

# Chemical Reactions: How can we identify the products formed as a result of a chemical reaction?

**Introduction:** You have already seen many chemical reactions. You have also learned how to recognize the evidence of a chemical reaction. These include: a color change, the formation of a solid, bubbles are produced, change in pH or a change in temperature. Chemists describe these reactions using chemical formulas. You have learned how to read chemical formulas and how to balance them. But if we mix two or more reagents together, how can we figure out what products are formed? In this investigation, you will learn how to determine which products are formed during a chemical reaction.

**The Problem:** Determine the balanced chemical formula for the following reactions...

1.  $\text{HCl (aq)} + \text{Zn (s)} \rightarrow$
2.  $\text{HCl (aq)} + \text{NaHCO}_3 \text{ (s)} \rightarrow$
3.  $\text{CuCl}_2 \text{ (aq)} + \text{Al (s)} \rightarrow$
4.  $\text{Al (s)} + \text{H}_2\text{SO}_4 \text{ (aq)} \rightarrow$
5.  $\text{CuCl}_2 \text{ (aq)} + \text{Na}_2\text{CO}_3 \text{ (aq)} \rightarrow$
6.  $\text{CuCl}_2 \text{ (aq)} + \text{AgNO}_3 \text{ (aq)} \rightarrow$

**Materials available for use:**

- |                                      |  |  |
|--------------------------------------|--|--|
| <input type="checkbox"/> Drying oven | <input type="checkbox"/> Test tubes        | <input type="checkbox"/> Alcohol burners             |
| <input type="checkbox"/> Beakers     | <input type="checkbox"/> Erlenmeyer flasks | <input type="checkbox"/> <b>Lab goggles</b>          |
| <input type="checkbox"/> Well plates | <input type="checkbox"/> Rubber stoppers   | <input type="checkbox"/> Other supplies as requested |
| <input type="checkbox"/> pH paper    | <input type="checkbox"/> Wood splits       |  |

**Safety Precautions:** There is no specific safety issues related to the materials that you will be using during this activity.

**Getting Started:** You will not need to submit a proposal to your instructor for approval before you begin. Your first step in this investigation will be to gather evidence about the chemical reactions you will be studying. Create a data table in your notebook where you can record your observations about each chemical reaction. Be as detailed as possible. Make sure you write down everything. Was there a precipitate that was produced? Was there a gas released? Did the pH change? What physical states of matter are present in your beaker? Once your team has finished making your initial observations, your instructor will give you some helpful information that will help you to identify the various products formed as a result of these reactions

**Interactive Poster Session:** Once your group has completed your work, prepare a whiteboard that you can use to share and justify your ideas. Your whiteboard should include all the information shown in the diagram at right.

|   |  |
|---|--|
| <b>Goal of your Investigation</b><br>What were you trying to do?                  | Group Member's Names                                       |
| <b>Your Explanation</b><br>How do you explain the phenomenon under investigation? | <b>Your Evidence and Reasoning</b><br>How can you be sure? |

To share your work with others, we will be using a **Round-Robin** format. This means that one member of the group will stay at your work station to share your groups' ideas while the other group members will go to the other group one at a time in order to listen to and critique the explanations developed by your classmates.

Remember, as you critique the work of others, you have to decide if their conclusions are valid or acceptable based on the coherence of their explanation and how well they are able to support their ideas with appropriate evidence and reasoning. In other words, you need to determine if their argument is **persuasive and convincing**. To do this, ask yourself the following questions:

- Is their explanation **sufficient** (i.e., it explains everything it needs to) and **coherent** (i.e., free from contradictions)?
- Did they use **genuine evidence** (they organized their data in a way that shows a trend over time, a relationship between variables, or a difference between groups and did they use **enough evidence** to support their ideas (they used more than one piece of evidence and all their ideas are supported by evidence)?
- Is their evidence of **high quality**? In other words, is their evidence valid (they used appropriate methods to gather the data) and reliable (they attempted to reduce error in their measurements or observations)?
- Is there any **counterevidence** that does not support their explanation?
- How well does their explanation **fit with other theories and laws** that are used in science to explain or describe how the world works?
- Is their reasoning **adequate** (they explain why the evidence was used and why it supports the explanation) and **appropriate** (rational and sound)?

Once the Round-Robin poster-session is complete, the **President** of the session will lead a discussion in an effort to synthesize all the various perspectives into one "class" explanation that is the most valid or acceptable way to scientifically explain *each chemical reaction*.

**Report:** Once you have completed your research, you will need to prepare a **persuasive investigation report** that consists of three sections. Each section should provide an answer for the following questions:

Section 1: What were you trying to explain (or figure out) and why?

Section 2: How did you go about your work and why did you conduct your investigation in this way?

Section 3: What is your argument?

Your report should answer these questions in 2 pages or less. This report must be typed and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your explanation is acceptable or valid!

## Peer Review

Paper By: \_\_\_\_\_ Reviewed By: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

| Criteria   | No    | Poor  | Good  | Excellent |
|--|-------|-------|-------|-----------|
| <b>Section 1: Goals</b>  |       |       |       |           |
| Did the author <b>introduce the phenomenon</b> under investigation and the problem to be solved? | _____ | _____ | _____ | _____     |
| Did the author <b>make the research question</b> and/or goals of the investigation explicit?     | _____ | _____ | _____ | _____     |
| Did the author explain <b>why the work was done</b> and why this work is useful or needed?       | _____ | _____ | _____ | _____     |
| Explain why your group gave any "Poor" or "No" marks in the space below...                       |       |       |       |           |

### Section 2: The Investigation

|   |       |       |       |       |
|---|-------|-------|-------|-------|
| Did the author describe <b>how</b> they went about his or her work?   | _____ | _____ | _____ | _____ |
| Did the author explain <b>why</b> the work was done in this way?  | _____ | _____ | _____ | _____ |
| Did the author use <b>appropriate terms</b> to describe the nature of the investigation (e.g., experiment, systematic observation, interpretation of an existing data set)? | _____ | _____ | _____ | _____ |
| Explain why your group gave any "Poor" or "No" marks in the space below...  |       |       |       |       |

| Criteria   | No    | Poor  | Good  | Excellent |
|--|-------|-------|-------|-----------|
| <b>Section 3: The Argument</b>   |       |       |       |           |
| Did the author include a well-articulated explanation that provides a <b>sufficient answer</b> to the research question? (It explains everything that it should)                     | _____ | _____ | _____ | _____     |
| Is the author's explanation <b>coherent</b> and <b>free from contradictions</b> ?  | _____ | _____ | _____ | _____     |
| Did the author use <b>genuine evidence</b> (trends over time, differences between groups or objects, relationships between variables) to support the explanation?                    | _____ | _____ | _____ | _____     |
| Did the author <b>present the evidence</b> in an appropriate manner? (The author should have used correctly formatted diagrams, graphs or tables.)                                   | _____ | _____ | _____ | _____     |
| Does the author have <b>enough evidence</b> to support the explanation? (The author supported all of his/her ideas and used more than one piece of evidence)                         | _____ | _____ | _____ | _____     |
| Is the author's evidence <b>valid</b> (appropriate methods were used to gather the data) and <b>reliable</b> (the author attempted to reduce error in the measurements)?             | _____ | _____ | _____ | _____     |
| Does the author's explanation <b>fit</b> with all the available evidence?  | _____ | _____ | _____ | _____     |
| Is the author's reasoning <b>sufficient</b> (it explains why the evidence was used <b>and</b> why it supports the explanation) and <b>appropriate</b> (rational and sound)?          | _____ | _____ | _____ | _____     |
| Is the author's explanation <b>consistent</b> with what the other groups found and what was discussed in class?  | _____ | _____ | _____ | _____     |
| Did the author leave out <b>inappropriate phrases</b> (e.g., it proves it, it's right, it's correct, my proof is) and use <b>key terms correctly</b> (e.g., hypothesis, prediction)? | _____ | _____ | _____ | _____     |
| Explain why your group gave any "Poor" or "No" marks in the space below...   |       |       |       |           |

### The Writing

**Content:** Did the author express their ideas clearly and provide the reader with valuable insight?

**Organization:** Does the writing have a sense of purpose and structure?

**Voice:** Does the reader get a sense that someone real is there on the page?

**Word Choice:** Did the author choose just the right words to make the writing sound natural and precise? Did the author use scientific vocabulary correctly?

**Sentence Fluency:** Did the author create a sense of rhythm with the sentences and a flow that is enjoyable for the reader?

**Conventions:** Did the author use appropriate grammar, spelling, punctuation, paragraphing and capitalization?

Final Decision: \_\_\_\_\_ Accept \_\_\_\_\_ Revise and Resubmit