# Halogen displacement reactions: supporting resources

# This resource supports the practical video Halogen displacement reactions, available here: <rsc.li/3tZxFgu>

## Intended outcomes

It is important that the purpose of each practical is clear from the outset, defining the intended learning outcomes helps to consolidate this. Outcomes can be categorised as hands on, what learners are going to do with objects, and minds on, what learners are going to do with ideas to show their understanding. We have offered some differentiated suggestions for this practical. You may wish to focus on just one or two, or make amendments based your learners’ own needs. (Read more at <rsc.li/2JMvKa5>.)

Consider how you can share outcomes and evaluation with learners, empowering them to direct their own learning.

**Hands on Minds on**

**Effective at a lower level Students correctly:**

* Use equipment to safely carry out tests
* Follow instructions
* Make careful observations

**Effective at a higher level Students correctly:**

* Plan and carry out an investigation into the reactivity of the halogens

**Students can:**

* Record observations in a results table
* Write a word equation for each reaction
* Use the results to deduce the trend in reactivity of the halogens

**Students can:**

* Use trends to make predictions about the reactivity of other non-metals
* Describe reactions as either oxidation or reduction
* Explain what is happening on a sub-microscopic level during the reaction
* Write balanced symbol and ionic equations for each reaction

**How to use the additional resources**

### Using the pause-and-think questions

Pause-and-think questions are supplied in two formats: a teacher version for ‘live’ questioning and a student version which can be used during independent study. The time stamps allow you to pause the video when presenting to a class, or learners to use for active revision.

The questions could also be used to support delivery of the experiment as a demonstration or class practical. Responses will help you to assess understanding and address misconceptions.

#### **Teacher version**

The questions are presented in a table and you can choose to use as many as appropriate for your class and the learning objectives.

Some questions have two timestamps to allow you to adapt the questions for different classes or scenarios. Pause the videos at the earlier timestamp to ask a question before the answer is given, useful for revision or to challenge learners. Pause at the later timestamp to ask a question reflectively and assess whether learners

have understood what they have just heard or seen. This would be useful when introducing a topic, in a flipped learning scenario or when additional support and encouragement is needed.

Think about how you will ask for responses. Variation may help to increase engagement – learners could write and hold up short answers; more complex questions could be discussed in groups.

Not all answers to questions are included in the video. Some of the questions will draw on prior learning or extend learners’ thinking beyond the video content.

#### **Student version**

The same questions are offered as a printable worksheet for learners. Use in situations where there is not a teacher present to guide discussion during the video, for example homework, revision or remote learning.

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## **Pause-and-think questions**

### Teacher version

|  |  |  |  |
| --- | --- | --- | --- |
| **Timestamp(s) Question Answer/discussion points** | | | |
| 00:14 | 00:21 | Name the halogens and describe where they are found in the periodic table. | Fluorine (F), chlorine (Cl), bromine (Br), iodine (I), astatine (At).  The halogens are found in group 7 of the periodic table which is the second column on the right hand side of the periodic table. They are non-metals. |
| 00:45 | 01:06 | What do you think is meant by the term ‘displacement’? Write a definition in your own words or share your ideas with the class. | Please see the separate Frayer model as an example of how to explore learners’ ideas about ‘displacement’. |
| 01:14 | 01:18 | Write down or improve your definition.  Try to write a general equation. | A displacement reaction is a type of chemical reaction where part of one reactant is replaced with another reactant:  AB + C → AC + B |
| 01:25 | | Why are displacement reactions being used in this experiment? | To investigate the reactivity of the halogens. |
| **The experiment** | | | |
| 02:39 | | How would you describe the colour and appearance of chlorine water? | Colourless, clear. |
| 02:50 | | How would you describe the colour and appearance of bromine water? | Clear, pale yellow. |
| 03:03 | | How would you describe the colour and appearance of iodine solution? | Clear, orange-brown. |
| 03:09 | | What will we be looking for during the tests?  How will you know if a chemical reaction has actually take place? | Signs that a chemical reaction has taken place.  A colour change, evolution of gas, formation of a precipitate. |
| 03:12 | | Why have some of the boxes in the table been shaded in? | A halogen will not displace itself from a compound. Therefore we do not need to test potassium chloride with chlorine water, for example. |
| 03:32 | | Why do you think distilled water is added to column 1? | To act as a control; so you can see the effect of dilution on the colour of the halogen waters. This should help to determine whether a reaction has taken place. |
| 03:46 | | Complete the first column of your table.  Why does the bromine water and iodine solution appear slightly paler? | Results on screen. It has been diluted. |
| 03:59 | 04:14 | Record observations in the table. | No colour change. |
| 04:19 | | Predict what changes will take place when potassium bromide is added to the halogen waters. | A reaction will take place with the chorine water but not the others. |
| 04:36 | 04:43 | Record observations in the table. | First row: colour change (colourless to pale yellow).  Second and third row: no change. |
| 05:06 | 05:10 | Complete the word and balanced symbol equation. | Potassium bromide + chlorine → potassium  chloride + bromine  2KBr(aq) + Cl2(aq) → 2KCl(aq) + Br2(aq) |

|  |  |  |  |
| --- | --- | --- | --- |
| 05:19 | | Predict what changes will take place when potassium iodide is added to the halogen waters. | A reaction will take place with the chorine water and the bromine water but not the iodine solution. |
| 05:32 | 05:40 | Record observations in the table. | First row: colour change (colourless to pale brown)  Second row: colour change (pale yellow to pale brown) |
| 05:48 | | Write down the word or symbol equations for the two reactions you have observed | Potassium iodide + chlorine → potassium  bromide + iodine  2KI(aq) + Cl2(aq) → 2KCl(aq) + I2(aq) Potassium iodide + bromine → potassium  bromide + iodine  2KI(aq) + Br2(aq) → 2KBr(aq) + I2(aq) |
| 05:56 | 06:05 | What is a redox reaction?  Define the words oxidation and reduction. | A redox reaction is one where oxidation and reduction occur at the same time.  An oxidation reaction is one in which there is a gain of oxygen or a loss of electrons.  A reduction reaction is one in which there is a loss of oxygen or a gain in electrons. |
| 06:11 | | When writing the ionic equation, why didn’t we include the potassium ion? | Ionic equations only include the ions or molecules that actually take part in the reaction. The potassium ions do not take part in the reaction as they are found both at the start and the end. Ions that do not take part are called spectator ions. |
| 06:31 | | Now write an ionic equation for the reaction of a) chlorine with potassium bromide and  b) bromine with potassium iodide. | Cl2(aq) + 2Br-(aq)) → Br2(aq) + 2Cl-(aq)  Br2(aq) +2I-(aq) → I2(aq) + 2Br-(aq) |
| 06:48 | 06:56 | From the results of this experiment, what can we conclude about the order of reactivity of the halogens? | Reactivity decreases as you go down the group.  Chlorine is more reactive than bromine, which is more reactive than iodine. |
| 06:57 | | Fluorine is found at the top of group 7 and astatine is found at the bottom. Predict the order of reactivity for the whole group. | Fluorine > chlorine > bromine > iodine > astatine |

## **Pause-and-think questions**

### Student version

*Pause the video at the time stated to test or revise your knowledge of these practical experiments.*

**Time Question**

00:14 Name the halogens and describe where they are found in the periodic table.

00:45 What do you think is meant by the term ‘displacement’? Write a definition in your own words.

01:14 Improve your definition.

Write a ‘general’ equation.

01:16 Why are displacement reactions being used in this experiment?

03:09 What will we be looking for during the tests? How will you know if what you are looking for has actually taken place?

How will you know if what you are looking for has actually taken place?

03:12 Why have some of the boxes in the table been shaded in?

03:32 Why do you think distilled water is added to column 1?

Results Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Halogen water** | **Distilled water** | **Potassium chloride solution** | **Potassium bromide solution** | **Potassium iodide solution** |
| Chlorine |  |  |  |  |
| Bromine |  |  |  |  |
| Iodine |  |  |  |  |

03:46 Complete the first column of your table.

Why does the bromine water and iodine solution appear slightly paler?

04:02 Record observations in the second column of your table.

04:19 Predict what changes will take place when potassium bromide is added to the halogen waters.

05:32 Record observations in the third column of your table. 05:06 Complete the word and balanced symbol equation:

potassium bromide + chlorine → +

2KBr(aq) + Cl2(aq) → +

05:19 Predict what changes will take place when potassium iodide is added to the halogen waters.

05:32 Record observations in the final column of your table.

05:48 Complete the word and balanced symbol equations for the two reactions you have observed.

potassium iodide + chlorine → +

2KI(aq) + Cl2(aq) → +

potassium iodide + → +

+ → +

05:56 What is a redox reaction?

Define the words oxidation and reduction.

06:11 When writing the ionic equation, why didn’t we include the potassium ion?

06:31 Write an ionic equation for the reaction of:

* 1. chlorine water with potassium bromide

+ → +

* 1. bromine water with potassium iodide

+ → +

06:48 From the results of this experiment, what can we conclude about the order of reactivity of the halogens?

06:57 Fluorine is found at the top of group 7 and astatine is found at the bottom. Predict the order of reactivity for the whole group.

06:58 Now try writing a longer answer to this question using the structure strips:

*Group 7 of the periodic table contains the elements known as the halogens. The order of reactivity of the halogens can be determined experimentally by carrying out displacement reactions.*

*Explain how displacement reactions can be used to show the relative reactivity of chlorine, bromine and iodine.*

**This question has a structure strip. Find more resources to support you here** rsc.li/3tZxFgu.