# Grade 4: Rocks, Minerals and Erosion

## Lesson: Potash Solution Mining- Dissolving Potash

## Overview

**Students will discover through guided inquiry and hands on activities how Saskatchewan's potash resource can be mined by dissolution. They will filter out the waste materials and describe the crystals formed when the salty solution evaporated.**

**Source:** This lesson plan has been adapted from an activity developed by Murray Schultz (Chief Chemist, Mosaic Potash Belle Plaine) for the SMA Teacher GeoVenture Tour and Showcase 2008, and from a lesson plan developed by Larry Bogdan (Teacher, Avonlea School, Prairie South School Division).

### Duration:

**Part 1: - one class period**
**Part 2: – one class period**
**Part 3: - one class period**

### Materials:

- 2 Clear glass jars(250ml) or glass beaker per group
- 250 ml measuring cup or graduated cylinder
- 1 litre wide mouthed glass or plastic container
- 2 lumps of Potash (sylvinite) per group (approximately 3cm x 3cm)
- Larger sample of potash for teacher display
- Room temperature water - 200 ml
- Coffee filter paper one per group
- One plastic coffee filter holder or a large funnel (more would make the activity proceed more quickly)
- Spoon or plastic stir stick per group
- Magnifying glasses or hand lens
- Materials to test hardness of minerals, nail, penny,
- **Teacher 's Sheets**
- **Student Handouts**
- **Potash Solution Mining in Saskatchewan diagram**
- **Photos**

**Note to Teachers:** These activities should be done after an introductory lesson on Potash (See lesson **Potash: What is It?)**

### Prior Knowledge:

Before attempting these activities students should have some understanding of the following:

- What potash is, where it is found
- Rocks and minerals
- Evaporation
- Dissolution of salt by water

### Instructional Methods:

- Brainstorming
- Discussion
- Guided inquiry
- Laboratory investigation

**Dredge on cooling pond. Mosaic Potash Belle Plaine**

**Photo: Mosaic Potash Belle Plaine**

## Learning Outcomes and Indicators

**RM 4.1 Investigate physical properties of rocks and minerals, including those found in their local environment.**

b) Document the locations and characteristics of rocks that exist in their local environment.

c) Observe and record physical properties of rocks and minerals such as colour, lustre, hardness, cleavage, transparency, and crystal structure.

d) Use appropriate tools (e.g., hand lens, safety glasses, brush, rock pick, knife, and gloves) safely while making observations and collecting information on the physical properties of rocks and minerals.

f) Demonstrate processes for testing the hardness of rocks, including reference to guides such as Moh's scale of mineral hardness

g) Record observations of rocks and minerals using jot notes, labelled diagrams, and charts.

Source: **Saskatchewan Evergreen Curriculum**

**Other:**

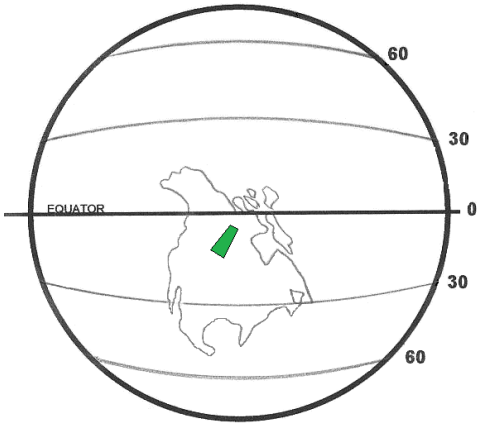
- Discover that the potash mineral mined in Saskatchewan is a salt and can be mined and separated from other minerals by being dissolved in water.
- Examine samples of potash ore and materials produced through dissolution and record qualitative physical properties of those objects in a chart.
- Describe what happens to the potash ore when it is dissolved in water.

## Big Picture Question

1. **How is potash mined if it is too deep in the ground to mine in the conventional underground method?**

## Background Information

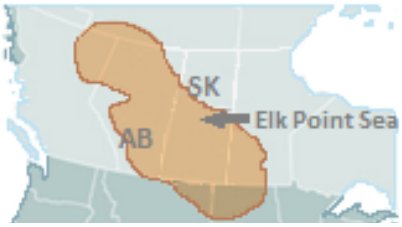
Around 380 million years ago Saskatchewan was located south of the equator.




**Devonian**

(Modified from Storer, J., 1989)

It was a tropical time with coral reefs forming. A large salt water sea covered Saskatchewan stretching from the Arctic to the Gulf of Mexico.




Modified from Globe and Mail, Friday, Nov. 05, 2010

Due to coral reefs occurring to the west and north of the Elk Point Sea and a land high towards the east, the flow of water into the sea became restricted with little to no influx into the deeper parts of the sea (the southern part of Saskatchewan). Concentrations of mineral salts increased until crystal layers began to form on the sea floor, similar to how salt or sugar crystals form in a glass when a saturated solution evaporates (Storer, J., 1989). The evaporites, which include Saskatchewan's potash deposits, formed for over 2 million years until normal circulation of the sea water returned as did sea life. No fossils are found in the Prairie Evaporite unit. It is thought that animals and plants could not live in the sea at that time due to the high salinity (Storer, J., 1989).

Potash is a general term covering several types of potassium salts, of which the most important is potassium chloride, the mineral sylvite (KCl). In Saskatchewan, potash is extracted from deep underground deposits (generally 1000 m or 1 km) using

either conventional (mining machines) or solution mining (brine is used to remove the mineral in solution) techniques.

The largest potash solution mine in the world is in Saskatchewan. With this technique the potash is dissolved deep underground and the solution is pumped to the surface where the potash is removed. The same process can be used above ground to extract the potash from the sylvinite ore. After potash is mined, it is processed in a surface mill, where it is separated into product (KCl) and waste (tailings comprised of salt and clays).

In 2010 there were 10 potash mines in Saskatchewan; two are solution mines, and the remaining 8 are conventional underground mines that use machines to mine the ore.

Potash is a nutrient essential for plant growth, and is a main component of modern agricultural fertilizers. Roughly 95 per cent of world potash production goes into fertilizer, while the other five per cent is used in commercial and industrial products - everything from soap to television tubes.

Potash is a major export of Saskatchewan. It is transported by rail to the United States and to Canadian ports where it is shipped to other countries including China, Korea, Japan, Malaysia, India, Brazil and Australia. Canadian markets make up less than 5% of potash sales.

## Safety concerns

- Do not eat potash sample
- Do not drink solution

## Vocabulary

| | |
|---|---|
| brine | dissolve |
| halite | ore |
| potash | solution |
| sylvite | sylvinite |
| waste rock | |

## ACTIVITY ONE

### Dissolving Potash

(Brainstorming, Hands-on lab) (60 minutes)

**Motivational Set (10 minutes)**

Inform students that around 380 million years ago there was a large salt water sea covering Saskatchewan. At that time Saskatchewan was located in the tropics. The hot climate caused the water to evaporate resulting in the growth of the salt minerals which settled on the bottom of the sea. The layers of salt minerals formed the Prairie Evaporite Unit where Saskatchewan's potash is found.

Explain that potash ore (sylvinite) is a mixture of halite (NaCl, table salt), sylvite (KCl), clay and iron minerals. Discuss the properties of table salt (NaCl) guiding the students to the conclusion that it can be dissolved in water. Explain that clay and iron minerals can't be dissolved in water. Inform the students that sylvite (KCl) is also a salt, and that the sylvite is the valuable mineral that the mining company wants.

Show the student a large lump of potash ore pointing out the salts (white and colourless), clay (grey) and iron (red) minerals. Brainstorm various methods of separating the potash from the other undesirable minerals (clays, iron minerals).

*The students should come up with the answer: by dissolving the salts and then separating the clay and iron minerals.*

Explain that one of the jobs of a potash company's Chemical Engineer, Chemical Technologist, Chemical Technician, Chemist, Geochemist and other general operations personnel is to come up with the best way to separate the valuable minerals from those that are not.

Today they, the students, are going to be the company Chemists.

**Part 1**: **Observation of dissolution of potash (30 min.)**

1. Have students work in groups of four.
2. Hand out Student Activity, Observation and Discussion sheets
3. Hand out 2 samples of potash ore to each group. Have students fill in *What do we know about the*

*minerals in the potash ore*? and *Hypothesis*.

4. Have students commence with lab. Students will place one lump of potash ore in a jar containing water and will observe and record the dissolution process.
5. While the potash sample is dissolving and students are waiting to write down their observations, have them describe the second lump of potash that they have been given. ***These samples will be returned to the teacher after description.***

**Part 2: Filtration of mixture (20 min. checking on sample over a period of days)**

1. At the beginning of the next class have students record their observations prior to moving the jar to their work station. Continue on with the lab.
2. Have students filter their mixtures by placing the filter in a coffee filter holder/funnel on top of their empty jar. Carefully pour all of their solution and the insoluble products (clay and iron minerals) into the filter. If insoluble particles remain in the jar use some of the solution to rinse them out.
3. Explain that the material in the filter is the clay and iron oxide and that they do not dissolve in water. . *Ask the students to look at their filters , do they have a lot of iron oxides and clay? Explain that the mining company does not want them as they cannot sell them. These minerals are waste and end up on waste rock piles. If the students don't have much in their filter that means they have a good piece of potash ore.*
4. Students should pour half of their solution into a clean 1 litre container.
   ***This container of solution will be used in the teacher demonstration. Once you have one litre of solution any extra can be poured down the drain. If you want the student sample to evaporate more quickly have them pour out more of their solution leaving approximately 2 cm of liquid.***
5. Have students put their names on their jar, mark the level of the solution on the jar, and set in a safe place.
6. Explain that in some places in Saskatchewan, the potash resource is too deep (greater than 1.5 km) to mine by the conventional underground method. As potash is very valuable, the mining companies use the method of dissolving the potash deep in the ground.
7. Show the students the diagram of how the potash is extracted from the ground in solution.
8 . Explain that this how Mosaic Potash Company mines the potash at Belle Plaine. Warm brine is injected down a well into the potash ore where it dissolves the salts NaCl and KCl. The solution is then pumped back up to the surface and to the mill where it is processed to recover the dissolved KCl. In the winter the KCl and NaCl rich brine solution from underground is pumped out into holding ponds where the cold temperature of the air cools the warm brine and causes the sylvite (KCl) to precipitate out. In the summer the precipitation is done inside the mill.
9. Over the next several days, or until the solution completely crystallizes have the students record their observations.
10. Continue with the Student Activity Sheet and Discussion Questions.

**Part 3: Looking at the crystals formed by evaporation of the solution (30 minutes)**

1. Once all the solution has crystallized have the students empty the salt crystals onto a piece of dark paper and record their observations, noting size, colour, shape, luster and transparency of the crystals. Encourage them to use the magnifying lens and draw pictures.
2. The crystals will be both salts (halite NaCl, and sylvite (KCl).
   *Explain to the students the need to take good notes and make good drawings as they will be comparing these minerals with minerals from the lesson "Recovering Dissolved Potash"*

## Assessment Method and Evidence

✓ Anecdotal notes and/or checklist
- students will demonstrate the ability to work in a cooperative learning environment.
- students will show safe and appropriate use of tools while collecting information and making observations on the physical properties of potash.

✓ Observation Chart:
- Students will document the characteristics of potash ore (sylvinite) that occurs in Saskatchewan and possibly in their local environment.
- Students will observe and describe the physical properties of the potash ore (sylvinite) prior to and during dissolution as well as the characteristics of the resulting salt precipitates and realize that the original potash ore minerals

differ from the precipitated salts.

- Students will record their observations of the potash ore and resulting precipitating crystals using jot notes and labelled diagrams on the Observation Chart.
- Students will take a sample of potash ore and separate the soluble salts from the insoluble waste materials through dissolution and precipitation.

✓ Discussion questions:

- Students will show they understand that the potash ore occurs at different depths in Saskatchewan and if the potash ore is more than one kilometers deep, solution mining is one method used to extract it.
- Student's answers will show their understanding that the potash mineral mined in Saskatchewan is a salt and can be mined and separated from other minerals through dissolution in water.
- Students understand that a Geochemist/Chemical Engineer/Chemist or Chemical Technician and chemistry play an important role in the production of potash.

## Summary

In a hands on laboratory students investigated how to mine potash deposits that are too deep to mine conventionally and how to separate the salts from the waste clays and iron oxides. Students compared the minerals in the potash ore samples to the minerals precipitated from solution allowed to evaporate (halite and sylvite

## Resources

### Web Resources:

Agrium Website: http://www.agrium.com

Globe and Mail, (Nov. 05, 2010): Riches under the prairie: Where potash comes from. Available at: http://www.theglobeandmail.com/globe-investor/potash/riches-under-the-prairie-where-potash-comes-from/article1788180/

International Fertilizer Association Website: http://www.fertilizer.org/ifa/default.asp

MacKenzie, J. (2003): Nourishing the Crops of the World: Saskatchewan's Potash Industry; Western Development Museum. Available at: http://www.wdm.ca/skteacherguide/WDMResearch/Nourishing%20the%20Crops%20of%20the%20World%20-%20Saskatchewan's%20Potash%20Industry%20by%20Janet%20MacKenzie.pdf

Mining and milling processes used at the PotashCorp mines. http://www.potashcorp.com/media/POT_Mini_Mine_Tour_brochure.pdf

Mosaic Potash Company Website: http://www.mosaicco.com

Potash Corporation of Saskatchewan Website: http://www.potashcorp.com/

Saskatchewan Mining Association Website: http://www.saskmining.ca

Saskatchewan Potash Interpretive Centre: http://www.potashinterpretivecentre.com/index2.htm

### Book/Report Resources:

Fuzesy, A. (1981): *Potash in Saskatchewan*; Saskatchewan Energy and Mines Report No.181, 44p.

Holter, M.E. (1969): *The Middle Devonian Prairie Evaporite of Saskatchewan*; Department of Mineral Resources-Geological Sciences Branch-Industrial Minerals Division-Province of Saskatchewan; Report No.123, 134p.

Storer, J. (1989 ): Geological History of Saskatchewan; Royal Saskatchewan Museum, Regina SK. 90p.

## Teacher Answer Sheet
## Dissolving and Precipitating Potash

**Problem:** How can the valuable potash mineral sylvite be separated from the rest of the rock?

**What do we know about the minerals in the potash ore**? *Sylvite is a salt and will dissolve in water. Halite is also a salt that dissolves in water. Clay and iron minerals do not dissolve in water.*

**Hypothesis:** (How you think you could do it and why it will work)
*If we place the potash ore in water then the salts (potash and halite) will dissolve and can be separated from the clay and iron* minerals which will not dissolve.

**Materials**: 2 Clear glass canning jars (250ml), measuring cup or graduated cylinder, lump of potash (sylvinite), 200 ml room temperature water, filter paper, spoon or stir stick, magnifying lens or geologists hand lens, tools to measure mineral hardness (nail, penny, fingernail).

**Procedure:**

**Part 1.**
1. Measure 200 ml of warm, not hot, tap water into a 250 ml jar. Put your names on the jar.
2. Carefully place your sample of sylvinite into the jar. Do not shake or stir the jar.
3. While you are waiting for something to happen describe the other potash sample a) dry, b) wet (drop a little water on it) Don't forget to check and see what is happening in the jar.
4. Watch what is happening to the sample in the jar for 20 minutes. Write down what you see on the observation sheet. Draw what you see. Label your drawing.
5. When the class is over place your jar in a safe place where it will not be moved until the next class.
6. Keep checking on your jar until the next science class. Write down what you see (your observations) along with the time and date.

**Part 2**
1. At the beginning of the next class write down your observations before you move the jar.
2. Stir the mixture to break up any of the bigger pieces, let it settle while you write down your observations.
3. Answer Discussion Question 3.
4. Put your names on the coffee filter.
5. Describe what you see in your jar and draw a picture.
6. When your turn is called, place your filter into the coffee filter holder and place the coffee filter holder on top of a clean jar. Carefully stir the bits of rock left in the jar and pour it all into the filter trying to get all of the rock bits into the filter. Place your filter in a safe place where it can dry.
7. Take a look at the liquid in your jar and write your observations.
8. Pour half the liquid in your jar into the teacher's container.
9. Draw a marker line on your jar where the top of the liquid is.
10. Describe what you think is going to happen in the jar if it is left alone for a while.
11. Check your filter when it is dry and record your observations. Answer Question 4.
12. Check your jar over the next several days observing and writing down what is happening. Draw pictures.
13. When all the water is gone, empty out the crystals onto a piece of dark paper. Use a magnifying lens to look at the crystals and describe them on your Observation Chart. Look at the colour, shape, hardness, lustre, transparency (can you see through it or not), and size.
14. Answer Questions 5 – 7.

# Observation Chart – Teacher's Answer Sheet

| Part 1. | Looking at the Potash Ore Sample | | | | |
|---|---|---|---|---|---|
| Time + Date | Observations (What you see) | | | | |
| **Description of dry sample** How many minerals can you see? Describe them using: colour, hardness, crystal shape lustre, transarency | **Colour** | **Hardness** | **Crystal Shape** | **Lustre** | **Transparency** |
| | *Red-orange Iron oxide* | *<2* | *No real shape occurs in between other minerals* | *Dull, earthy* | *opaque* |
| | *White Halite or sylvite* | *2-2.5* | *May be able to see a cubic shape* | *Dull to glassy (vitreous)* | *Opaque – Translucent, milky* |
| **Description of wet sample** You should be able to see the minerals a bit better. Add any other descriptions. | *Colourless (clear - will look greyish) Halite, sylvite* | *2-2.5* | *May be able to see a cubic shape* | *glassy* | *transparent* |
| | *Grey –Beige clays* | *<2* | *No real shape occurs in between other minerals* | *Dull, earthy* | *opaque* |
| **Draw a picture of what the rock looks like** | | | | | |

| Part 1. | Looking at the Dissolving Potash Ore | |
|---|---|---|
| **Time + Date** | **Observations (What you see)** | **Drawings** |
| **Start to 5 minutes** | *Tiny bubbles rise to the top, colours of the sample are more distinct, tiny white flecks like dust moved off the sylvinite and sank, white flecks are rising to the surface.*<br>*Looking closely at the face of the potash ore there is a "wavy, flowing" look. This is the salt on the edge of the sample dissolving in the water. As the water dissolves the crystals you will see small cloud like eddies form which appear to fall down to the bottom of the beaker.* | |
| **10 to 15 minutes** | *Larger red particles are rising and sinking, most particles are less than a millimetre, the surface of the ore is rougher and the clearer crystal part seems to be disappearing, there is a reddish layer about the same depth as the ore and when sinking red particles hit this layer they stop sinking.* | |
| **20 minutes** | *Larger flakes are rising and sinking, the ore looks rough, red and grey, red flakes are accumulating on the surface, very little clear crystal is visible.* | |
| **Later on in the day or next day** | *Lots of sediment is on the bottom around the ore, more red particles rising and sinking, more particles suspended at a level near the top of the ore and not moving.* | |

| Time + Date | Observations | |
|---|---|---|
| **Part 2. Before you move your jar** | *There are many air bubbles attached to the sides of the jar/beaker, some red flakes are floating on the surface, some are suspended in the clear liquid, there doesn't appear to be a reddish liquid zone near the bottom anymore, where the ore was on the bottom there is now a layer of red and grey sediment, all of the clear crystals are gone.* | Drawing |
| **After stirring** | *At first the solution will be red and cloudy but it will eventually settle and fine grained layers will be visible on the bottom (red – iron oxides; beige –clays). No more bumps and lumps.* | Drawing |
| **After pouring it through the filter** | *The liquid is clear and should be almost colourless; it may have a faint pink tint.*<br><br>*The filter residue is reddish with some grey materials.* | |
| **What do you think is going to happen to the solution if you leave it for a while?** | | |
| **When the filter is dry** | *When dry it looks pink, powdery with some oddly shaped white particles. (See photos)* | Drawing |
| **What is happening in the jar?** | *The water is evaporating and crystals are starting to form on the sides of the jar and on the bottom. The crystals on the bottom are larger than those on the side. Crystals on the side look like a fine powdery coating.* | |
| **When all the water is gone describe the crystals** | *Crystals will vary from opaque white to colourless and clear. Many will exhibit a cubic habit (shape) and will look as if they are growing into each other.* | Drawing |

## Discussion Questions: (answer in full and complete sentences)

**Part 1**

1. Look at your sample of potash ore. How many different minerals can you see? Describe them.
   *Students should have three or four substances in their samples. A red mineral (iron oxide), grey mineral (clay), clear grey/white mineral and a cloudy or milky white mineral (the salts NaCl and KCl).If students had a nail they could test how hard the minerals are.*

2. What did you use to tell the minerals apart other than colour?
   Lustre, hardness, transparency, and possibly crystal structure

**Part 2**

3. What has happened to the potash sample? Do you see the same minerals that you saw before you Shook it up? What minerals are left?
   *The potash sample has dissolved. The iron and the clay minerals are left on the bottom.*

4. Describe what is in your filter. Explain why these minerals are in your filter.
   *Students should see some very fine red powder and possibly some white or cloudy crystals (see photos). These minerals are the ones that do not dissolve in water. These minerals are the waste rock; they are not valuable and need to be separated from the more valuable salts.*

5. What is the difference between the potash ore sample and the crystals in your jar?
   *The original potash sample was made up of 4 minerals, KCl and NaCl, (colourless or white, translucent or opaque), clay (grey) and iron oxide (red). The crystals were large. The resulting precipitate is composed of milky (opaque) white clumps of small crystals.*

6. If the companies can not dig the potash out of the ground because it is too deep, what is another way they can extract it?
   *The mining company could dissolve it using warm water and pump it up to the surface where it gets sent to a processing plant to take the potash out of the solution.*

7. What is one of the jobs the potash company Geochemist/Chemical Engineer/Chemist does?
   *The company chemists play an important role in the company. They help to find the best way to extract the potash from the ore.*

8 . What courses do you think these scientists need to be good in? *Science and Math*

## Activity 1: Dissolving and Precipitating Potash

**Procedure:**

**Part 1.**

1. Describe the potash sample a) dry, b) wet
2. Measure 200 ml of warm, tap water into your jar. Put your names on the jar.
3. Carefully place your sample of sylvinite into the jar. Do not shake or stir the jar.
4. Watch what is happening to the sample for 20 - 30 minutes. Write down what you see on the observation sheet. Draw what you see. Put labels on your drawing.
5. When the class is over place your jar in a safe place where it will not be moved until the next class.
6. Keep checking on your jar until the next science class. Write down what you see (your observations) along with the time and date.

**Part 2**

1. At the beginning of the next class write down your observations before you move the jar.
2. Stir the mixture to break up any of the bigger pieces, let it settle while you write down your observations.
3. Answer Discussion Question 3.
4. Put your names on the coffee filter.
5. Describe what you see in your jar and draw a picture.
6. When your turn is called, place your filter into the coffee filter holder and place the coffee filter holder on top of a clean jar. Carefully stir the bits of rock left in the jar and pour it all into the filter trying to get all of the rock bits into the filter. Place your filter is a safe place where it can dry.
7. Take a look at the liquid in your jar and write your observations.
8. Pour half the liquid in your jar into the teacher's container.
9. Draw a marker line on your jar where the top of the liquid is.
10. Describe what you think is going to happen in the jar if it is left alone for a while.
11. Check your filter when it is dry and record your observations. Answer Question 4.
12. Check your jar over the next several days observing and writing down what is happening. Draw pictures.
13. When all the water is gone, empty out the crystals onto a piece of dark paper. Use a magnifying lens to look at the crystals and describe them on your Observation Chart. Look at the colour, shape, hardness, lustre, transparency (can you see through it or not), and size.
14. Answer Questions 5-7.

## Observation Chart

| Part 1. | Looking at the Potash Ore Sample | | | | |
|---|---|---|---|---|---|
| Time + Date | Observations (What you see) | | | | |
| **Description of dry sample** How many minerals can you see? Describe them using: colour, hardness, crystal shape lustre, transarency | **Colour** | **Hardness** | **Crystal Shape** | **Lustre** | **Transparency** |
| | | | | | |
| | | | | | |
| **Description of wet sample** You should be able to see the minerals a bit better. Add any other descriptions. | | | | | |
| | | | | | |
| | | | | | |
| **Draw a picture of what the rock looks like** | | | | | |

| Part 1. | Looking at the Dissolving Potash Ore Sample | |
|---|---|---|
| **Time + Date** | **Observations (What you see)** | **Drawing (please label)** |
| **Start to 5 minutes** | | |
| **10 to 15 minutes** | | |
| **20 minutes** | | |
| **Later on in the day or next day** | | |

Student Sheet Activity 1: Dissolving Potash

| Time + Date | Observations | |
|---|---|---|
| **Part 2. Before you move your jar** | | **Drawing** |
| **After stirring** | | **Drawing** |
| **After pouring it through the filter** | | |
| **When the filter is dry** | | Drawing |
| **What is happening in the jar** | | |
| **When all the water is gone describe the crystals** | | Drawing |

## Discussion Questions: (answer in full and complete sentences)

**Part 1**

1. Look at your sample of potash ore. How many different minerals can you see? Describe them.

2. What did you use to tell the minerals apart other than colour?

**Part 2**

3. a) What has happened to the potash sample?

   b) Do you see the same minerals that you saw before you shook it up?

   c) What minerals are left?

4. a) Describe what is in your filter.

Name:_____

b) Explain why these minerals are in your filter.

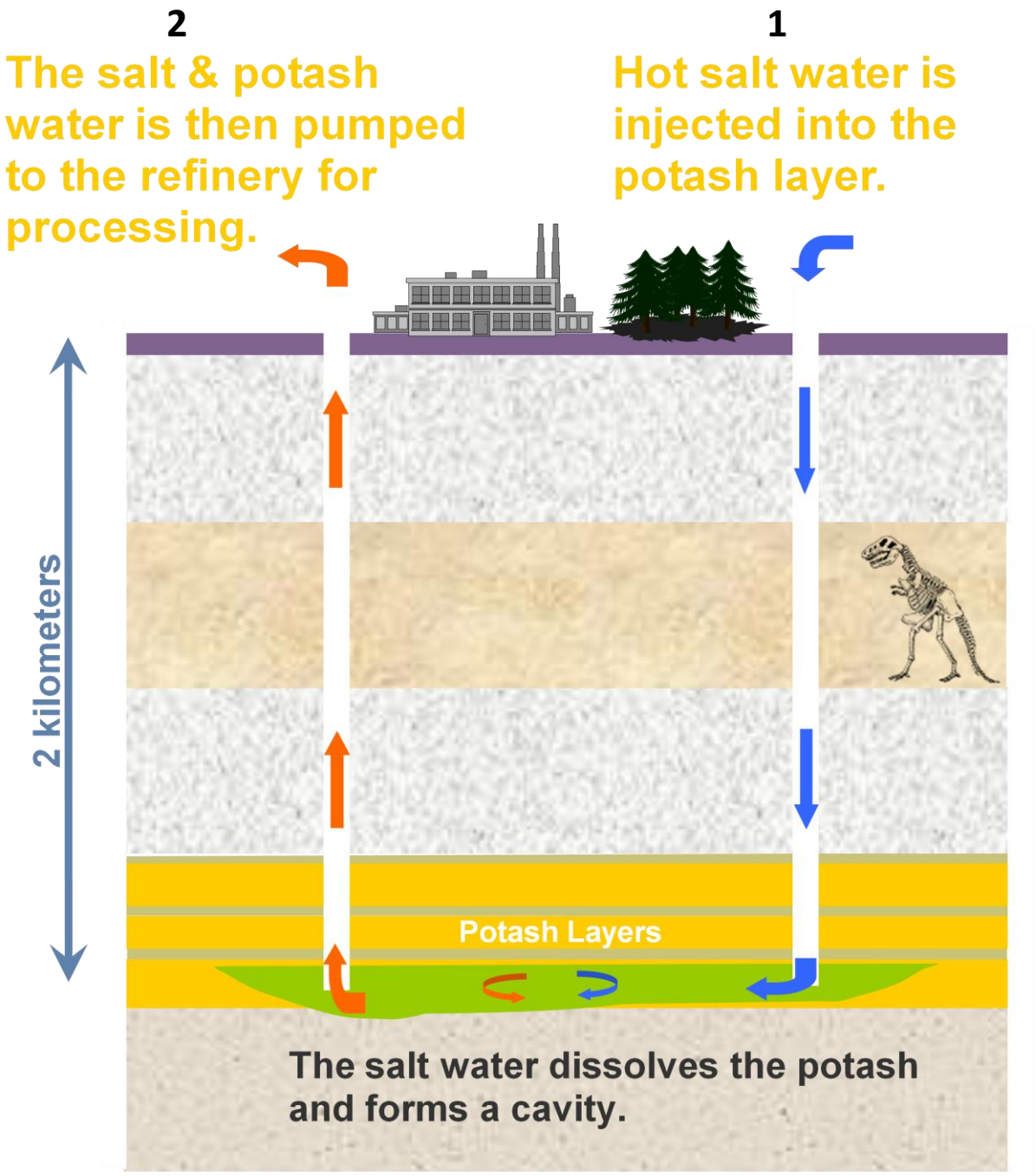
5. What is the difference between the potash ore sample and the crystals in your jar?

6. If the companies can not dig the potash out of the ground because it is too deep, what is another way they can extract it?

7. What is one of the jobs the potash company Geochemist/Chemical Engineer/Chemist or Chemical Technician does?

8. What courses do you think these scientists need to be good in?

## Potash Solution Mining in Saskatchewan



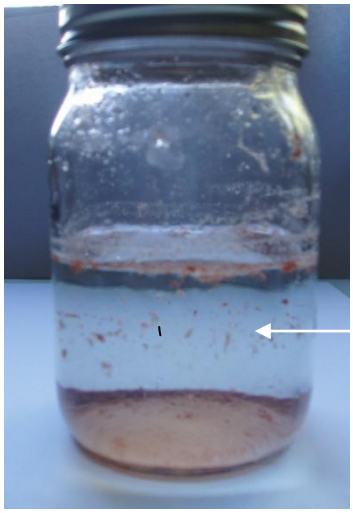

From: Mosaic Potash PowerPoint BellePlaine

## Photos

Potash Sample


Potash sample in water in jar. The water looks cloudy as the clay minerals dissolve. Sometimes the iron oxide minerals float to the surface.

Red iron oxides float up and down in the brine. The sylvinite sample crumbles as the salt minerals dissolve.

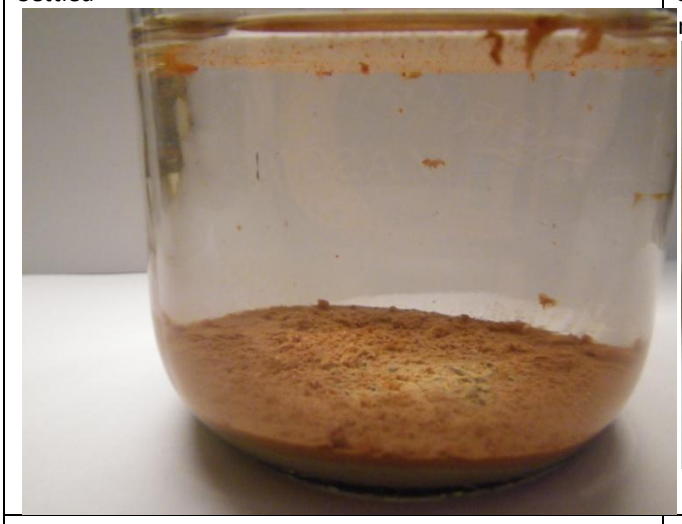


Sometimes you might see a layer of iron oxides forming in the brine. This is because the iron oxide minerals are less dense than the brine.

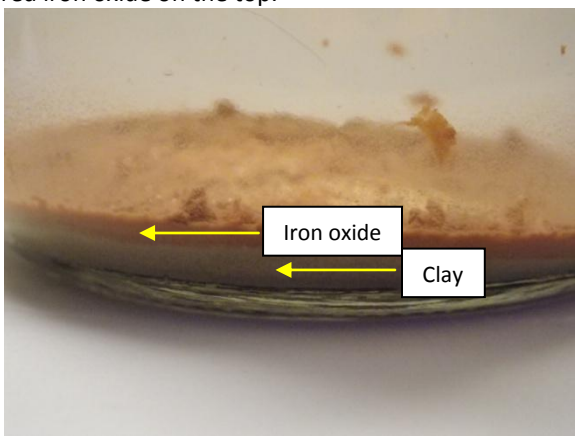
After 12 or more hours the water clears as the bits and pieces settle. Some lighter iron oxides stay floating at the surface

Stirred up

Settled



Sediment layers form: grey clay on the bottom and red iron oxide on the top.




A wet filter with iron oxide and clay minerals.

Filtered material showing very fine grained iron oxide (red) and clay (grey) minerals.

**Evaporated Solution**

Minerals growing in the jar.

Crystals formed by evaporation. These will be a combination of halite (NaCl) and sylvite (KCl) crystals.

| | |
|---|---|
| Close up of the minerals  |  |

## Vocabulary

**Brine:** Salty water**.** The water of a sea or an ocean is a brine.

**Dissolve:** To break apart and become liquid forming a solution.

**Halite:** A mineral, we know it as salt. It is made up of **s**odium and chlorine (NaCl). It normally occurs as colourless to whitish, cubic crystals.

**Ore:** Is rock that contains important minerals including metals**.** The ore is extracted through mining and processed to take out the valuable mineral(s). Ore contains minerals that can be mined to make money.

**Potash:** Is Saskatchewan's provincial mineral. Potash is the common name for the potassium rich ore mined in Saskatchewan. It is made up of the minerals sylvite, halite, clay and iron oxides.

**Solution:** A liquid with something dissolved in it.

**Sylvinite:** Sylvinite is the most important ore for the production of potash. It is a mixture of sylvite (KCl, or potassium chloride) and halite (NaCl, or sodium chloride).

**Sylvite:** Sylvite is the name of the potash mineral It is made up of potassium chloride (KCl). It forms very similar to normal rock salt, halite (NaCl). Sylvite is usually colorless to white. It has a Mohs hardness of 2.5. Sylvite has a salty taste with a distinct bitterness. Its principal use is as a potassium fertilizer.

**Waste rock:** This is the rock that has been mined, but is not of value to the mining company. It is removed ahead of the milling processes.

**Source:**

Wikipedia. Available at: http://en.wikipedia.org/wiki/

Dictionary of Mining, Minerals and Related Terms. Available at: http://xmlwords.infomine.com/xmlwords.htm

Oxford English Dictionary on-line: Available at: http://oxforddictionaries.com

Yahoo Kids: Available at: http://kids.yahoo.com/reference/dictionary/english/