

Creating Science – Simple Spectrometry

How can we recognise the kinds of atoms that make things up? Well, for one, we can set them on fire...

#CreatingScienceSimpleSpectrometry

Suggested outcomes

(NOTE: This is by no means an exhaustive list of possible outcomes, neither is it intended that ONLY these outcomes can or should be met. Science is a deeply interrelated activity, and you may find cross curriculum links you can and should use.)

Chemical sciences F: Objects are made of materials that have observable properties.

Chemical science 5: Solids, liquids and gases have different observable properties and behave in different ways.

Also:

Physical science y5: Light from a source forms shadows and can be absorbed, reflected and refracted.

Chemical science y9: All matter is made of atoms which are composed of protons, neutrons and electrons.

Science vocabulary words

Tier 1 (Everyday words) – Fire

Tier 3 (Specialised vocabulary) - Spectrometry – the science of measuring light, or more precisely, rainbows.

Warning

- FIRE IS HOT
 - All hair tied back
 - All shoes enclosed
 - No loose clothing – all clothing ready for mess! You WILL stain your clothes today.
 - All students knowing fire escape plan, “stop, drop, roll”, and how to act responsibly around fire.
- Prepare the venue. Please make sure;
 - There is plenty of ventilation.
 - There is a fire resistant drop sheet for students.
 - All students are going to behave responsibly around fire.
- DO NOT attempt this activity unless you are confident that you can manage all student behaviour, and that you are willing to accept all legal responsibility for its execution and outcome.

- Copper sulphate RUSTS ALMOST EVERY METAL. Be careful.
- Potassium Iodine STAINS ALMOST EVERYTHING IT TOUCHES. Be careful.
- All chemicals should be handed in a well ventilated area.

Preparation

- Set up four stations; with ONE chemical each, and a funnel, measurer, sprayers, some water, burner, sand and other fire safety gear, etc. Keep the fuel for the burners well out of reach.
- The chemicals from the kit (You can easily obtain MSDS for the chemicals online).
 - Copper sulphate (plant fertiliser)
 - Potassium iodine
 - Strontium chloride
 - Sodium Chloride (table salt)
- A burner. See images.
- DO NOT attempt this activity unless you are confident that you can manage all student behaviour, and that you are willing to accept all legal responsibility for its execution and outcome.

Suggestions for other year levels

As always, more material is presented here than can be used by the average class during the average lesson time. However, since the students' questions can and should guide student learning, more material is presented for your convenience. Remember, it is not uncommon for students to only remember those points which answered their personal questions.

Younger:

Do this as a demonstration only, or with one adult per two children.

Take extra care squirting liquids, you may wish for an adult to try it the first time.

Middle:

As intended. You might be able to display a spectrum and point out the wavelengths of light. Giving a number to a colour opens up a whole new world of mathematics.

Teen:

Discuss how atoms create light using electron energy levels and quanta.

Learning Intent (student friendly)

'We are learning to' (WALT) – set fire to things, safety, and that different materials will glow different colours depending on what that material is.

Success criteria

'What I'm looking for' (WILF). – safe behaviour and coloured fire.

Student learning goals

Help students make a self-monitored learning goal for this lesson.

Evidence of learning

How will you know when the learning goal is achieved? What EVIDENCE do you have that your students have met or exceeded the learning expectations?

- Students can successfully identify the different flame test chemicals.

Engage

Discuss safety around fire.

Remember: Science is DANGEROUS¹. This leaves us with two choices. We can either:

1. Run from it – stop doing science.
2. Learn from it – do science safely, which means MANAGE THE DANGER.

If we learn how to manage the dangers of science properly, we can have fun, and be safe, and learn from science. But we need to:

1. Be prepared! Learn from the mistakes of others so you don't have to make them yourself! Follow all safety instructions as though YOU are the one who might get hurt.
2. Learn from your own mistakes. Unexpected things can happen, but most accidents can be avoided and prepared for. Be amazing, and share your experiences so that others don't get hurt!

Explore

- ⇒ Using practical safety methods and exact measurement skills, perform the 'simple spectrometry' activity at the end of this lesson.

Explain

Explain: Atoms are too small to see, but there are other ways we can appreciate them. Each kind of atom produces a different light. When we heat them up enough, we can often see those colours.

Note: Atoms also produce colours that we cannot see, such as infrared. Aluminium, for instance, can produce ultra violet light. So while so scoldingly hot it can melt your finger right through in a second, solid aluminium appears as grey at it does at room temperature – very dangerous!

¹ Because LIFE is DANGEROUS

Elaborate

What makes atoms glow?

As we know, atoms are made up of protons and neutrons in the centre, and little electrons around the outside.

One way to understand those electrons is to see them as planets spinning around a sun. Each electron planet has an orbit it likes to stay in (and they can share orbits too, unlike planets. The first orbit has 2 electrons, the second 8... it gets very confusing!).

When you add energy, such as heat, the electrons can get knocked into other orbits. In order to drop back down to their preferred energy level, they have to lose energy. They do this... by glowing...

Each atom emits a single photon of light in order to lose one level of energy. This photon has a very specific amount of energy depending on the atom's design. You can tell exactly what atom lost the energy by what photon of light was emitted.

Evaluate

Diagnostic:

Take time to focus on planned content material during the engage phase, for example, survey students regarding their understanding of the concept "atom". Have them draw what they think they might look like, or have them draw their understanding of what metal looks like as you get smaller and smaller.

Formative:

Have student tell or retell parts of their story, and welcome them sharing their contributions. There are far more scientists than this brief retell shares, and contributions may be welcomed.

Summative:

Help students consider ways they can communicate their new understanding to others, just as scientists need to do. Perhaps they can:

- Design a time line on the *history of the theory of the atom*, highlighting the major experiments that changed our way of thinking, as well as the scientists and the countries they came from.

Creating science

By setting fire to aerosol sprays can result in many colours, we can see that;

- Chemical sciences F: Objects are made of materials that have observable properties
- Chemical science 5: Solids, liquids and gases have different observable properties and behave in different ways

Also;

Science inquiry skills - safety

Fire, as a part of science, is dangerous. Be prepared and be aware.

Scientist Name:

Date:

Experiment:

Activity – Simple Spectrometry

Preparation

- Fire safety equipment: Water for **burns**, sand for **spills**. Extinguisher, fire blankets. A fire resistant surface to experiment on. Hair back, shoes on.
- Four 'mystery chemicals' labelled A,B,C,D (copper sulphate, Potassium iodine, Strontium nitrate, and sodium chloride.), Four empty, clean spray bottles and 4 funnels labelled A,B,C,D.
- Four disposal bottles, labelled A,B,C,D.
- A Medium fire container - a small milo tin stuffed with towelling and drenched with methylated spirits. When not in use KEEP THE LID ON, this is highly flammable.

Procedure

- Set up laboratory. Prepare safety gear and procedures.
- Get ONE spray bottle. Take off the lid.
- Go to the mysterious chemical bottles. Using the same funnel per mysterious chemical (so as not to mix them up), place a $\frac{1}{2}$ teaspoon of powder into your spray bottle.
- Fill your spray bottle up with 20ml of water. BE VERY ACCURATE!
- Put the lid on your spray bottle carefully and properly.

Now for the fire

- On a fire resistant surface, set up your medium flame source. Keep well clear.
- Have a grownup check your plan, and have the grownup light the medium flame source.
- With grownup help, spray the mysterious chemical onto the fire. KEEP CLEAR!

Name your chemicals

A

B

C

D

Clean-up

- Make sure the fire is out, then put the lid back on the medium fire source.
- Make sure you keep the left over chemicals in the CORRECT disposal bottle. **Do not** waste the chemicals, they can still be used. Wash down your surface thoroughly. The chemicals in this activity are best used as fertiliser, NOT put down the drain. Wash your hands thoroughly, indeed, you might even want to have a shower to be extra sure.

Simple Spectrometry



Copper

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Strontium



Potassium

By Dr Joe
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Colours
are
Approximate

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Sodium

