Science in School
The European journal for science teachers

ISSUE 68 – April 2024 **Topic** Chemistry

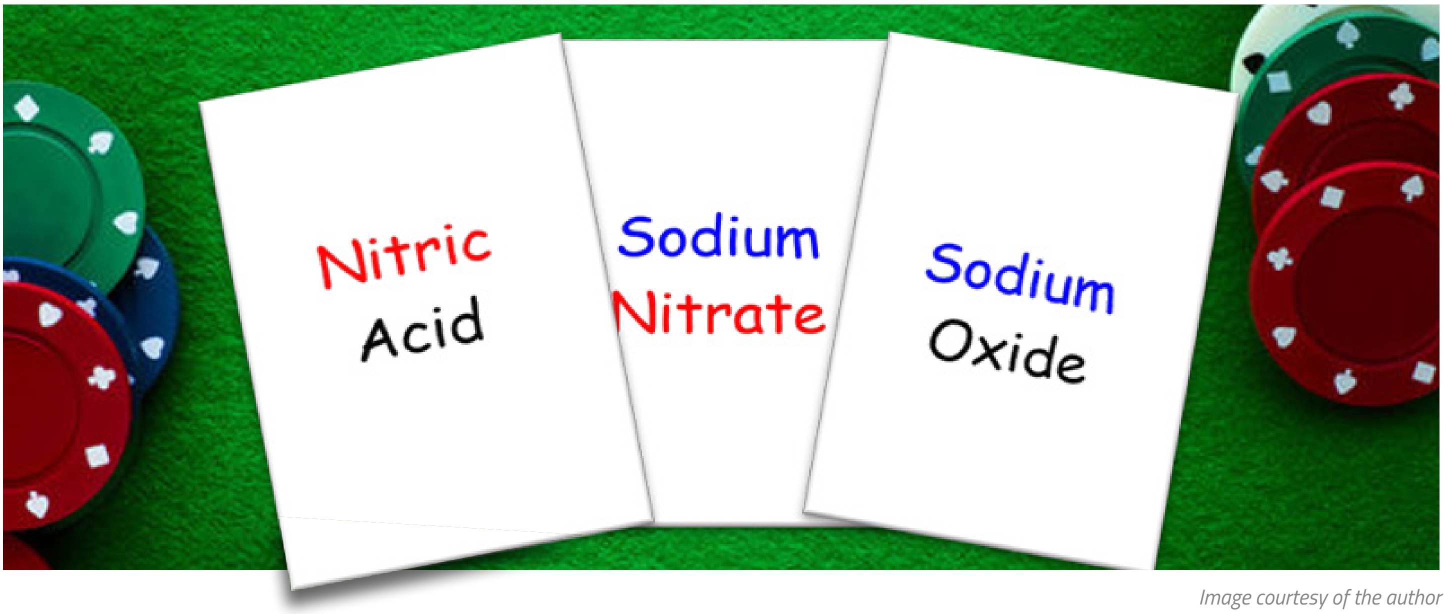


Image courtesy of the author

Stealth learning – how chemical card games can improve student participation

Peter Johnson

Play your cards right: Everyone enjoys playing games, so use chemical card games to get students to learn through play without them realising.

My love of using card games in an educational setting came about when I started to research active learning as opposed to passive learning. I came across an article in *Education in Science*, the Association for Science Education (ASE) magazine, which discussed the use of element symbols as the numbers for a game of bingo. With no idea how it would work in a class situation, I tried it out with a year 8 chemistry class. The results were quite amazing, with all students actively participating and getting very excited as they got closer to getting a 'full house'! I used clues about the uses or properties of the elements, rather than just saying the name or giving the atomic number of the element, and this meant that the students were also learning other information without realizing. When I tried the same game with older students, I got the same response, which led me to try and develop more games. Three of these games are described below and cover the topics of types of bonding, rates of reaction, and the formation of salts from acids and bases.

Sixth-form students at Stewart's Melville College in Edinburgh playing chemical card games.
Image courtesy of the author

Activity 1: Element bingo

This is a fun way for students to learn the symbols of some common elements and their position in the periodic table. Students work individually and this game lasts 10 minutes. It is suitable for students aged 12 and above.

Materials

- Printed sheets of bingo cards, cut up to form unique individual cards (one per student)
- Access to a periodic table
- One bingo calling sheet for the bingo caller

Procedure

S	Ni	Cl
W	N	Hg
Au	P	Ar

1. Hand out a unique bingo card to each student.
2. The teacher randomly calls out an element from their sheet.
3. Students cross off the symbol of the element if the teacher calls it out.
4. Prizes can be awarded for the first student to get a line of three, or all four corners; they can shout "line" or "corner" at this point. The winner is the first student to cross off every symbol correctly and shout "BINGO"!
5. Alternative more advanced games are to use the element's atomic number, or give information about the properties and/or uses of the element instead of naming it.

Discussion

Questions to ask students could include the following:

- Identify where in the periodic table each of their elements is found.
- Identify a property or use of each element.

Activity 2: Bonding cards

Names of different elements and compounds are given on the cards. The cards are first used in some sorting exercises to recap knowledge. Students then play a game, similar to rummy, to review and revise their familiarity of the different types of bonding; metallic, ionic lattice, covalent small molecular and covalent giant molecules (networks).

Students work in groups of two or three and the game lasts 10 minutes. It is suitable for students aged 14 and above.

Materials

- Printed sheets of bonding cards, cut up to form individual cards
- One set of cards for every two or three students

Procedure

Recap your knowledge task

1. Hand out one set of bonding cards to each group.
2. Students place the cards face up, so they can see all of them.
3. Students discuss and group the cards into four groups based on bonding type, such as metallic, ionic lattice, covalent small molecular, and covalent giant molecules (networks).
4. Ask students to separate the elements from the compounds.
5. Optional: ask students to identify the diatomic elements.

6. Optional: ask students to identify the groups in the periodic table where the metals are found.
7. Optional: give chemical and physical information about one substance and get students to identify it.

Rummy card game

1. Students try to get sets of three cards with the same bonding type.

2. Groups of four students shuffle the cards and then deal out six cards to each player.
3. The rest of the pack is placed face down, and the first card is turned over.
4. The first player then chooses to take that card or the next unseen card to help complete a set of three cards with the same bonding type.
5. They then place an unwanted card face up next to the rest of the pack, and the next player gets to go.
6. When a player has two sets of three cards with the same bonding type, they are the winner.

Discussion

Peer discussion is an important part of the activity, especially in the initial sorting tasks. If there is any disagreement on a particular categorization within the group, encourage the students to discuss it, with each party giving their reasons, and reach an agreement.

Activity 3: Reaction-rate sentence cards

This is a great revision or quick reminder game on speeding up reactions. Paragraphs describing collision theory and how it explains how concentration, particle size, and temperature affect the speed of a reaction have been cut up into strips. Students work in groups of two or three. The game lasts 15 minutes and is suitable for students aged 12 and above.

Materials

- Printed sheets of reaction-rate sentences cut up to form individual cards
- One set of cards for every two or three students

Procedure

1. Hand out one set of reaction-rate sentence cards to each group.
2. Students place the cards face up, so they can see all of them.

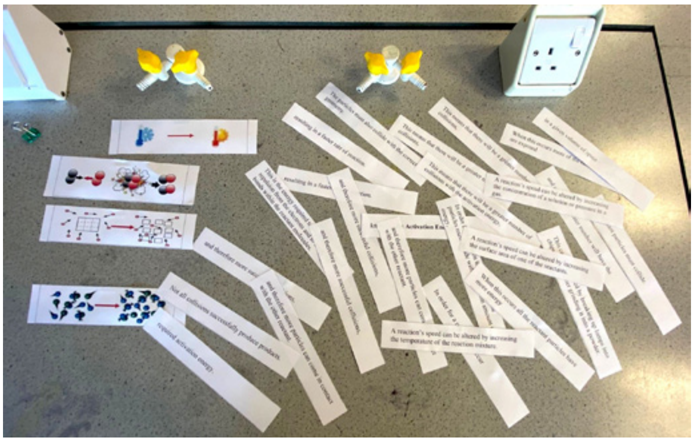
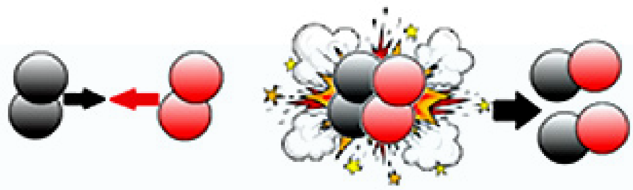


Image courtesy of the author

3. Students discuss and place the cards into four sets based on reaction-rate explanations.
4. Each set should have a relevant picture and consist of seven text sections that, when read together in order, explain how *collision theory, temperature*, *surface area*, or *concentration* affect the rate of reaction.



In order for a reaction to occur

the reactant particles must collide.

Not all collisions successfully produce products.

In order for a collision to be successful the particles must collide with a minimum amount of energy,

known as the **Activation Energy**.

This is the energy required to overcome forces of repulsion from the electrons and to break any bonds within the reactant molecules

The particles must also collide with the correct geometry.

Image courtesy of the author

Discussion

Students could be given a particular chemical reaction. They should explain how they would speed up the reaction in simple terms and then go into the specific practical details of how this could be carried out.

This method can be used for a number of different topics. Once the groups have completed the task once, it can be used as a review exercise at the start of the next lesson, where teams race each other to be first to complete the task.

Activity 4: Salt cards

Introduction

This game is a similar to happy families, where three members of the same family are made into a set. It looks at the reaction of acids with bases to form salts. A variety of acids and different bases can be combined to form the desired salt. Students work in groups of two or three. The game lasts 10 minutes and is suitable for students aged 12 and above.

Materials

- Printed sheets of salt cards, cut up to form individual cards
- One set of cards for every two or three students

Procedure

Recap your knowledge task

1. Hand out one set of salt cards to each group.
2. Students place the cards face up, so they can see all of them.
3. Students discuss and group the cards into groups of three, containing an acid, a base, and the correct salt they would form.
4. Optional: give the name of a salt and ask for as many different reactions that would give this salt.
5. Optional: ask students to devise an experiment where they could make and isolate a named salt.

Happy families card game

1. Students try to get sets of three cards with an acid, a base, and the salt they form making up their family.

2. Groups of four students shuffle the cards and then deal out six cards to each player.
3. The rest of the pack is placed face down, and the first card is turned over.
4. The first player chooses to take that card or the next unseen card to help complete a set of three cards for the formation of a salt from an acid and a base.
5. They then place an unwanted card face up next to the rest of the pack, and the next player gets to go.
6. When a player has two sets of three cards with the correct combination of acid, base, and salt formed, they are the winner.

Summary

I have nearly 80 different games now, covering all age ranges and areas of the chemistry curriculum. The students love playing them, and I have never had anyone complain that “it’s boring” or “it’s too easy”. As my skills in developing different types of games evolved, I started to use them as a way to encourage those deeper learning conversations that students need to have with their peers to help them actively understand concepts. I find it very empowering to hear students arguing over where a card should go and then backing up their view with chemical knowledge, and the other student suddenly ‘getting it’.

I hope you want to try out these games and use the blank templates to create your own. I am sure that, like me, you will find that:

- Students love playing games and will readily take on each game without realising that underneath the fun they are actually learning.
- The student’s learning is interactive.
- Important ideas can be easily reinforced at the start of each lesson, in a fun way.
- Revision lessons are more effective and accessible for all.

«

Resources

- See the author’s website for other games and resources.
- Discover simple adaptations of experiments to make chemistry accessible to students with vision impairment: Chataway-Green R, Schnepp Z (2023) Making chemistry accessible for students with vision impairment. *Science in School* **64**.

- Read an article on how to run effective demonstrations in science lessons: Walsh E (2021) The art of science demonstration. *Science in School* **55**.
- Read an introduction to microscale chemistry in the classroom: Worley B (2021) Little wonder: microscale chemistry in the classroom. *Science in School* **53**.
- Learn about click chemistry and how it has revolutionized biomolecular research: Godinho T (2022) Click does the trick: understanding the 2022 Nobel Prize in Chemistry. *Science in School* **60**.
- Read about the colour blue in nature and the chemistry behind it: Bettucci O (2022) Colour in nature: true blue. *Science in School* **60**.
- Learn about the problem of pseudoscience in the media: Domenici V (2022) Fake news in chemistry and how to deal with it. *Science in School* **59**.
- Read about the environmental costs of fireworks: Le Guillou I (2021) The dark side of fireworks. *Science in School* **55**.
- Learn how some of the elements used in modern technology are scarce and finite resources: Furze J, Harrison T (2021) Elements in danger! *Science in School* **54**.
- Learn more about helium and why we need to conserve it: Lord M (2021) Elements in focus: helium. *Science in School* **53**.
- Use baker's yeast to demonstrate biofuel cells in the classroom: Grandrath R, Bohrmann-Linde C (2023) Simple biofuel cells: the superpower of baker's yeast. *Science in School* **66**.
- Learn about a variety of biochemical aspects of honey through a series of simple experiments: Scheuber T (2023) To bee or not to bee: the chemistry of honey. *Science in School* **65**.
- Enhance your students' understanding of electrolysis using microscale chemistry techniques: Worley B, Allan A (2022) Elegant electrolysis – the microscale way. *Science in School* **60**.
- Try classroom activities on how using and controlling fire: Paternotte I, Wilock P (2022) Playing with fire: stoichiometric reactions and gas combustion. *Science in School* **59**.
- Isolate limonene and other fragrance compounds from plant material: Butturini F, Fernández JJ (2022) Citrus science: learn with limonene. *Science in School* **58**.
- Explore chemical reactions using tea: Prolongo M, Pinto G (2021) Tea-time chemistry. *Science in School* **52**

AUTHOR BIOGRAPHY

Peter Johnson is a teacher, educator, and author. In 2005, he set up Kitchen Chemistry to promote the use of innovative activities for the teaching of science. He has written a number of revision books for chemistry and run continuing professional development (CPD) courses to help chemistry teachers bring fresh approaches to their teaching.