ROYAL SOCIETY OF CHEMISTRY

# Chemistry in Curriculum for Wales

## How to use the curriculum planning support document

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# Chemistry in Curriculum for Wales: How to use the curriculum planning support document

This document has been developed from our online teacher support sessions and aims to provide guidance on how to use the document 'Chemistry in Curriculum for Wales: curriculum planning support (progression step 4)' whilst maintaining the ethos of both the Royal Society of Chemistry's curriculum framework and the new Curriculum for Wales. The example included in this document is smart devices and is not exhaustive, nor is this the only way to implement the guidance. It is offered as a starting point for those wanting more direction and inspiration.

## Introduction

On pages 7–12 of the document 'Chemistry in Curriculum for Wales: curriculum planning support (progression step 4)' you will find a table that includes information from the Royal Society of Chemistry's curriculum framework, and descriptions of learning from relevant What Matters statements from the new Curriculum for Wales. A detailed outline for suggested progression within progression step 4 (ages 11–14) is sandwiched in between. This table is not prescriptive but offered to inspire and inform teachers when planning their curriculum.

The aim is not to use the curriculum planning support table from top to bottom (as the topics are not in any specific order). The table enables teachers to pick out related skills, concepts and understanding from the left, at first, and teach these in a cohesive, logical order before developing these further by moving across to the right. This should be done over the three or so years of this progression step. Teachers should use their professional judgement on how much of the concepts and skills in this document can be covered in the time they have allocated and omit/differentiate their curriculum appropriately to suit their school's curriculum model.

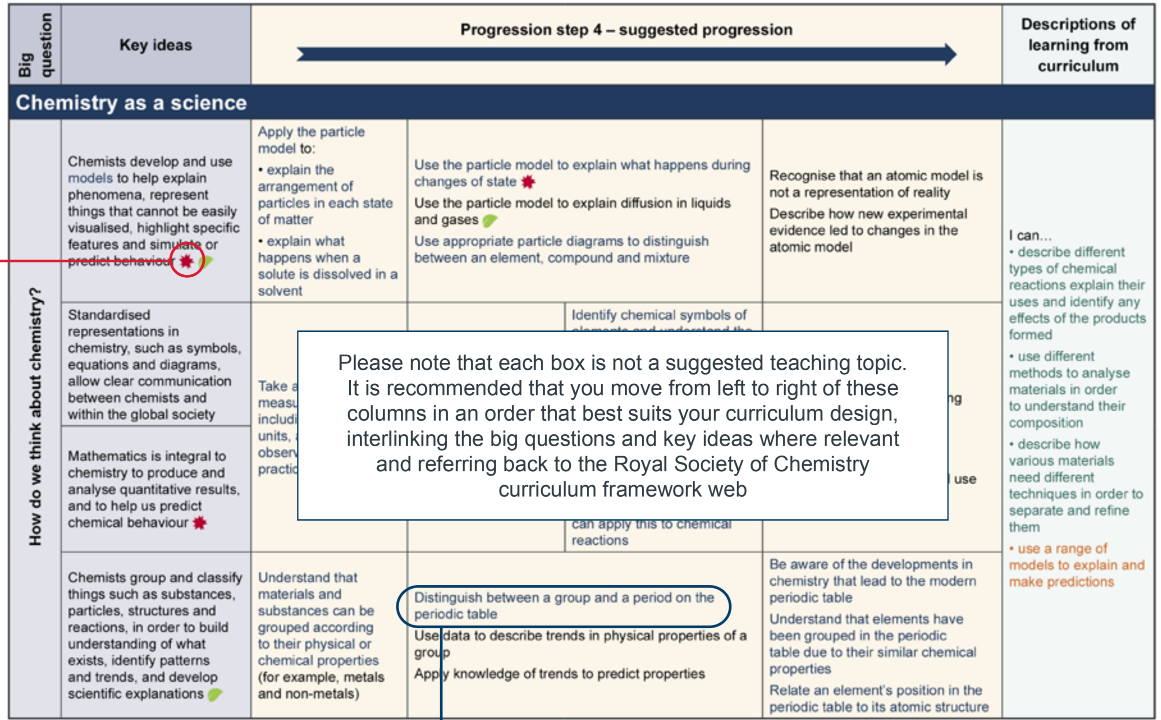
Figure 1 on page 3 offers a visual guide to the curriculum planning support table and the different columns and content it provides.

This document aims to give an example of how the information in the table can be used effectively and appropriately when planning your chemistry curriculum. Each school in Wales is expected to have its own unique approach to their curriculum design and we are aware that some departments may have more choice about contexts for the new curriculum than others. For this example, the context chosen is smart devices. The rationale behind this choice is explained, followed by some examples of how to put this into practice.

***Figure 1. A guide to the table from 'Chemistry for Wales: curriculum planning support.'***

A detailed outline of what good progression in chemistry (and related science) might look like in order to build deeper understanding and lay suitable foundations for progression step 5. For 'chemistry as a science' and 'chemical concepts', Best Evidence Science Teaching resources along with other STEM resources on working scientifically[5] were used to develop this section. The 'chemistry and the world' contextual information was provided by the Royal Society of Chemistry's curriculum working group alongside some more specific ideas identified in navy.

Directly from the Royal Society of Chemistry curriculum framework: a big question followed by the key ideas that help us to answer the question




Descriptions of learning from each What Matters statement in the Science and Technology AoLE that could be relevant to this particular area of the framework. They are colour coded as follows:

- Being curious and searching for answers is essential to understanding and predicting phenomena
- Matter and the way it behaves defines our universe and shapes our lives
- Computation is the foundation for our digital world

Cross-curricular links have been highlighted using the following symbols:

- Design thinking and engineering offer technical and creative ways to meet society's needs and wants
- The world around us is full of living things which depend on each other for survival
- Forces and energy provide a foundation for understanding our universe
- Computation is the foundation for our digital world

Statements in blue are hyperlinked to relevant Royal Society of Chemistry resources and articles that support teaching and develop these particular concepts and skills

## Why chose to teach about smart devices?

Smart devices offer lots of opportunities for teaching chemistry content, as well as lots of valuable curriculum links.

The **chemistry content** within this context includes:

- materials used to make the smart device: identifying the type of material; states of matter; particle model; is it an element or a compound?
- physical properties of these materials
- chemical properties of these materials
- extraction of these materials: the chemical reactions that take place, real life examples of this
- investigating the properties of these materials and developing practical skills
- 'endangered elements' – finite resources used

Useful resources to support this last bullet point are: Endangered elements - critical thinking and Be mindful of many of the elements as a limited resource.

**Cross-curricular links** within the Science and Technology Area of Learning and Experience (AoLE) for this topic include:

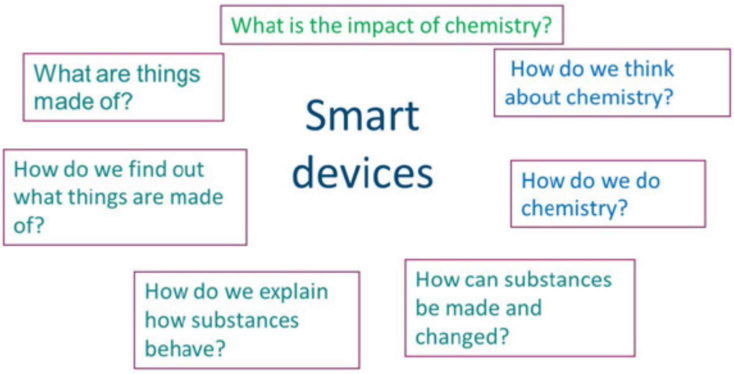
- learning about materials and electrical circuits in technology
- the particle model in physics
- electricity and circuits in physics
- coding in computer science
- measuring heart rate and effect of exercise on this in biology (links to spectroscopy in smart watch)
- use of smart technology and its impact on our health and well-being
- use of 'conflict materials' and the ethical, moral and socio-economic implications

**These lists are not exhaustive, nor is the content that follows but it is given as a starting point for those wanting more guidance and inspiration.**

## How can I use the curriculum planning support table with this context?

Begin by placing the big questions from the Royal Society of Chemistry's curriculum framework around the topic/context/teaching module. This can help to maintain the interconnected nature of these questions and the key ideas that answer them. All of these big questions overlap with relevant descriptions of learning within the What Matters statements: Being curious and searching for answers is essential to understanding and predicting phenomena; and Matter and the way it behaves defines our universe and shapes our lives.

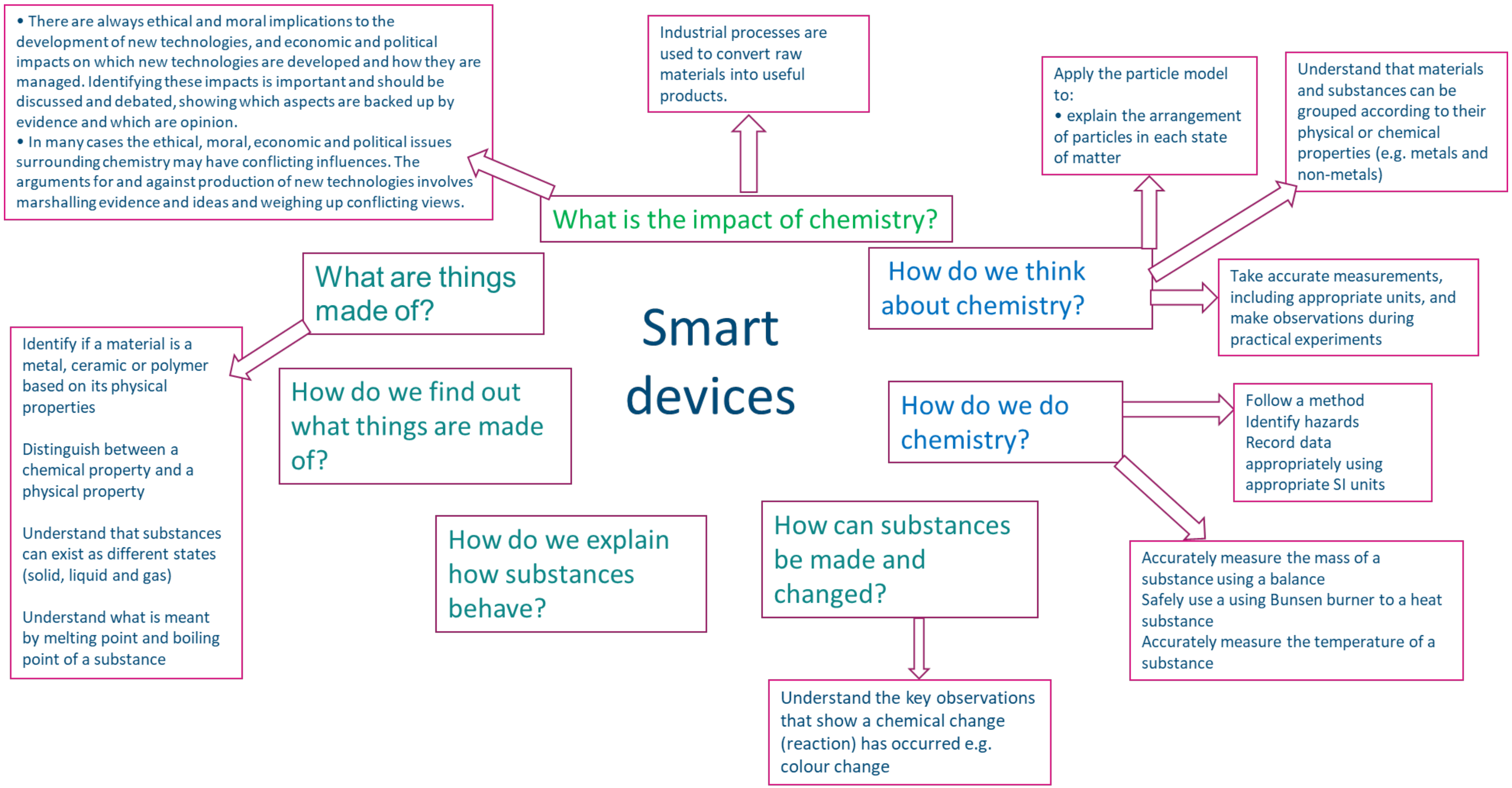
***Figure 2. First place the big questions around the topic/context/teaching module.***




Consider each question in turn, deciding which progression statements on the left hand-side of the table might be relevant to this context/topic/ teaching module, see figure 3.

These are all the statements that could be relevant but that does not mean they would all have to be taught at this time. This all depends on how much time you have for a context/topic/teaching module, bearing in mind that there would be links made to other areas of the AoLE too. For example, you may wish to just use a context/topic/teaching module to focus on physical properties and then the next topic/context you could develop knowledge of properties further and introduce chemical properties. **Ultimately the goal, as outlined in the Curriculum for Wales 'Principles for Progression' is that learners would be able to apply and use this knowledge in other scenarios and context, therefore it might be that other examples are taught alongside (or perhaps after) this to ensure this progression is developed.**

***Figure 3. Consider each big question in turn deciding which progression statements might be relevant.***



## How do these progression statements link up and how could these be taught in context?

Please note this is one perspective; you might interpret the relevance and connections of the progression statements differently. The following information is for the purpose of giving an example of how the framework questions and ideas are interconnected and should be taught alongside each other, not as separate, linear topics.

Refer to figure 4 on page 8.

## Statements with purple stars

Deciding where to start might be a challenge. We have chosen to start with teaching the statements highlighted with a purple star in figure 4 on page 8, because the key concept map from Best Evidence Science Teaching suggests starting with identifying materials. This does link well with what learners should be able to do by the end of progression step 3. Additionally, for those that are aware of Johnstone's triangle, it suggests learners benefit by starting with the macroscopic, which is relatable, before moving on to think about particles and atoms. If you are interested in reading more about this try the following links:

- EiC research article: Triangulation to tame the triplet
- EiC feature: Develop deeper understanding with models
- EiC ideas article: Practical ideas for using Johnstone's Triangle

The two statements highlighted in figure 4 could be taught in a series of lessons looking at the materials within a mobile phone or a smart watch and their properties; and explore how we know that some of these are metals or polymers etc.

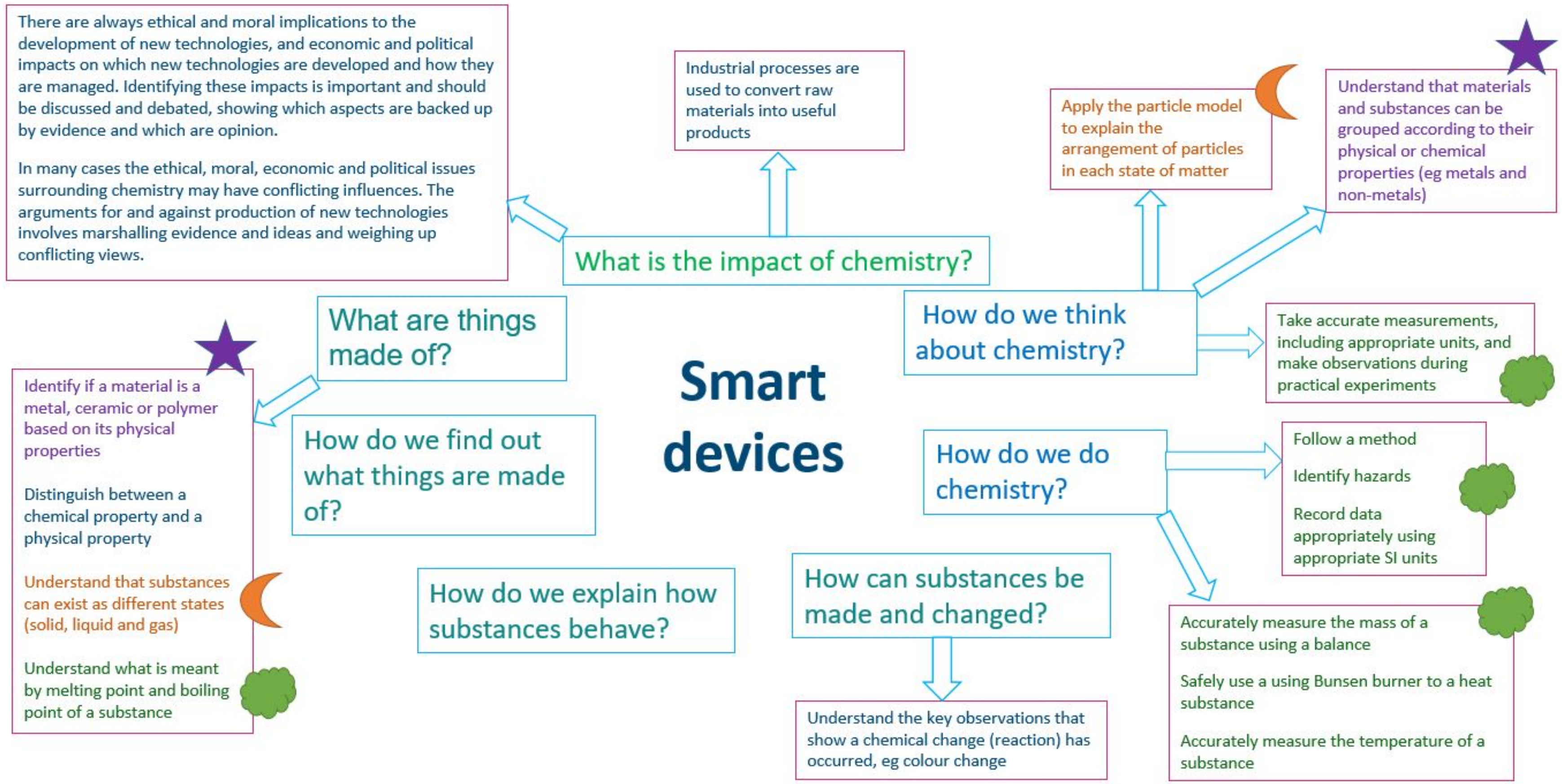
## Statements with orange moons

Once you have discussed physical properties you might then go down the route of discussing the materials' states and introduce learners to the particle model. Although most materials in smart devices are solid it is possible to include other relevant states, for example some phone cases are filled with colourful decorative substances that might be liquid and/or gases, some screen displays are liquid crystal and so on.

## Statements with green clouds

This would lead well to the next group of statements, marked on figure 4 with a green cloud. You could perhaps teach a series of lessons about what happens during melting and how this is related to melting point and similarly for boiling point. This offers a lot of opportunities to develop practical skills. Naturally we wouldn't melt a mobile phone or a smart watch, but you can look at data relating to the actual materials/ metals in a smart device and possibly conduct the more traditional practical investigations where melting different substances is investigated and discuss why these wouldn't be suitable for a smart device. There is scope to then develop understanding of changes of state, which would mean moving to the statements further to the right of the table in the support document. For this example, a different route has been chosen but, certainly the point is for you to design your curriculum in a way that you see fit.

*Figure 4 Suggested order to begin working through the progression statements, see each colour/symbol group.*



## Statements with red stars

Finally, it might be possible to start to look at the difference between a physical and chemical property, see statements marked with red stars in figure 5 on page 10.

For example, there is copper in a smart device. Learners have developed an understanding of copper's physical properties (high melting point and boiling point, ductile, malleable, a good conductor) that are indicative of a metal. Learners could now explore what happens if we try to react it with other substances. An example of this, which is already commonly taught at this stage in learning, might be oxidation of metals. Learners can begin to develop an understanding of how we know a chemical change has occurred and/or look into the reactivity of different metals.

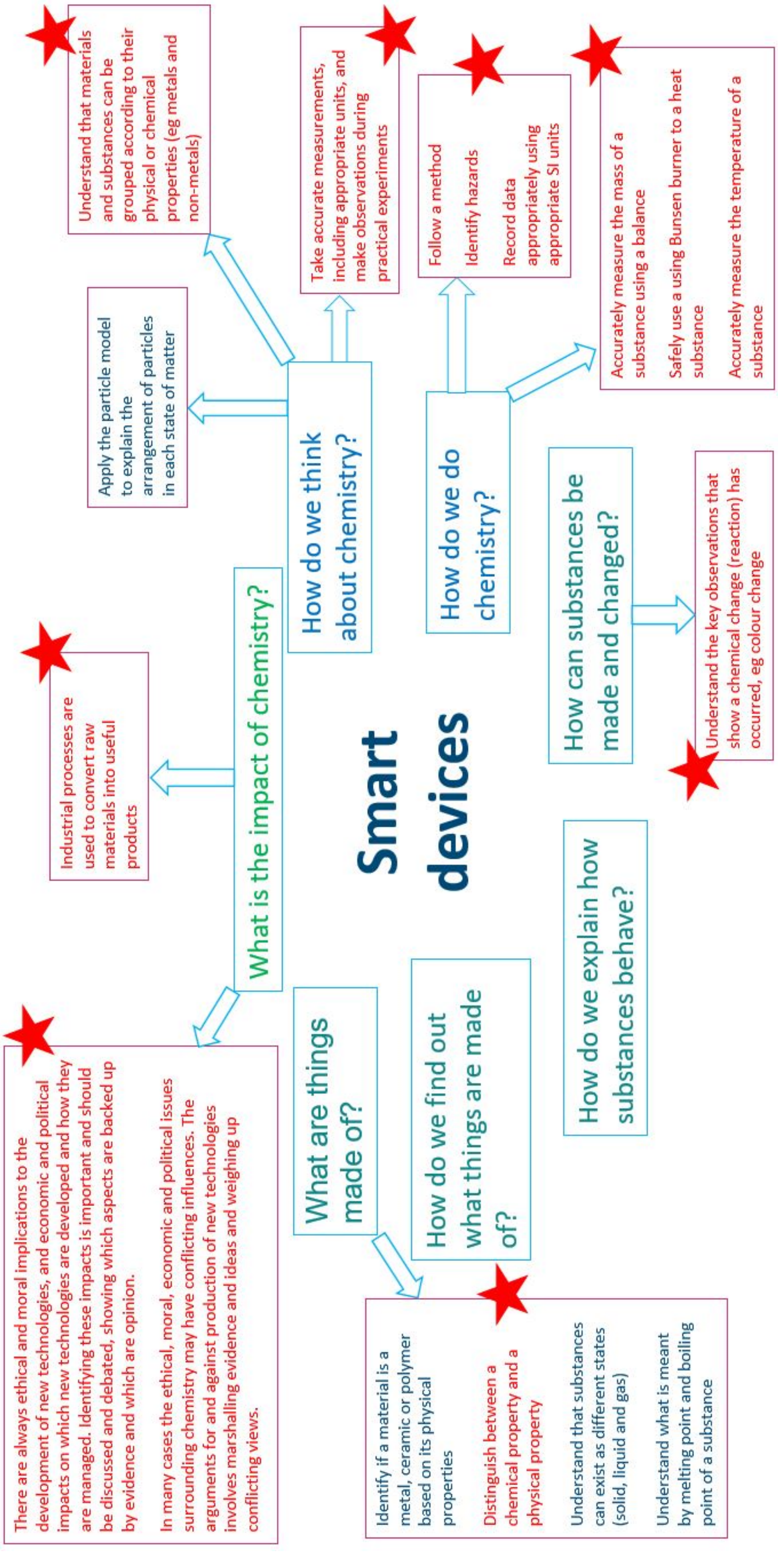
This learning could then be developed further, either in the same context/topic and/or others. Whereby, learners start to develop an understanding of how to represent this as chemists do in equations and what's actually happening on an atomic level. For now, perhaps the aim would be to introduce them to the idea of chemical properties and chemical changes and how chemical and physical properties differ. This is a fundamental concept to understand for later on in their learning when they start to talk about structure and bonding etc.

You may also discuss how metals are extracted – copper doesn't just come out of the ground ready to use – and that chemical changes occur based on chemical properties to extract the pure metal.

This whole topic links to wider implications about use of technology and about the how materials used in smart devices are limited/finite and are essentially running out and what we can do to combat this. This also has a knock-on effect socially and economically – metal extraction and processing play a major role in Wales and communities are built around this, as well as mining that occurs on a global scale. This last point has the potential to be interwoven through this context depending on which metals are chosen to learn about.

*Figure 5. Suggested final step for working through the progression statements using this context.*



## Other approaches for using this model

Of course, this model does not have to be topic based. Again, it depends on how your school designs their curriculum. These steps can just as easily be done or modified if you are considering what to teach in the first module, term or even year. There are many statements identified in this example that could be relevant, but these can be cut down or even added to where you see fit, for the allocated teaching time that you have.

Examples of how this can be altered to suit your learners or the needs of your curriculum at the point in time this would be taught are given below. These can also be used to help differentiate teaching to allow for individual learner-tailored progression as outlined in Curriculum for Wales, ie you may have learners working on same key idea but at different levels of progression.

- Remove something that you feel isn't necessary, as you have covered it previously and learners have grasped it.
- Swap out statements for ones further to the right in the curriculum planning support table. For example, switching out the statement 'understand key observations that show a chemical change (reaction) has occurred, eg colour change' for 'understand that word equations represent what happens during a chemical reaction' so learners who are ready can turn their observations and names of reactants and products into a word equation, whilst understanding what it represents.

As you move from left to right across the table you will develop the answer to each question and can start to answer the two other big questions not addressed here.