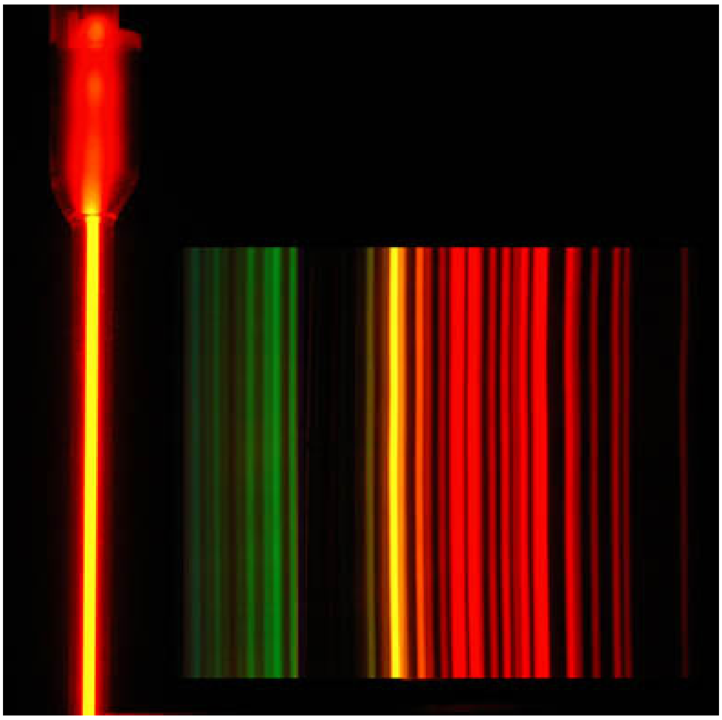


Image of Neon's emission spectrum next to the discharge tube. Credit: R Nave/Hyperphysics.

## Method

1. Set up the discharge tubes around the room.
2. Warn the students that they get very hot and they must not touch the tubes or the power packs.
3. Get the students to look through the spectroscopes at each gas and guess which gas it is by matching the spectra they see to a reference on the board (see the image on page 12).

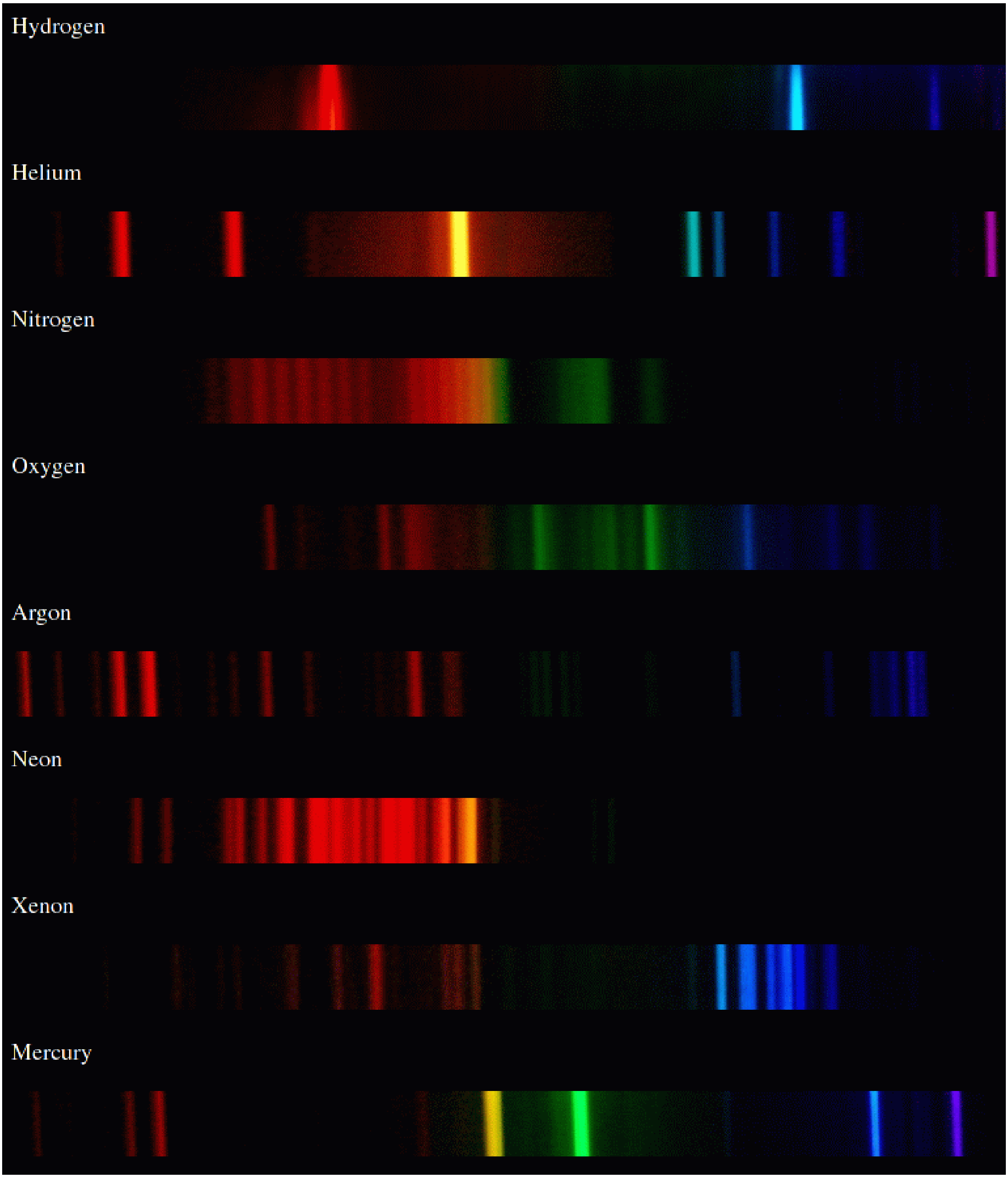
If you only have one power pack you will have to wait five minutes for one tube to cool before putting another one in.

Some spectroscopes are not very good! Get the students to also have a look using the diffraction gratings. Dim the lights if possible. Standing closer to the tubes is better since you get less stray light.

Students will see the spectrum to the SIDE of the tube! This is important since sometimes students say they can't see anything but they're looking in the wrong place.

If you are working with younger students you could make a small table for their guesses.

A set up discharge tube.
Credit: Dimitrios Theodorakis.




Reference emission spectra for several different gases. Credit: Rochester Institute of Technology, CC BY-NC-SA 2.0.