

Atoms and ions

This resource is part of the **Structure strip** series of resources, designed to support literacy in science teaching. Find more structure strips for a range of chemistry topics at: rsc.li/4aXYgzt

Learning objectives

- 1 Describe what happens to each subatomic particle when an ion is formed.
- 2 Explain what affects how easily ions are formed.

Introduction

Atomic structure is one of the most important topics in chemistry. Lots of other topics depend on understanding the structure of the atom and the properties of the subatomic particles. This is covered in the **Structure of the atom** structure strip: rsc.li/3wmBP89.

Ions are formed when electrons are lost and gained. The periodic table can help us understand ion formation.

How to use structure strips

Structure strips are a type of scaffolding you can use to support learners to retrieve information independently. Use them to take an overview at the start of the topic, to activate prior knowledge, or to summarise learning at the end of a teaching topic.

Structure strips have sections containing prompts, sized to suggest the amount that learners must write. Learners glue the strips into the margin of an exercise book and write their answers next to the sections, in full sentences. When learners have finished using the structure strip, they should have an A4 page set of notes and examples.

Scaffolding

To further support learners to answer the questions you can include a list of keywords or add prompts to the structure strip. As learners grow in confidence, they may be able to attempt the follow-up question first and then use the structure strip to improve or self-assess their answer.

Metacognition

This activity supports learners to develop their metacognitive skills in three key areas.

- **Planning:** the strips provide scaffolding to plan the written response. Learners will decide where to gather information from (textbooks, own notes, revision websites). Ask learners: is the source of information you are using reliable?

TEACHER NOTES

- **Monitoring:** learners are prompted by the questions in the structure strip and can check their answer against the prompts. Ask learners: have you covered all of the questions in the space provided? Do you need to change anything to complete the task?
- **Evaluation:** learners can self-assess or ask a peer to check their work against the answers. Ask learners: did you achieve what you meant to achieve? What might you do differently another time?

Follow-up question

Learners should answer the question after completing the structure strip. The structure strip activates the required knowledge which learners can then apply to the question.

Explain why sodium forms 1^+ ions but fluorine forms 1^- ions.

Answers

Find suggested answers for the structure strip activity on page three.

Answer to follow-up question

Sodium is in group 1 of the periodic table, therefore has one electron in its outer shell. When it forms ions, this electron is lost, so the ion formed has a full outer shell of electrons. This leads to the sodium ion having one more positive proton than the number of negative electrons, leaving a 1^+ charge.

Fluorine is in group 7. When it forms ions, it gains one electron and the ion formed has a full outer shell of electrons. This leads to the fluorine ion having one more negatively charged electron than the number of positive protons. So, a 1^- charge is left over.

Structure strip Atoms and ions	Suggested answer
Define the term ion.	An ion is an atom that has lost or gained one or more electrons, so it has an overall charge.
Describe, in terms of subatomic particles and electronic structure, what changes and what stays the same when ions are formed.	When an ion is formed, one or more electrons are lost or gained. If an atom has 1, 2 or 3 electrons in its outer shell (valence electrons) it is likely to lose them. If an atom has 5, 6 or 7 electrons in its outer shell it is likely to gain more. Only the outer shell of electrons changes, the inner shells do not change. The number of protons and neutrons does not change when ions are formed.
Zinc has a mass number of 65 and an atomic number of 30. State the number of each subatomic particle in a Zn^{2+} ion.	Zn^{2+} has: <ul style="list-style-type: none"> • 30 protons • 28 electrons ($30 - 2$) • 35 neutrons (mass number – atomic number, $65 - 30 = 35$)
Explain how the group number indicates the charge on the ions formed in groups 1 and 2.	Atoms in groups 1 and 2 have one and two electrons in their outer shell. When they form ions, all of the electrons in the outer shell are lost, meaning they are left with more protons than electrons. This means that group 1 elements form 1^+ ions and group 2 elements form 2^+ ions.
Going down group 1 it gets easier to lose an electron. Explain this observation.	Going down group 1: <ul style="list-style-type: none"> • Atoms get larger. • There are more full inner shells of electrons which shield the nucleus. (This explanation is A-level only in Northern Ireland). • There is less attraction between the nucleus and the outer electron, so the electron is easier to lose (takes less energy).
Explain how the group number indicates the charge on the ions formed in groups 6 and 7.	Atoms in groups 6 and 7 have six and seven electrons in their outer shell. When they form ions, the outer shell gains electrons until it is full. This means they are left with more electrons than protons. This means that group 6 elements form 2^- ions and group 7 elements form 1^- ions.
Going down group 7 it gets more difficult to gain an electron. Explain this observation.	Going down group 7: <ul style="list-style-type: none"> • Atoms get larger. • There are more full inner shells of electrons which shield the nucleus. (This explanation is A-level only in Northern Ireland). • There is less attraction between the nucleus and the incoming electron, so it is harder to gain an electron (takes more energy).