Science Stage 5

The periodic table

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# Overview

**Stage and Learning Area**: Science Stage 5

**Description**: this resource has been designed to address **SC5-16CW** the atomic structure and properties of elements are used to organise them in the Periodic Table.

This learning sequence builds an understanding of:

* the organisation of elements in the periodic table using their atomic number and
* the properties of elements in relation to their position in the periodic table.

A range of strategies are used to develop literacy and working scientifically skills.

**Duration**: while timing will vary based on the mode of delivery, differentiation strategies employed and class or school context, this series of activities should take approximately five x 50-minute lessons.

# Information for teachers

The students should understand the atom, it’s structure and the symbols used for elements before they begin this lesson.

## Introduction

This learning sequence is designed to build skills gradually throughout the task. Teachers may wish to modify the task or focus on specific sections based on their class context, student ability and current mastery of content.

This content also links with other sections of the Years 7–10 Science course, including:

* **CW1** scientific understanding changes and is refined over time through a process of review by the scientific community.

## Outcomes

* **SC5-16CW** explains how models, theories and laws about matter have been refined as new scientific evidence becomes available
* **SC6-6WS** undertakes first-hand investigations to collect valid and reliable data and information, individually and collaboratively
* **SC5-7WS** processes, analyses and evaluates data from first-hand investigations and secondary sources to develop evidence-based arguments and conclusions
* **SC5-8WS** applies scientific understanding and critical thinking skills to suggest possible solutions to identified problems
* **SC5-9WS** presents science ideas and evidence for a particular purpose and to a specific audience, using appropriate scientific language, conventions and representations.

[Science Years 7–10 Syllabus](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/science/science-7-10-2018) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2018.

## Learning intentions and success criteria

The learning intentions and success criteria below are a guide and may be adapted to meet your students’ needs.

Students describe the organisation of elements in the periodic table and relate the properties of some common elements to their position in the periodic table.

Students can:

* identify simple and complex patterns
* identify simple patterns in the periodic table
* model trends within the periodic table
* explain that the model of the periodic table is not static
* use the periodic table to identify elements and their properties.

**Differentiation consideration**: learning intentions should not be differentiated. All students need access to the same core content, big ideas and concepts. Differentiation should be evident in the success criteria, or the activities/support needed to achieve the success criteria (Wiliam and Leahy 2015). Teachers may co-construct the success criteria with students or adjust them to suit their class context, for example, using the strategies and resources for curriculum planning on the [Planning, programming and assessing 7–12](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12) webpage.

# Teaching and learning activities

## Review prior knowledge

The students recall prior knowledge of atomic structure using the [Quick writes](#_Prior_knowledge:_Quick) activity in the student resources section of this document. A copy is also included in [The periodic table supporting PowerPoint](https://education.nsw.gov.au/teaching-and-learning/curriculum/science/planning-programming-and-assessing-science-7-10) that can be used instead of printed worksheets.

**Differentiation:** Quick writes are used to encourage students to develop their writing skills using regular, short opportunities. Dot points are an acceptable form of expressing their knowledge in this case. The activity can be differentiated by changing the amount of detail required by students in their responses. It can be further differentiated by allowing students to discuss their answers with a partner before they write an individual response. Students requiring support in expressing themselves through writing may be given options for the representation of their knowledge.

## Activity 1 – the Periodic Table song

Introduce key vocabulary terms to the students by listening to [SLOW "The NEW Periodic Table Song (in Order)".(4:20)](https://youtu.be/-I7l8TgtuLQ?list=RD-I7l8TgtuLQ) or [The Periodic Table Song (2018 Update!) (3:04)](https://youtu.be/rz4Dd1I_fX0). The students listen to the song as it is played through once. Replay the song while the students create a word bank of new or unfamiliar terms. They should also include terms that are used in a new way, for example, shells. The students should not include the names of elements in their word list. Discuss the terms that are identified with the class. The students will continue to develop the word bank through the learning sequence so it is not necessary that they have all the meanings in this lesson.

**Differentiation:** the slower version of the song is more accessible for most students. Ensure that closed captions are turned on to increase accessibility and encourage vocabulary development for all students.

## Activity 2 – getting to know the periodic table and its elements

### Part A – looking for patterns

The modern periodic table was developed by looking for patterns and trends in the elements. In this activity, the students practise looking for patterns before creating their own periodic table model.

**Inquiry cube**

**This activity is adapted from** [Making Models: Wooden Blocks – Perimeter Institute](https://resources.perimeterinstitute.ca/collections/individual-lessons/products/making-models-wooden-blocks?variant=29960598487118). This is a free download after you sign into the Perimeter Institute.

**The activity uses small cubes with labels attached to 5 faces of the cube with one face left blank.**

1. **Divide the class into groups of 4.**
2. **Place the inquiry cube in the middle of the table, blank face down, with one face towards each student. Do not let them see the bottom face of the block.**
3. **Each student records observations about the vertical face closest to them without touching the cube.**
4. **The students share observations with their opposite partner and discuss any patterns.**
5. **Combine observations with the adjacent pair. Discuss the patterns that emerge.**
6. **The group build a detailed model that describes how the labels are assigned (these models can be discussed as a class).**
7. Using observations of the top face and their model, predict the hidden face (share predictions with the class).
8. Conduct a class discussion on looking for patterns, making inferences and gaps in patterns. Lead this into a discussion on the periodic table and its development based on patterns.

**Differentiation consideration:** inquiry cubes can be created with differing levels of complexity. Simple cubes will have one pattern to discover and use to make predictions. To better reflect the complexities of the periodic table cubes with 2 or 3 patterns to match could be used. To extend students further, cubes could be created with 4 or 5 patterns to match and make predictions. The cube label template included in [Making Models: Wooden Blocks – Perimeter Institute](https://resources.perimeterinstitute.ca/collections/individual-lessons/products/making-models-wooden-blocks?variant=29960598487118) could be modified by adding shapes or colours. Consider the needs of your students and adjust the template for this activity as required.

Another way to use the cubes is to allow the students to manipulate the cube and make observations on all sides as a group.

**Possible patterns that may be identified (examples only, other patterns may be identified)**

**Sample response:**

* Words on opposite sides have the same starting letters.
* The top right hand corner numbers add to seven.
* The bottom left-hand number on opposite sides is the same
* The bottom left-hand number is equal to the number of shared starting letters in the names.

#### Part B – patterns in the periodic table

Begin this section of the lesson by providing a [periodic table](https://educationstandards.nsw.edu.au/wps/wcm/connect/98664936-221f-4c49-88e1-d002ec69285c/chemistry-formulae-sheet-data-sheet-periodic-table-hsc-exams-2019.pdf?MOD=AJPERES&CVID=) to the students and asking them to look for patterns. This could be conducted as a [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645#:~:text=Also%20known%20as%3A%20turn%20and,combined%20knowledge%20with%20the%20class.) activity. Encourage the students to find as many trends as they can. These could include:

* atomic number
* atomic mass
* location of gases
* atomic radius
* the location of common metals
* patterns in naming and symbols.

Ask the students to look for places where the patterns are broken, for example, the mass order is reversed for tellurium and iodine.

**Extension:** ask the students to predict the reason for different patterns and breaks in the pattern. Emphasise that they are not expected to know the answers, so it is ok to not know the answer.

Discuss the importance of the patterns in the periodic table (to quickly predict the properties of an element).

Watch the video [The Periodic Table: Crash Course Chemistry #4 (11:21)](https://youtu.be/0RRVV4Diomg) (you may choose to stop the video at 8:33 minutes and watch the rest of the video in Activity 4. The students should add any new and unfamiliar terms to their word bank.

**Anchor chart**

Create an anchor chart of the periodic table with the students for them to reference later.

1. Label the groups I-VIII.
2. Label the periods 1–7.
3. Colour the metals red.
4. Colour the non-metals green.
5. Hatch over the metalloids.

[The periodic table – classification of elements (8:56)](https://youtu.be/t_f8bB1kf6M) or refer to slide 5 in [The periodic table supporting PowerPoint](https://education.nsw.gov.au/teaching-and-learning/curriculum/science/planning-programming-and-assessing-science-7-10) may be used to facilitate this activity. Give the students time to discuss annotations on their periodic table, create a key for their annotations and discuss terminology.

**Extension:**

* Label the alkali metals
* Label the alkali earth metals
* Label the halogens
* Label the noble gases

**Differentiation:** the section in the video from 0:38 to 0:59 can be skipped for lower ability classes.

**Game:** the [mystery puzzle](https://contrib.pbslearningmedia.org/WGBH/conv19/phy03-int-ptable/index.html) may be used as a fun activity to consolidate understanding of patterns in the periodic table. The game refers to electron configuration for some elements, however, if the students focus on patterns, they should be able to complete the activity without an understanding of electron shells.

## Activity 3 – modelling trends in the periodic table

### Part A – modelling the Bohr atom

In this activity students create physical models of the Bohr atom to identify trends in the periodic table.

Provide the students with the [Models of the atom](#_Activity_3:_Models) table to complete. It may be necessary to remind students how to find the atomic number and mass number on the periodic table. You may also need to remind students how to calculate the number of protons, electrons and neutrons from this information. (The number of neutrons = mass number – atomic number.)

**Teacher note: this activity could be conducted as a jigsaw activity. Divide the class into groups of 4. Each student will fill out the information for 2 columns. They will share the information with the rest of the group. The group will then discuss what is going on in each of the columns.**

See Table 1 below for an example of suggested responses.

Provide the students with 3 different coloured chocolates or coloured counters. They will need up to 22 of each colour. The students use the counters to create models of 4 elements showing the position and number of protons, neutrons and electrons. The elements that are created should come from a range of groups and periods.

The students describe the trends that they observe:

* increasing proton number
* increasing number of electrons
* number of protons is often the same as the number of neutrons
* the number of electrons in the outer shell is the same as the group number
* the number of shells with electrons in it is the same as the period number.

**Differentiation:** model the completion of the table and construction of the Bohr model for one or 2 elements.

The number of elements that the students construct may be modified to suit the needs of the class and individual students.

This activity could be conducted in small groups or as a whole class discussion to support student learning.

It may not be necessary for students to complete the table or create a model for all 12 elements for them to observe patterns and trends.

**Extension:** students could be extended by asking them to explain the trends that they observe.

Table – atomic structure suggested responses

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Atomic number | Element | Mass number | Period | Number of shells | Group | Electrons in outer shell | Protons (equals the atomic number) | Neutrons (= mass number − atomic number) |
| 1 | Hydrogen | 1 | 1 | 1 | I | 1 | 1 | 0 |
| 2 | Helium | 4 | 1 | 1 | VIII | 2 | 2 | 2 |
| 3 | Lithium | 7 | 2 | 2 | I | 1 | 3 | 4 |
| 4 | Beryllium | 9 | 2 | 2 | II | 2 | 4 | 5 |
| 5 | Boron | 11 | 2 | 2 | III | 3 | 5 | 6 |
| 6 | Carbon | 12 | 2 | 2 | IV | 4 | 6 | 6 |
| 7 | Nitrogen | 14 | 2 | 2 | V | 5 | 7 | 7 |
| 8 | Oxygen | 16 | 2 | 2 | VI | 6 | 8 | 8 |
| 9 | Fluorine | 19 | 2 | 2 | VII | 7 | 9 | 10 |
| 10 | Neon | 20 | 2 | 2 | VIII | 8 | 10 | 10 |
| 11 | Sodium | 23 | 3 | 3 | I | 1 | 11 | 12 |
| 12 | Magnesium | 24 | 3 | 3 | II | 2 | 12 | 12 |
| 13 | Aluminium | 27 | 3 | 3 | III | 3 | 13 | 14 |
| 14 | Silicon | 28 | 3 | 3 | IV | 4 | 14 | 14 |
| 15 | Phosphorous | 31 | 3 | 3 | V | 5 | 15 | 16 |
| 16 | Sulfur | 32 | 3 | 3 | VI | 6 | 16 | 16 |
| 17 | Chlorine | 35 | 3 | 3 | VII | 7 | 17 | 18 |
| 18 | Argon | 40 | 3 | 3 | VIII | 8 | 18 | 22 |
| 19 | Potassium | 37 | 4 | 4 | I | 1 | 19 | 18 |
| 20 | Calcium | 40 | 4 | 4 | II | 2 | 20 | 20 |

### Part B – tableau (optional activity)

Ask the students to work in small groups to create a [tableau](https://www.theteachertoolkit.com/index.php/tool/tableau) demonstrating one of the trends that has been identified. The rest of the class watch the tableau and guess the trend. For example, students may model increasing size down a group by standing in a line to represent a group. Each person makes their body take up more space as they go down the group.

## Activity 4 – a very different periodic table

This activity develops the students’ ability to locate and extract explicit and implicit information from a text while exploring the variety of models of the periodic table and that are still evolving. This activity uses the Cosmos article [A very different periodic table](https://cosmosmagazine.com/science/chemistry/the-periodic-table-might-have-looked-very-different-indeed/).

The document: [Locating explicit and implicit information](https://resources.education.nsw.gov.au/detail/C-52) has additional information on supporting student comprehension skills.

### Introduction

Discuss the terms explicit and implicit. Explain the difference between the 2 terms and the need to be able to determine both types of information when reading texts.

* Explicit: clear, no space for interpretation.
* Implicit: implied or strongly suggested.

### Reading the text (explicit information) – skimming and scanning

**Skimming:** the students skim the text to identify the main idea of the article. This can be done by looking at headings, subheadings, pictures and captions and the first and last paragraph of the text.

#### Suggested answers to question 1

1. **Use skimming techniques to answer the following questions:**
2. **Is the text imaginative, persuasive or informative? How do you know?**

The text is informative because it contains factual information about the periodic table, its different forms and its creators.

1. **What is the text about?**

The text is about the evolution of different models of the periodic table.

1. **What is the first paragraph about?**

The first paragraph is about the significance of the periodic table and Mendeleev’s contribution.

1. **What does the image ‘Theodor Benfey’s spira table (1964)’ show?**

It shows a model of the periodic table that has the elements spiralling outwards. The spokes of the wheel are like groups in the modern periodic table. Each line represents a group of elements.

1. **What does the image ‘The Underground Map of the Elements’ show?**

This image shows how the elements in the periodic table could be organised in groups like a map of railway lines.

1. **What is the last section, ‘Settling on a design’ about?**

This section of the article informs us that the format of the periodic table is still changing and evolving and that there are many different forms that it takes.

**Differentiation:** this and the following activities could be carried out as a ‘Think aloud’ activity, either for the whole class or small groups. The teacher skims the text and verbalises their thinking and highlights key information on the board as they read.

The students could carry out this activity in small groups to support their understanding and confidence.

The use of home languages should be encouraged to discuss and consolidate understanding of new terms.

**Scanning:** the students scan the text to identify key dates, names and models of the periodic table.

#### Suggested answers to question 2

1. **Scan the text to answer the questions below.**
2. **When did Mendeleev develop his model of the periodic table?**

1869

1. **Who was the first person to arrange the elements in a table?**

Dalton

1. **Who was the first scientist to sort elements based on their properties?**

Newlands

1. **When did Werner add the noble gases to the periodic table?**

1905

**Who created the model of the periodic table that is the basis of the modern periodic table?**

Werner

**Reading the text (implicit information)**

The students now read the text looking for implications in the text. This information can be used to answer higher order questions. The process for extracting implicit information can be modelled using the ‘Think aloud’ strategy.

The students now complete questions 3–8.

#### **Suggested responses to question 3**

1. **Describe how the way that Mendeleev approached the model of the periodic table was different to that of other scientists.**

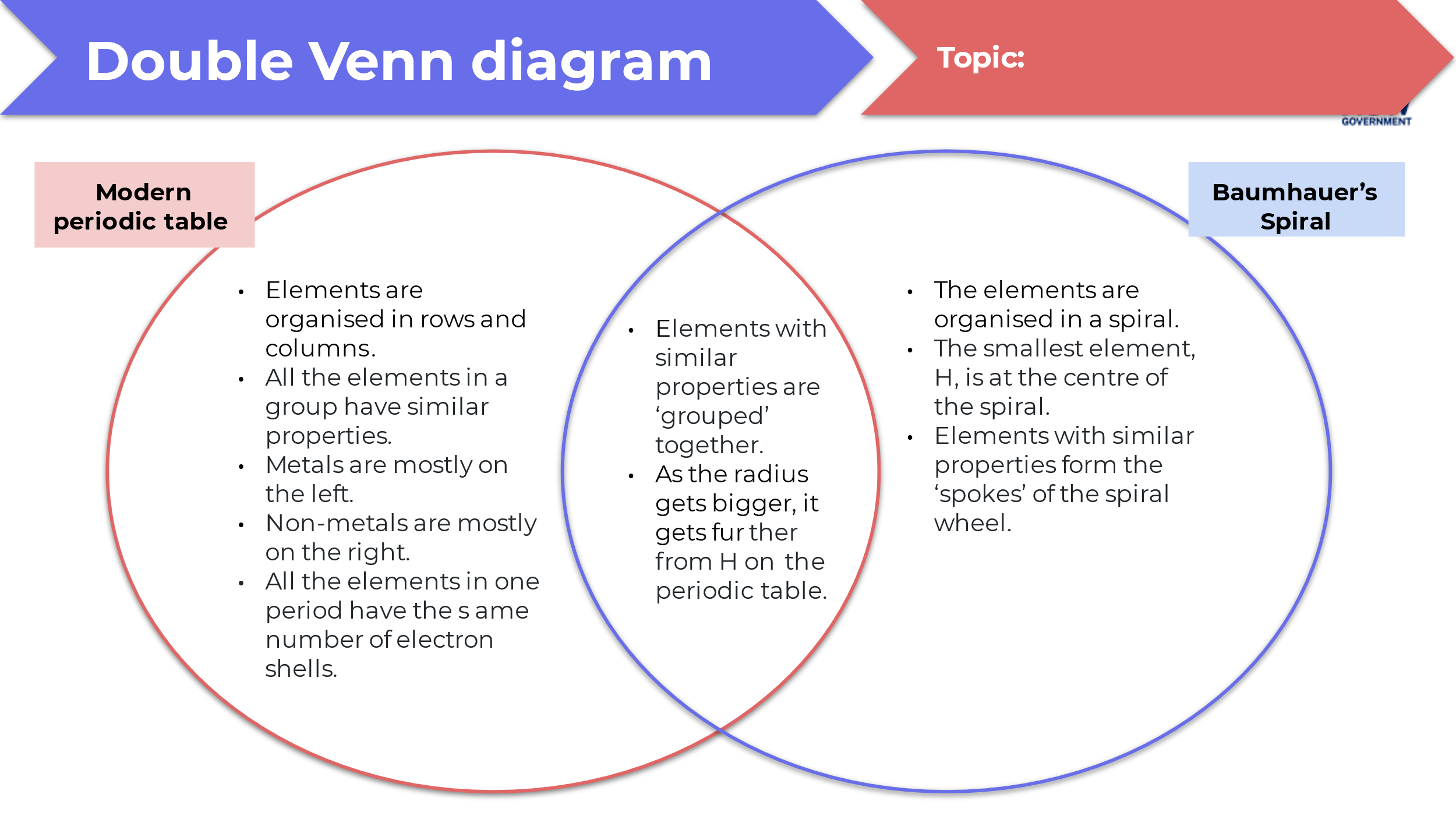
Mendeleev organised the elements according to chemical and physical properties. He also added gaps for elements that he predicted as missing.

1. **Explain why Mendeleev’s model of the periodic table was important.**

Mendeleev’s model of the periodic table was important because it contained predictions of elements that were as yet unknown and their predicted properties. This meant that scientists could look for these elements.

1. **Create a Venn diagram to identify similarities and differences between Baumhauer’s spiral model and the modern periodic table.**

**Sample response on next page and on slide 6 of** [The periodic table supporting PowerPoint](https://education.nsw.gov.au/teaching-and-learning/curriculum/science/planning-programming-and-assessing-science-7-10)**.**



1. **Select one of the alternative models of the periodic table, for example: The Underground Map of the Elements, the 3D ‘Mendeleev flower’. Evaluate how effective the model is to find the elements and predict their properties. The following databases may be used to discover other models of the periodic table.**

**The underground map of the elements**

This model of the periodic table is an engaging model. The colours and train lines show elements that have similar properties. The lines could be extended as new elements are discovered, for example, the lanthanides.

The model demonstrates the overlap of some properties, such as no stable isotopes and the actinides. However, there are limitations as this line ends and should not.

The obvious limitation to the model is that there is no pattern showing increase in atomic number, electron configuration or reactivity. This means that the model has limited use as a tool for predicting chemical reactivity or elemental behaviour.

1. **Evaluate the statement: ‘The modern periodic table is based on evidence and will not change.’**

This statement is not an accurate statement. Although it could be predicted that the overall structure may not change significantly, our knowledge and understanding of elements and their properties is constantly developing. It is expected that there may be small changes to the structure of the periodic table as new discoveries are made.

The following websites contain models of the periodic table that may be used to further extend the students’ understanding of the range of models that have been developed.

* [Leach's database](https://www.meta-synthesis.com/webbook/35_pt/pt_database.php)
* [3D models of the periodic table](https://www.meta-synthesis.com/webbook/35_pt/pt_database.php?Button=3D+Formulations)

## Activity 5 – examining a trend in the periodic table (PEOE)

### Setting the scene

The students will identify and investigate a trend in chemical reactivity of the alkali earth metals using the Predict-Explain-Observe-Explain (PEOE) model.

Introduce the activity by watching [Alkali Metals Reacting with Water (3:16)](https://youtu.be/jI__JY7pqOM). Discuss the trends that are observed in the video. The students will then use the information from this discussion to complete the ‘Predict’ and ‘Explain’ sections of the PEOE activity.

### Practical activity

The students will now conduct a short experiment to investigate the reactivity of group II elements. The data they collect will provide them with information to complete the ‘Observe’ and ‘Explain’ sections of the activity.

The goal is to go through the process of making predictions and providing reasons for their predictions **before** they do the practical component. Class discussions can be used to support their final explanations and correct misunderstandings after they have attempted the activity.

**Differentiation:** ensure that closed captions are turned on before watching the video. The video may be watched more than once to reinforce understanding.

Discussion of observations and predictions may be carried out in small groups or as a whole class. Encourage the use of home languages in small group discussions.

Students may be provided with opportunities to represent their ideas in a manner that they are most comfortable with because report writing is not the focus of this activity.

Two scaffolds are provided for students to complete this activity. A standard scaffold and an extension scaffold. These may be modified to provide further scaffolding as required by your class.

### Teacher preparation

The following equipment will need to be made available to each group.

* Magnesium
* Calcium
* Strontium turnings
* 50 mL graduated cylinder
* 5 × 100 mL beakers
* Mass balance
* 3 × 50 mL beakers
* Timer
* Hydrochloric acid (1 M)
* Universal indicator solution (dropper bottle)
* De-ionized water
* Tweezers

### Method

1. Measure 20 mL of hydrochloric acid into each of the three 50 mL beakers.
2. Add 3 drops of universal indicator to all 3 beakers. Swirl the solution to mix.
3. Place two 1 cm pieces of magnesium into the second 100mL beaker.
4. Place 2 similar sized pieces of calcium into the first 100 mL beaker.
5. Place 2 similar sized pieces of strontium into the last 100 mL beaker.
6. One person should be ready to time this next step.
7. Each of the 3 volunteers should get ready to pour the hydrochloric acid solution into each of the beakers at the same time.
8. The timing person should record the time it takes each metal to disappear.
9. If one element takes longer than 5 minutes, stop the time and write down 5+.
10. You should now know which element reacts the fastest, faster, and slowest.
11. Discuss this data with your small group and complete the rest of the PEOE table.

This experiment may be conducted as a teacher demonstration if preferred.

#### Suggested response

Table – Predict-Explain-Observe-Explain (PEOE)

|  |
| --- |
| **Description of focus**  Reactivity of group II elements. |
| **Predict** (what do you expect to see? Give reasons to support your predictions.)  In the demonstration, the elements further down the group will react more quickly than the elements higher in the group. |
| **Explain** (why do you think this will happen?)  The reactivity of metals will increase down the group due to increase in atomic size. |
| **Observe** (what do you see?)  The strontium will react the most quickly, with the most bubbles. Magnesium took the longest to react. (The common misconception is that the metal is dissolving in the acid, it is reacting.) |
| **Explain** (Add to or change your previous explanation. Why does this trend occur?)  The reactivity of the elements will increase down a group in the group I demonstration. Therefore, we expect the reactivity of elements in group II to increase as well. Strontium will be the most reactive and magnesium the least reactive.  (Extension: The electrons participating in the reaction are in the valence shell. As you go down a group, the valence shell is further from the nucleus and the electrons are held less strongly and can therefore be more easily transferred.) |

If strontium turnings are not available, this experiment could be modified to use calcium and magnesium. The reactivity of magnesium and granulated calcium in water could be investigated and then compared to the reactivity of magnesium and granulated calcium in hydrochloric acid.

### Risk assessment

A thorough risk assessment should be conducted before conducting the experiment. We suggest that you inspect the SDS for the chemicals before proceeding with this experiment. All safety measures must be implemented when conducting this experiment.

Table – sample risk assessment

|  |  |  |
| --- | --- | --- |
| Items/Chemicals | Hazard | Control Measures |
| Beakers, measuring cylinders | Breakage of beaker. Cuts from chipped glassware. | Use standard handling procedures. Inspect and discard broken glassware. Sweep up broken glass with a dustpan and brush; do not use fingers to clean up broken glass. Wear enclosed leather shoes. |
| Hydrochloric acid | Splashing chemicals in eyes or on skin. | Wear safety glasses throughout the experiment. Wear enclosed leather footwear. Wash splashes off the skin with cool water. |
| Magnesium | Produces flammable gases on contact with water which may ignite spontaneously. | Wear safety glasses throughout the experiment. Keep in a container away from water until use.  Do not place excess in the garbage or down the drain. |
| Calcium | In water releases flammable gases. | Wear safety glasses throughout the experiment. Keep in a container away from water until use.  Handle in a well-ventilated area.  Provide students with a few grains of strontium only. |
| Strontium | Produces flammable gases on contact with water which may ignite spontaneously.  May cause skin irritation. | Wear safety glasses throughout the experiment. Keep in a container away from water until use.  Handle in a well-ventilated area.  Provide students with a few grains of strontium only. |
| Spills, bags, chairs | Slips, trips and falls. | Bags are to remain away from the work area. Spills are to be cleaned immediately. No running in the lab. |

## Activity 6 – scavenger hunt

In this activity the students conduct a scavenger hunt to find as many elements as they can. The students could include a photograph of the item containing the element as evidence that they found it. Alternatively, they can add a detailed location to the table. Edit the table as required to suit your class needs.

A copy of [The Periodic Table of the Elements, in Pictures and Words [PDF 1 KB]](https://elements.wlonk.com/Elements_Pics+Words_11x8.5.pdf) could be printed to support students in identifying where elements can be found.

**Teacher notes:** this activity could be conducted within the classroom with items placed strategically to be found by the students or the students could be given boundaries to search around the school. This activity could be extended as a homework task with the students being challenged to find as many elements as possible.

Clear time frames and boundaries should be provided to facilitate classroom management.

**Differentiation:** this activity provides opportunities for students to express themselves in the form that they are most comfortable with. This could include drawing the item instead of describing it in words.

## Activity 7 – periodic table battleships (optional activity)

In this activity the students play battleships using the periodic table as their grid. Period and group numbers become the code for ship locations.

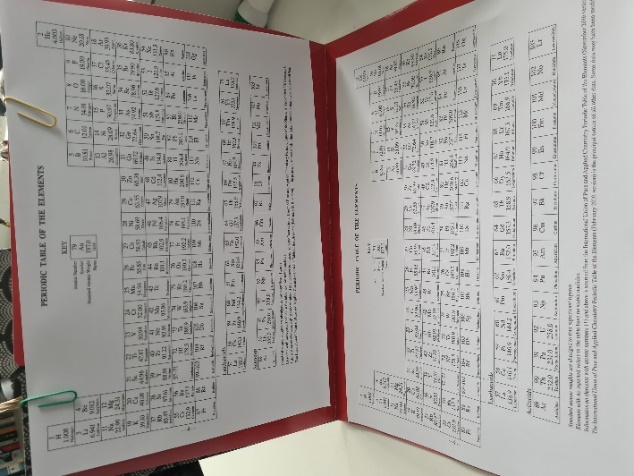
**Equipment** (per pair)

* 4 laminated copies of the periodic table
* 2 whiteboard markers
* 2 large paper clips or dog clips
* 2 folders

**How to play**

1. Attach a copy of the periodic table to each side of the folders (on the inside).
2. Open the folders and clip one side of each folder together so that the open folders will stand up facing each student. They should be able to see their 2 periodic tables in front of them, one is vertical and one is flat.

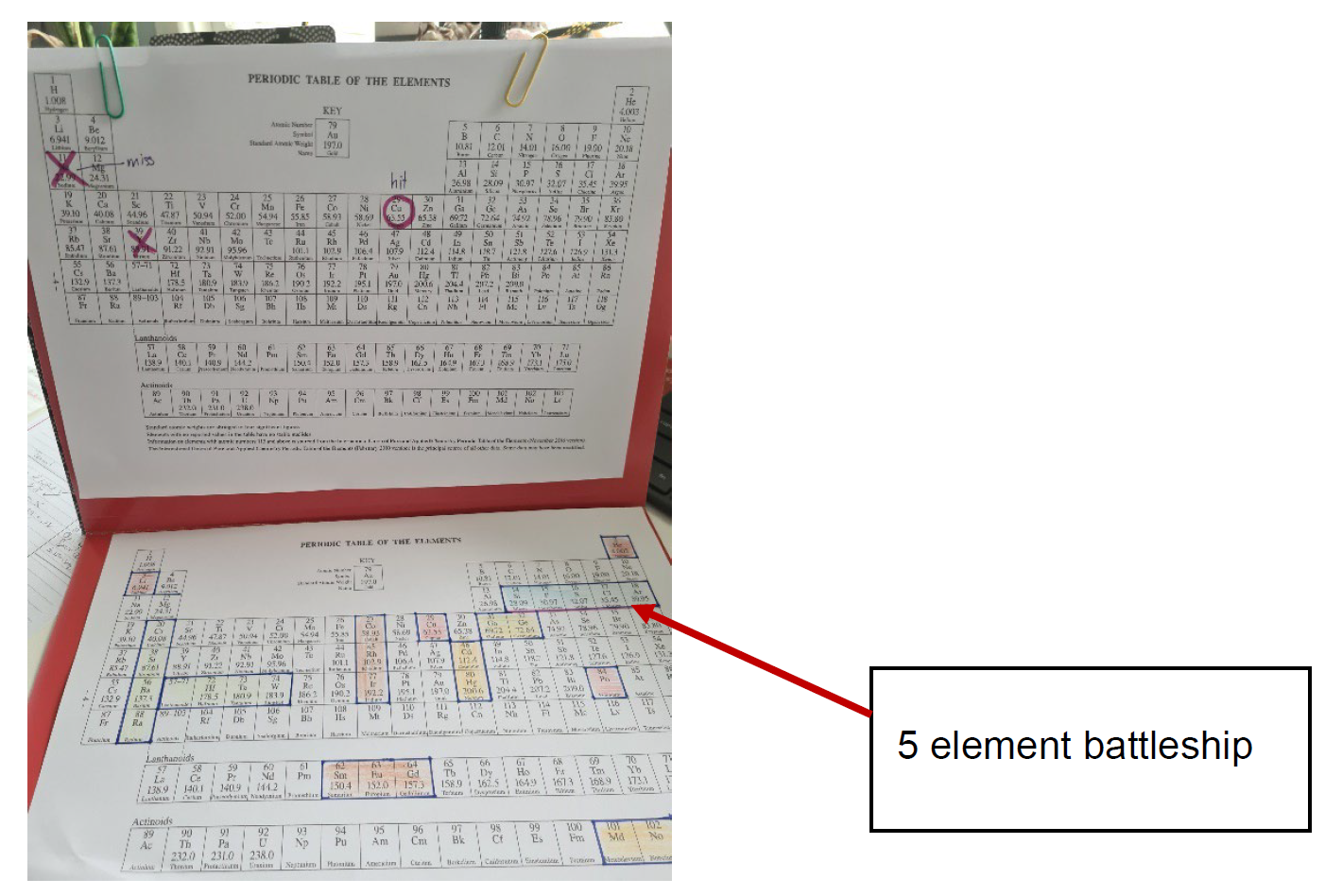
Figure – periodic table battleships setup



1. Mark the battleships on the flat periodic table by circling elements.

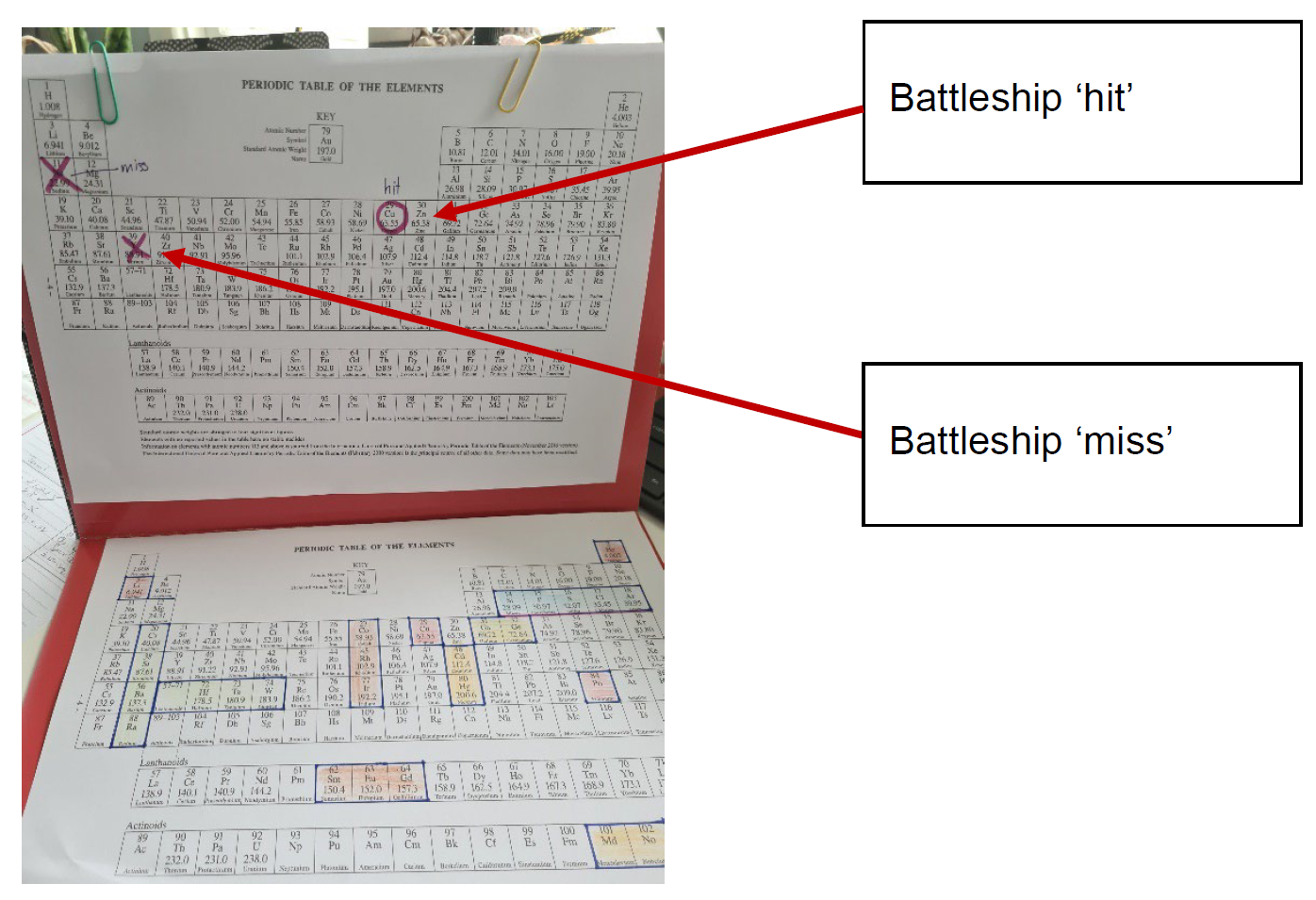
* 1 × 5 element ship
* 2 × 4 element ships
* 2 × 3 element ships
* 3 × 2 element ships
* 4 × 1 element ships

Figure – periodic table battleships – the battleships



1. Play a round of scissors-paper-rock (or other suitable game) to determine who starts play.
2. The first player identifies coordinates using the group and period numbers, for example, group 2 – period 3.
3. Use the vertical periodic table to track your hits. Mark the selected element with an ‘X’ if it is a miss and circle the element if it is a hit.
4. Play continues until all ships have been sunk.

Figure – periodic table battleships – hit and miss

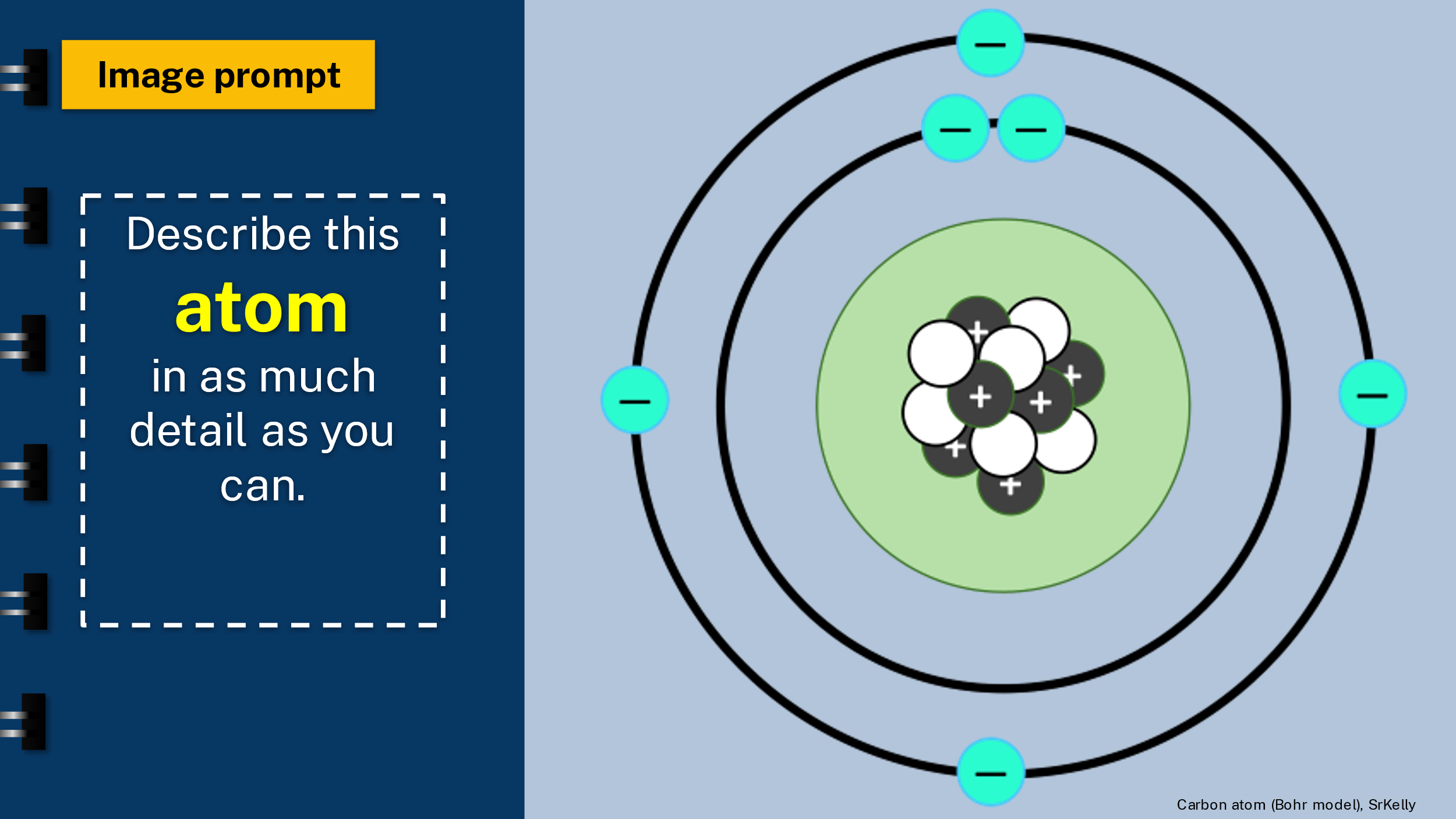


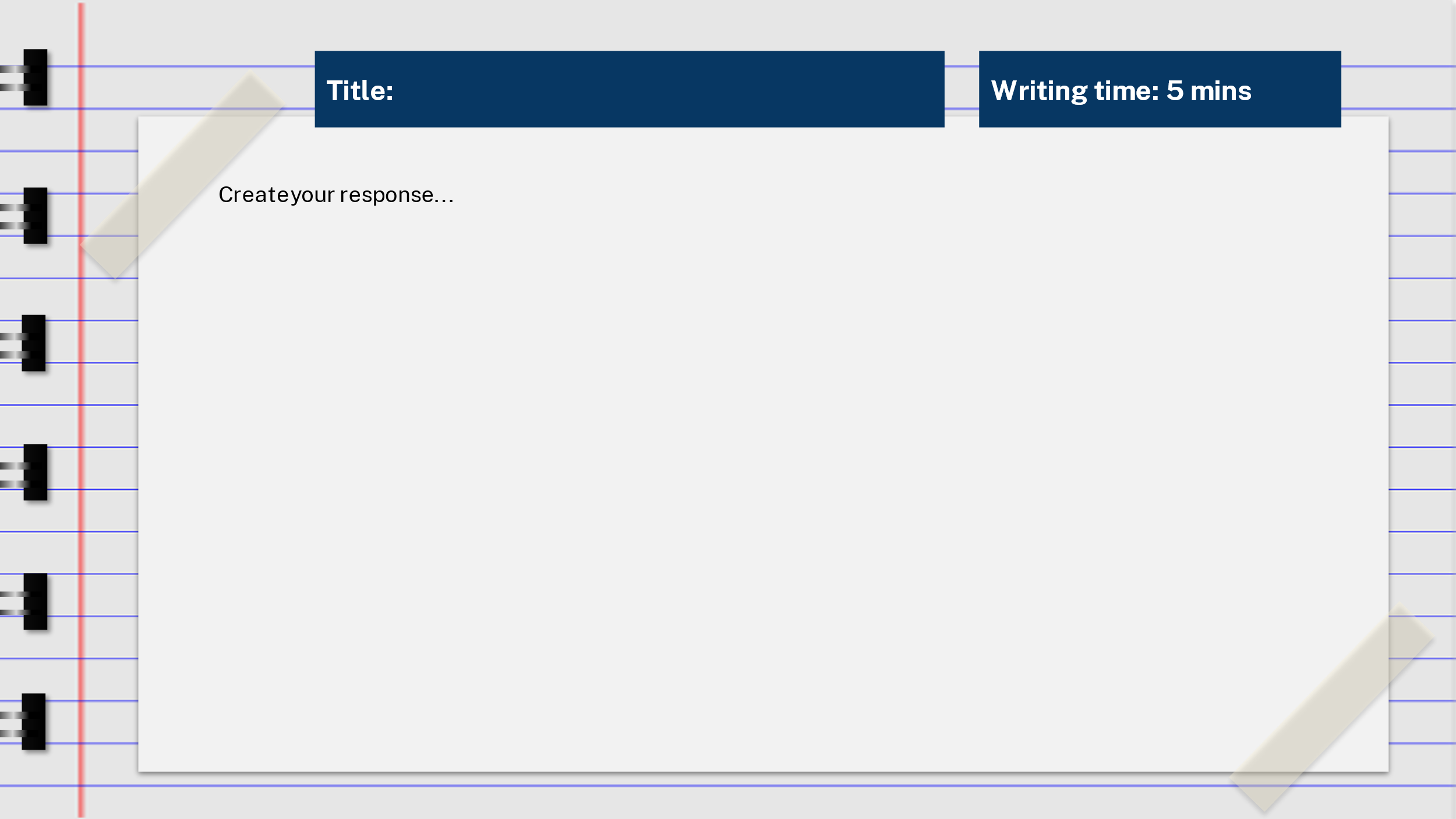
**Differentiation:** element names or symbols could be used instead of coordinates with a time limit for finding the element.

If students are not familiar with scissors-paper-rock, dice could be rolled to select the first player.

# Student resources

## Prior knowledge – Quick writes





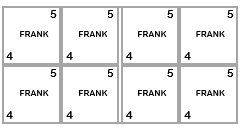
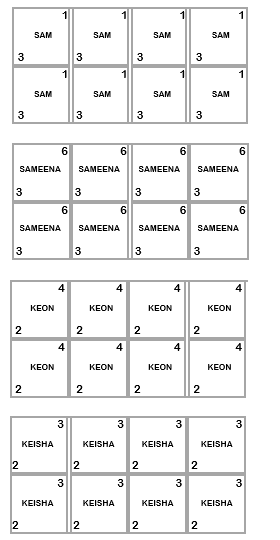
## Activity 1 – word bank

In the table below, write down unfamiliar terms as you listen to the [SLOW "The NEW Periodic Table Song (in Order)" (4:20)](https://youtu.be/-I7l8TgtuLQ?list=RD-I7l8TgtuLQ) (do not include the names of elements in your word bank).

|  |  |
| --- | --- |
| Term | Meaning |
|  |  |
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## Activity 2 – getting to know the periodic table and its elements

### Part A – looking for patterns – inquiry cube labels



## Activity 3 – models of the atom

Use your periodic table to complete the Atomic structure table below.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Atomic number | Element | Mass number | Period | Number of shells | Group | Electrons in outer shell | Protons (equals the atomic number) | Neutrons (= mass number - atomic number) |
| 1 |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |
| 11 |  |  |  |  |  |  |  |  |
| 12 |  |  |  |  |  |  |  |  |
| 13 |  |  |  |  |  |  |  |  |
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| 17 |  |  |  |  |  |  |  |  |
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| 19 |  |  |  |  |  |  |  |  |
| 20 |  |  |  |  |  |  |  |  |

### Modelling the Bohr atom

Use the template to create models of atom. Use different coloured counters to represent atoms, protons and electrons.

1. Identify each atom.
2. Count the correct number of protons, electrons and neutrons needed for the atom.
3. Place them in the correct place on the template.
4. Ask your teacher to check your work.

Figure – Bohr model of the atom scaffold

## Activity 4 – a very different periodic table

Read the Cosmos article [A very different periodic table](https://cosmosmagazine.com/science/chemistry/the-periodic-table-might-have-looked-very-different-indeed/).

In questions 1 and 2 you will be looking for explicit information. Questions 3–6 use implicit information gained by reading the text.

1. Use skimming techniques to answer the following questions:
2. Is the text imaginative, persuasive or informative? How do you know?
3. What is the text about?
4. What is the first paragraph about?
5. What does the image ‘Theodor Benfey’s spira table (1964)’ show?
6. What does the image ‘The Underground Map of the Elements’ show?
7. What is the last section, ‘Settling on a design’ about?
8. Scan the text to answer the questions below.
9. When did Mendeleev develop his model of the periodic table?
10. Who was the first person to arrange the elements in a table?
11. Who was the first scientist to sort elements based on their properties?
12. When did Werner add the noble gases to the periodic table?
13. Who created the model of the periodic table that is the basis of the modern periodic table?
14. Describe how the way that Mendeleev approached the model of the periodic table was different to that of other scientists.
15. Explain why Mendeleev’s model of the periodic table was important.
16. Create a Venn diagram to identify similarities and differences between Baumhauer’s spiral model and the modern periodic table.
17. Select one of the alternative models of the periodic table, for example: The Underground Map of the Elements, the 3D ‘Mendeleev flower’.
18. Evaluate how effective the model is to find the elements and predict their properties. The following databases may be used to discover other models of the periodic table.
19. Evaluate the statement: ‘The modern periodic table is based on evidence and will not change.’

## Activity 5 – examining a trend in the periodic table – Predict-Explain-Observe-Explain (PEOE) extension

You have watched the video [Alkali Metals Reacting with Water (3:16)](https://youtu.be/jI__JY7pqOM) demonstrating a trend in how group I elements react with water. Your task is to:

* Predict: the reactivity trend of elements in group II of the periodic table (the alkali earth metals).
* Explain: why you think that this will happen.
* Observe: design and carry out an experiment to investigate and observe the reactivity of group II elements.
* Explain: explain the trend that you observe.

**Use the table below to Predict-Explain-Observe-Explain.**

|  |
| --- |
| **Description of focus**  Reactivity of group II elements. |
| **Predict** (what do you expect to see? Give reasons to support your predictions.) |
| **Explain** (why do you think this will happen?) |
| **Observe** (what do you see?) |
| **Explain** (Add to or change your previous explanation. Why does this trend occur?) |

Develop a valid and logical method to check your prediction. Include a complete risk assessment. Have your method, risk assessment and data collection process checked by your teacher before you conduct the experiment.

The following equipment is available to you.

* Magnesium
* Calcium
* Strontium turnings
* 50 mL graduated cylinder
* 5 × 100 mL beakers
* Mass balance
* 3 × 50 mL beakers
* Timer
* Hydrochloric acid (1 M)
* Universal indicator solution
* De-ionized water
* Tweezers

Carry out your experiment and complete the PEOE table.

## Activity 5 – examining a trend in the periodic table – Predict-Explain-Observe-Explain (PEOE)

You have watched a video demonstrating a trend in how group I elements react with water. Your task now is to predict, explain and observe the trend in reactivity of elements in group II of the periodic table (the alkali earth metals).

1. Complete the ‘Predict’ and ‘Explain’ sections of the table below based on your observations from [Alkali Metals Reacting with Water (3:16)](https://youtu.be/jI__JY7pqOM) and your class discussion.
2. Carry out the experimental method provided. Discuss your observations with your small group and complete the rest of the table.

**Use the table below to Predict-Explain-Observe-Explain.**

|  |
| --- |
| **Description of focus**  Reactivity of group II elements. |
| **Predict** (what do you expect to see? Give reasons to support your predictions.) |
| **Explain** (why do you think this will happen?) |
| **Observe** (what do you see?) |
| **Explain** (Add to or change your previous explanation. Why does this trend occur?) |

### Equipment

* Magnesium
* Calcium
* Strontium turnings
* 50 mL graduated cylinder
* 5 × 100mL beakers
* Mass balance
* 3 × 50 mL beakers
* Timer
* Hydrochloric acid (1 M)
* Universal indicator solution
* De-ionized water
* Tweezers

### Method

1. Measure 20 mL of hydrochloric acid into each of the three 50 mL beakers.
2. Add 3 drops of universal indicator to all 3 beakers. Swirl the solution to mix.
3. Place two 1 cm pieces of magnesium into the second 100 mL beaker.
4. Place 2 similar sized pieces of calcium into the first 100 mL beaker.
5. Place 2 similar sized pieces of strontium into the last 100 mL beaker.
6. One person should be ready to time this next step.
7. Each of the 3 volunteers should get ready to pour the hydrochloric acid solution into each of the beakers at the same time.
8. The timing person should record the time it takes each metal to disappear.
9. If one element takes longer than 5 minutes, stop the time and write down 5+.
10. You should now know which element reacts the fastest, faster, and slowest.
11. Discuss this data with your small group and complete the rest of the PEOE table.

## Activity 6 – scavenger hunt

How many of the elements can you find in the everyday things that you use?

You have 15 minutes to locate as many elements as you can. Fill out the table below. You may wish to include a photograph of the item.

|  |  |  |  |
| --- | --- | --- | --- |
| Element | Item | Location | Photograph |
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# Support and alignment

**Resource evaluation and support**: all curriculum resources are prepared through a rigorous process. Resources are periodically reviewed as part of our ongoing evaluation plan to ensure currency, relevance and effectiveness. For additional support or advice, or to provide feedback, contact the Science Curriculum team by emailing [Science7-12@det.nsw.edu.au](mailto:Science7-12@det.nsw.edu.au).

**Differentiation:** further advice to support Aboriginal and Torres Strait Islander students, EALD students, students with a disability and/or additional needs and High Potential and gifted students can be found on the [Planning, programming and assessing 7–12](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12) webpage.

**Assessment**: further advice to support formative assessment is available on the [Planning, programming and assessing 7–12](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12) webpage.

**Professional learning**: relevant professional learning is available on the [Science statewide staffroom](https://education.nsw.gov.au/teaching-and-learning/curriculum/statewide-staffrooms).

**Related resources**: further resources to support Years 7–10 Science can be found on the [Science Curriculum page](https://education.nsw.gov.au/teaching-and-learning/curriculum/science).

**Consulted with**: Aboriginal Outcomes and Partnerships and subject matter experts.

**Alignment to system priorities and/or needs**: [School Excellence Policy](https://education.nsw.gov.au/policy-library/policies/pd-2016-0468), [School Success Model](https://education.nsw.gov.au/public-schools/school-success-model/school-success-model-explained).

**Alignment to the School Excellence Framework**: this resource supports the [School Excellence Framework](https://education.nsw.gov.au/policy-library/policies/pd-2016-0468) elements of curriculum (curriculum provision) and effective classroom practice (lesson planning, explicit teaching).

**Alignment to Australian Professional Teaching Standards**: this resource supports teachers to address [Australian Professional Teaching Standards](https://educationstandards.nsw.edu.au/wps/portal/nesa/teacher-accreditation/meeting-requirements/the-standards/proficient-teacher) 2.1.2, 2.5.2, 3.2.2,

**Author**: Science 7–12 Curriculum Team

**Resource**: Classroom resource

**Creation date**: 3 July 2023

# References

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### Further reading

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