**ACTIVITY: Iodised salt**

**Activity idea**

In this activity, students test a variety of commercially available table salts for the presence of iodine – a micronutrient essential for health and wellbeing.

By the end of this activity, students should be able to:

* recognise the difference in structural terms between the element iodine and one of its ionic forms known as iodide ion
* describe a simple chemical test to detect the presence of iodine in iodised salt and explain in simple terms the chemistry underlying the test
* effectively manipulate simple laboratory equipment
* successfully test commercially available table salts for the presence of iodine
* demonstrate an understanding of the role iodine plays in the body.

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**Introduction/background**

Iodine is a micronutrient essential for normal function of the thyroid gland. Insufficient supply of iodine via the diet and drinking water causes the thyroid gland to enlarge (goitre), and production of several thyroid hormones is interrupted. This results in disruption to the body’s metabolic rate.

Iodine in the form of either potassium iodide or potassium iodate is added to table salt to produce iodised salt. This provides consumers with a convenient dietary supply of this essential micronutrient.

In the first part of this activity, the difference in meaning between the terms ‘iodine’ and ‘iodide’ is highlighted through a series of simple tests.

The element iodine is a shiny, purple black solid, which, on gentle heating, sublimes to give a purple vapour.

I2(s) → I2(g)

The presence of iodine in solution [I2(aq)] can be detected by adding a few drops of starch solution. The development of a blue/black colour indicates the presence of iodine.

When potassium metal is exposed to iodine vapour, a chemical reaction occurs, and the product is the ionic compound potassium iodide.

2K(s) + I2(g) → 2KI (s)

 potassium iodide

Potassium iodide is a white solid, readily soluble in water to form an electrically conductive solution, typical of ionic solutions.

The presence of iodide ion in a given solution can be detected using lead nitrate solution. The solution to be tested is acidified with dilute nitric acid and then a drop of lead nitrate solution is added. If iodide ion is present, a bright yellow precipitate forms.

Pb2+(aq) + 2I-(aq) → PbI2(s)

lead ions iodide ions lead iodide solid (yellow)

The presence of iodate ion can be detected by reducing the iodate ion to iodine and then using starch solution to indicate the iodine formed. The reducing agent is acidified iodide ion.

IO3-(aq) + 5I-(aq) + 6H+(aq) → 3I2(aq) + 3H2O(l)

**What you need**

* Iodine crystals
* Potassium iodide solid
* 0.1molL-1 nitric acid
* 0.1molL-1 lead nitrate
* 0.1molL-1 potassium iodide solution
* 1% starch solution
* 1% iodine solution (tincture of iodine)
* ‘Iodised’ table salt, ‘sea’ salt, ‘normal’ table salt
* Distilled water
* Spatula
* Test tubes; test tube rack
* Stoppers; eye dropper
* 250mL conical flask and bung
* Bunsen burner
* 250mL beaker
* Conductivity test kit
* Small amount of crushed ice
* Copies of the student worksheet: [Testing for iodine](#testing)

**What to do**

1. Circulate a sealed vial of iodine solid for students to view.
2. Place a few crystals of iodine in the conical flask and lightly stopper. Heat very gently by passing the handheld flask through a low Bunsen flame to promote sublimation. View the purple vapour formed.
3. Carefully remove the stopper and hold a test tube full of crushed ice in the upper reaches of the flask.
4. View the iodine crystals that form on the surface of the test tube.
5. Test the electrical conductivity of an iodine crystal.
6. To indicate the presence of iodine in a given solution, add a few drops of starch solution and note the appearance of a blue/black colour.
7. Circulate a sealed vial of potassium iodide crystals for students to view.
8. Place a few crystals of potassium iodide in a conical flask and heat gently at first and then more strongly. Note that no change of state has occurred.
9. Place 100mL of distilled water in the 250mL beaker. Test the electrical conductivity of the water in the beaker.
10. Add several spatula loads of potassium iodide to the water and stir to dissolve. Test the electrical conductivity of the potassium iodide solution formed.
11. To indicate the presence of iodide ion, add 5mL of dilute nitric acid followed by 5mL of 0.1 molL-1 lead nitrate solution. A bright yellow precipitate forms.
12. Emphasise the following:
* The physical properties of iodine are not the same as those of potassium iodide. They are different types of substance. Iodine is a molecular solid, potassium iodide is an ionic solid.
* Potassium iodide solution conducts electricity due to the presence of charged particles called ions.
* Adding lead nitrate solution can show the presence of iodide ion. A bright yellow precipitate of lead iodide forms.
* The presence of iodine in solution can be detected using starch solution.
* Iodine and iodide are **not** the same.
1. Hand out copies of the student worksheet: [Testing for iodine](#testing) and have students work in pairs to complete the experiment and answer the questions. Discuss the results.

**Testing for iodine**

1. Half fill each of 3 racked test tubes with distilled water.
2. Place a full spatula load of ‘iodised’ salt into one of the test tubes, stopper and shake to dissolve the salt. Repeat with the other two salt samples.
3. Remove the stoppers from the racked test tubes and to each add 5 drops of dilute nitric acid using an eyedropper.
4. Add 5mL of potassium iodide solution to each test tube.
5. Stopper and shake each tube.
6. Remove the stoppers and add 5 drops of 1% starch solution using an eyedropper.
7. The development of a blue-black colour indicates the presence of iodine. Take note of those salt samples that gave a positive test for iodine.

***Questions to consider***

1. In what ways does iodide differ from iodine?
2. In which commercially available ‘salts’ was the presence of iodine detected?
3. What other ingredients are included in ‘iodised’ table salt apart from salt and potassium iodate? Why are they needed?
4. The recommended daily intake of iodine for an adult is 150μg. From the information on the salt packet label, calculate the amount in grams of iodised salt needed to meet this requirement.
5. The thyroid hormones are required for normal growth and development of individual tissues such as the central nervous system, bone and muscle. They are also involved in energy production and oxygen consumption in cells, and this helps to maintain the body’s metabolic rate. Where in the body is the thyroid gland located?
6. The principal hormone produced by this gland is known as 3,5,3',5'-tetraiodothyronine. Which part of this name indicates that iodine is present?