Saskatchewan's Mineral Resources

Lesson: Exploring for Minerals in Saskatchewan: Stream Sediment and Soil Sampling

Overview

In this activity, students use information from geochemical surveys (stream sediment and soil samples) to predict the location of a mineral deposit.

Source: This lesson has been modified from a lesson developed for Oresome Resources.

Duration: one class

Materials:

- Student Activity Sheet
- Teacher Answer Sheet

Instructional Methods:

Guided inquiry

Learning Outcomes and Indicators

Grade 7 Mixtures and Solutions
MS7.3Investigate the properties and applications of solutions, including solubility and concentration.

j. Research how various science disciplines and engineering fields study and apply scientific knowledge related to solutions.

Grade 7 Earth's Crust and Resources
EC7.2Identify locations and processes used to extract Earth's geological resources and examine the impacts of those locations and processes on society and the environment.

f. Provide examples of technologies used to further scientific research related to extracting geological resources (e.g., satellite imaging, magnetometer, and core sample drilling).

g. Evaluate different approaches taken to answer questions, solve problems, and make decisions when searching for geological resources within Earth (e.g., trial-and-error prospecting versus core sampling).

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Source: **Saskatchewan Evergreen Curriculum**

Big Picture Questions

1. How do they find mineral deposits in Saskatchewan?

Background Information

In the soil and rocks near a mineral deposit, higher-than-normal concentrations of metals and other elements often exist. These are known as geochemical anomalies and are more extensive than the actual ore deposit. This makes them somewhat easier to target and locate.

Geochemistry is the scientific process of locating these geochemical anomalies by sampling and chemical analysis of rocks, soils, water or vegetation. Geochemical analysis can determine whether the level of an element found in a particular area is at background levels or at higher levels, which could mean that economic mineral concentrations are nearby.

By collecting and analysing sediment samples from creeks, rivers, lake bottoms and soils, geoscientists can trace minerals back to the source rocks. The sample sites are located on high-quality aerial photos. These days each sample location also has its location recorded using a global positioning system.

Stream sediment surveys

A series of samples are taken working upstream along a creek bed. This involves collecting 500 grams of stream sediment samples from creek beds. The number of stream sediment samples taken varies, but is usually one to four samples for each square kilometre.

Rock sampling

Explorers use a geological pick to break small pieces of rock from an outcrop to send to a laboratory for chemical analysis.

Soil sampling

Two hundred grams of soil samples are collected below the grass roots. Geochemical soil sampling is usually conducted over a relatively small area. Soil samples are typically collected by hand from a small hole dug to a depth of about 10 centimetres.

Gas sampling

Mineral deposits can emit gases that leak to the surface. These can accumulate in soils or be emitted to the atmosphere in extremely low concentrations. Attempts have been made to collect and analyse these gases, both with ground and airborne collection systems. Results to date have been variable.

Geo-botanical sampling

Certain plant species are capable of taking up metals from the soil through their root systems and concentrating them in leaves and bark. Geo-botanical surveys, based on direct sampling of plants or ground litter, have been undertaken with some success around the world. These surveys are often used when it is difficult to get access to the ground to obtain samples.

Vocabulary

analysis	assay
geochemistry	ore
till	

THE ACTIVITY

Motivational Set (5 minutes)

Show the picture of the two prospecting methods to the students.

Ask the students what they think each man is doing. *Most students will be familiar with the idea of the old prospector panning for gold.*

Panning is still used for gold and other minerals that are heavy. It is back breaking work that takes many hours and running water.

Ask the students what it is the modern day prospector or exploration geologist is sampling. *The samples taken for chemical analysis can range from coarse gravel through sand, silt, and mud.*

Not all minerals/metals can be found by panning. Today most prospectors and exploration geologists will collect samples of the stream and lake sediment, and soil. The samples are sent to a laboratory where they will be crushed, sieved and dissolved in acid to determine their chemistry. This process is called assaying the sample. Once the assay results are back to the mining company they are plotted on a map.

In this class the students will be the exploration geologists interpreting the results.

Activity:

1. Provide students with a copy of the work sheet and read through the task together. Students may complete the task individually or in groups of two.
2. Discuss student findings after the work sheet is completed.

Assessment Method and Evidence

✓ **Maps**

- Students will be able to how geologists apply the results obtained from solutions derived from a sediment sample in their exploration for mineral deposits.
- Using the information gained from geochemical analysis of sediments, students will determine the most likely location of a mineral deposit and propose an area for further exploration by drilling.
- Students will be able to show how geochemistry is used to help pin point the location for further exploration, such as diamond drilling, for mineral resources

✓ **Questions**

- Students will be able to explain how the concentration of an element in a solution derived from a sediment can help determine an exploration program.
- Students will able to explain why geologists must take into consideration the affects of glaciations when searching for geological resources within the earth.
- Students will be able to show how the geochemistry of sediments/soils, used to explore for mineral resources, is an example of how science and technology are an integral part of Saskatchewan's lives and communities related to the minerals industry.

Resources

Oresome Resources The original resource is available at: http://www.oresomeresources.com/resources_view/resource/publication_the_science_of_mining/section/resources/parent//category/exploration

Wikipedia Gold Prospector. Available at: Source: http://en.wikipedia.org/wiki/File:Gold_prospector.jpg

Vocabulary

Analysis: The identification and measurement of the chemical constituents of a substance or specimen. Samples are sent to the laboratory for analysis.

Assay: To analyze the proportions of metals in an ore; to test an ore or mineral for composition, purity, weight, or other properties of commercial interest.

Geochemistry: The study of the presence of elements in the earth; their abundance and distribution.

Ore: A source of minerals that can be mined at a profit. Ore refers to either metallic or nonmetallic deposits such as sulfur.

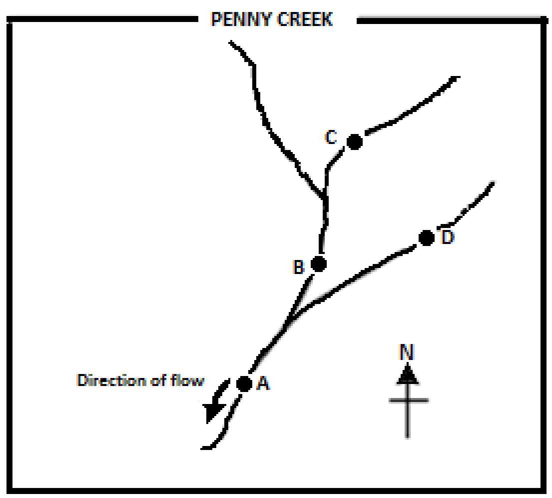
Till: Unsorted and unstratified, unconsolidated clay, silt, sand, gravel and boulders deposited directly by and underneath a glacier without subsequent reworking by melt water.

Name:______________________________

Student Activity Stream Sediment Sampling

Survey One - June

During the summer, geologists mapping near Penny Creek in the Flin Flon area, find indicators that an ore deposit containing copper is nearby. They collected stream sediment samples from the four points on the map and sent them to the Acme Chemistry Lab to be analysed. When they got the results back the samples from A and B showed traces of copper, but C and D did not. With these results in mind they had to plan where they were going to sample next.



1. Circle the area on the map showing where you think the ore deposit is likely to be.

2. Explain why you think it is located where you have shown it.

3. Why do you think the sediment from the stream was sampled instead of the water?

Once you have finished these questions ask for the results from the second survey.

Name: ______________________________

Survey Two - September

The search was narrowed to the north area of Penny Creek. Stream sediment samples or soil samples were taken at each point on a grid marked on a map of the area thought most likely to contain the ore. The table below gives the map references of locations where medium, high and very high concentrations of copper were found.

Copper concentration	Locations
Medium	C3 C5 D3 D6 E3 E6 F7 G4 G7 H5 H7 I6 I7 I8 I9 J7 K8 K10 L9 L11
High	C4 D5 F4 F6 G5 G6 H6 J8 J9 K9 L10 M10
Very High	D4 E4 E5 F5

1. Use different coloured pens or pencils to plot the locations where medium, high and very high concentrations of copper were found.

2. Using the same coloured pencils used above, shade in the predicted location of the ore deposit showing medium, high and very high copper concentrations.

3. What is the approximate size of the ore deposit on the surface? Use the scale 1 cm = 20 m.

4. The next step in exploration is to drill and collect samples for analysis. Your budget allows only three holes. Give the map references of the three places you would drill, mark the locations with an X, and explain your choice.

In parts of the world where there have been no periods of glaciation this would be a great way to find an ore deposit. However, in Saskatchewan the last glaciers swept across the province from the north-east to the south-west. The glaciers scraped off some of the surface rocks and deposited them along the way as it advanced (moved forward). This is something the geologists in Saskatchewan must consider when planning their exploration and drill programs.

5. How will this new information affect where you are going to put your drill

6. Drilling holes into the ground is very expensive, up to $1,000.00 per meter in some rock types.

   Do you have enough information based on the stream sediment and soil geochemistry to accurately know where to put your drill? Explain why or why not.

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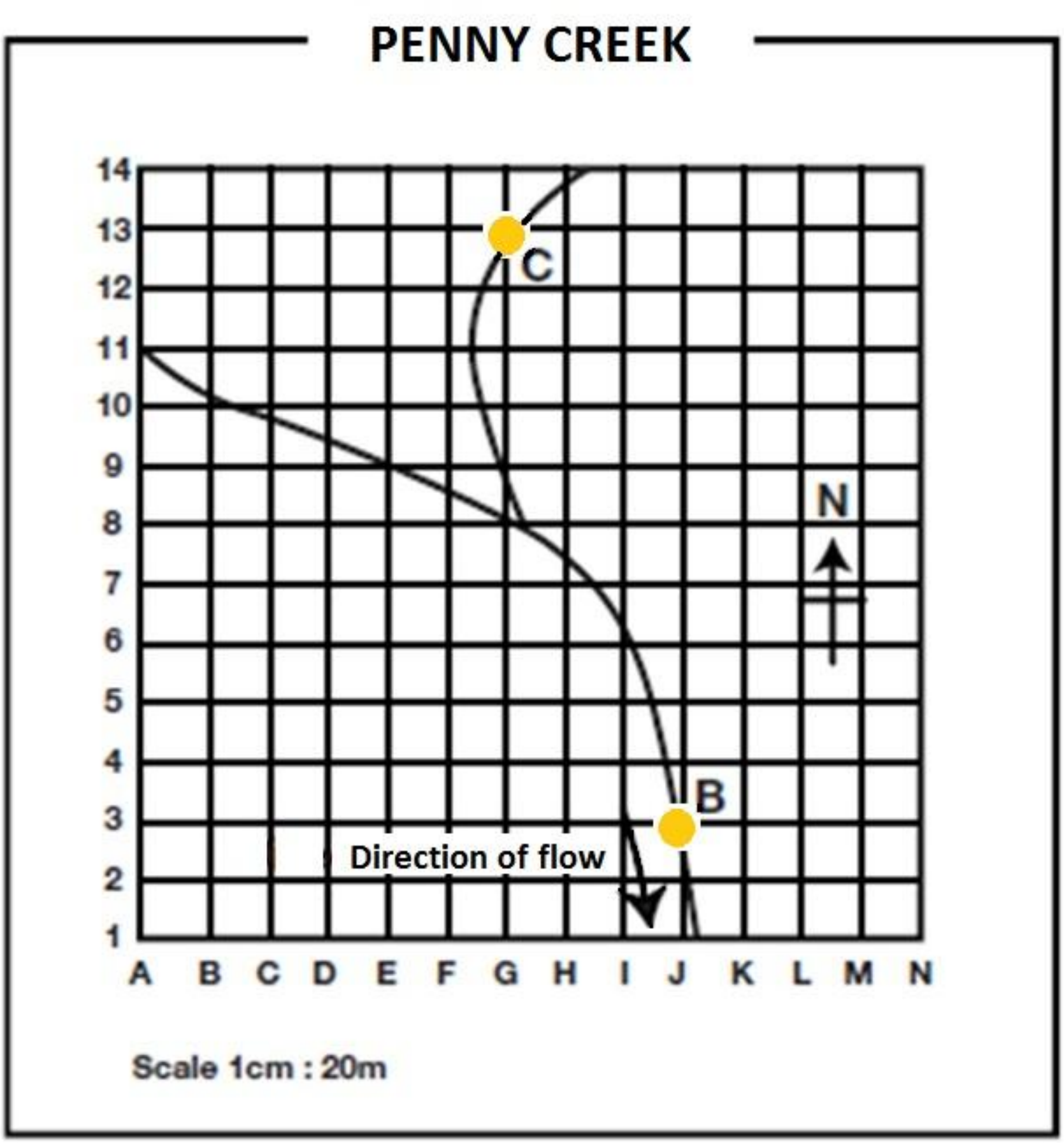
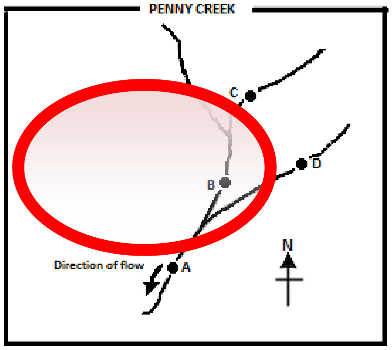

PENNY CREEK
14
13
12
11
10
9
8
7
6
5
4
3
2
1
A B C D E F G H I J K L M N
C
B
N
Direction of flow
Scale 1cm : 20m

Answers to worksheet questions
Part A

1. Students should circle an area that excludes site C and D



2. Copper will be present only in areas downstream from the mineral deposit. Because no copper is at C and D, the copper deposit must be located to the north-west of B.

3. Concentrations in the water are too low and can be inconsistent. Heavy rains will dilute the concentration.

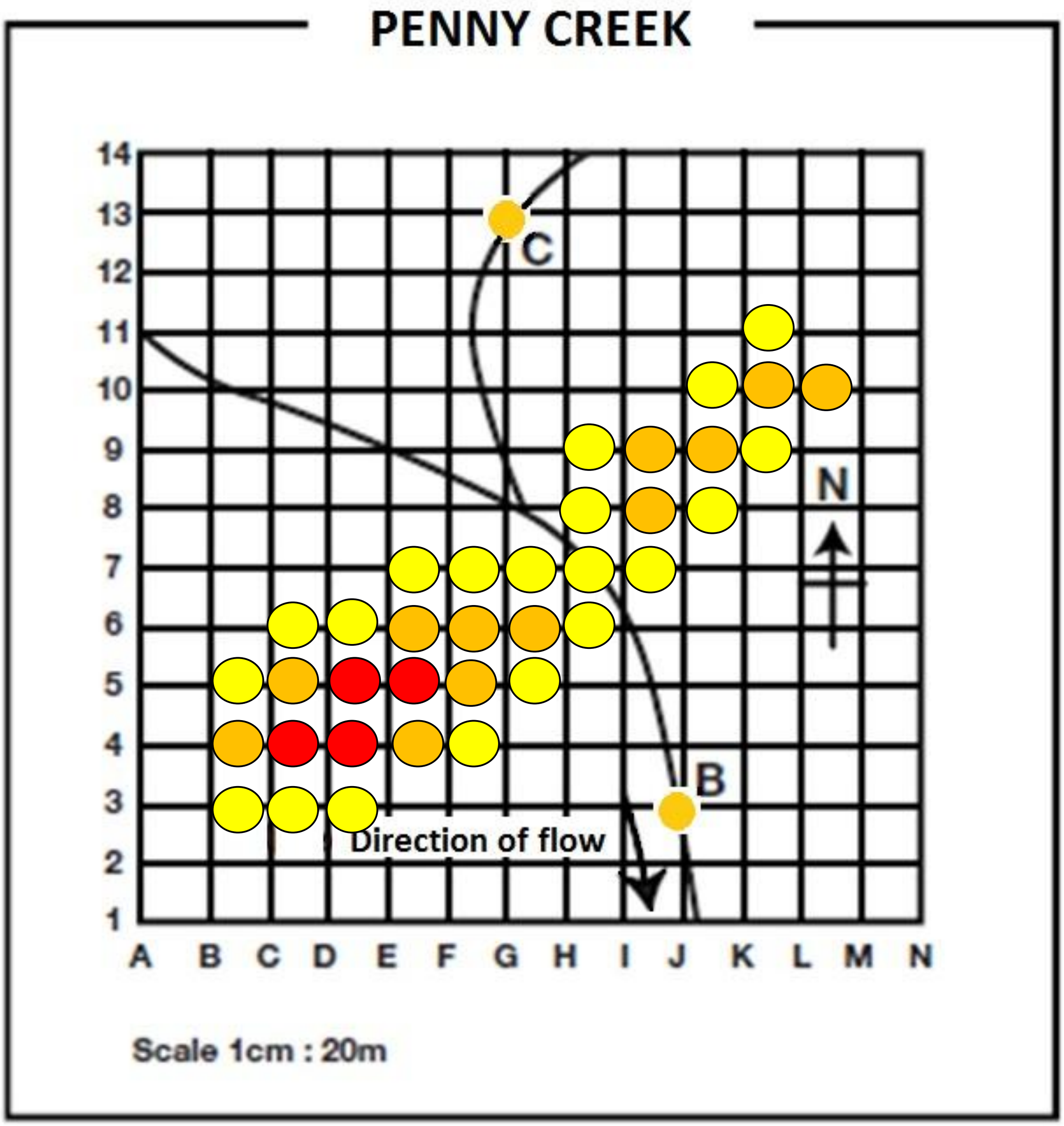
Part B

3. About 800 square metres.

4. D4, E4.5, F6. Drill in the section that has the highest copper concentrations.

5. Geologists in Saskatchewan have to consider that the trace ore minerals found in the samples may have been scraped off of an ore deposit and transported along with the glacier. They therefore have to consider which direction the glacier came from and will have to sample more in that direction (generally to the north-east) before they decide to drill. If they drilled on the highest anomaly there may be nothing below it, rather the ore deposit could be several kilometres away up the path of the glacier.

6. No, you must consider more factors such as the local geology (are the rocks the right type for a copper deposit?), glacier direction, geological history (are there any faults in the area).
Answers will vary



Copper concentration	Locations
Medium	C3 C5 D3 D6 E3 E6 F7 G4 G7 H5 H7 I6 I7 I8 I9 J7 K8 K10 L9 L11
High	C4 D5 F4 F6 G5 G6 H6 J8 J9 K9 L10 M10
Very High	D4 E4 E5 F5

Source: Wikipedia.