



SESSION 3: INTRO TO SNOLAB

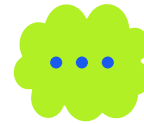
~45-60 minutes

SESSION OVERVIEW

In this session, students are introduced to SNOLAB, where scientists work to answer some of the scientific questions about the world around us. They are given a brief overview of the various conditions in the underground lab that make it a unique spot to perform complicated experiments. Finally, students can participate in a live virtual tour from the SNOLAB team!

LEARNING GOALS

- **Understand** why SNOLAB is located deep underground
- **Investigate** the unique conditions seen in the lab
- **Observe** the research taking place at SNOLAB
- **Ask** SMART scientific questions about real-world science
- **Build** curiosity and an appreciation for science



Investigate



Observe

SCIENTIFIC BACKGROUND

Some of the biggest questions in science cannot be answered in a typical laboratory setting. At SNOLAB, scientists use a unique underground environment and specialized technology to reduce background noise and detect rare space particles. By exploring how and why this research happens, students will discover how scientists investigate some of our universe's biggest mysteries.

CURRICULUM CONNECTIONS

Science & Technology

- Grade 4-8: A1.1 - A1.5

Language Arts

- Grade 4-8: A1.2, A3.1, B1.1, B1.2

*The Arts

- Grade 4-8: D1.1, D1.3, D1.4, D2.2, D2.4

*Language Arts

- Grade 4-8: D1.2, D1.4, D2.1, D2.6, D3.1, D3.2

*Mathematics

- Grade 4-5: C4, D1.2, D1.3, D1.6, D2.1
- Grade 6-8: B2.1, B2.12, C4, D1.1 - D1.3, D1.6, D2.1

* Indicates an extension activity connection



SESSION 3: INTRO TO SNOLAB

~45-60 minutes

MATERIALS

- Session 3 presentation
- Laptop
- SMART board or projector
- Speakers or sound system
- Optional: SNOLAB handout

Note: To include a live virtual tour in this session you must reach out to SNOLAB Education & Outreach in advance to schedule a date and time.

DISCUSSION PROMPTS

Before

- Have you ever heard of SNOLAB? What do you know about it?
- Is there anything about space or the universe that you are curious about?
- If you were a scientist, what would you want to study?

During

- What do you notice about the underground laboratory?
- Was SNOLAB what you expected a science lab to look like?
- Why is SNOLAB built deep underground? How does that help scientists?

After

- What is one thing that you learned?
- If you could investigate one thing at SNOLAB, what would it be and why?
- What new questions do you have after seeing SNOLAB and its experiments?

EXTENSIONS & ASSESSMENT

STEM focused: Finding a signal in the noise activity

- Students explore the rare particle events seen at SNOLAB through a Math game

Cross-curricular: SNOLAB poster contest (Art)

- Students showcase their learning by creating a poster about the science at SNOLAB

Assessment: Session 3 Exit ticket

See the appendix for more details on this section



SESSION 3

- Introduction to SNOLAB Exit Ticket (Grade 4 - 6)
 - Introduction to SNOLAB Exit Ticket (Grade 7 - 8)
 - Introduction to SNOLAB Worksheet Answer Keys
 - Extension Activity: SNOLAB poster activity (optional)
 - Extension Activity: Signal seekers (optional)
- 



INTRODUCTION TO SNOLAB

Name: _____

1

What is SNOLAB? Circle the best answer.

- a) A zoo for rare animals
- b) An underground science lab where scientists study tiny particles
- c) A weather station in Northern Ontario that tracks snow
- d) A hospital for astronauts

2

Why is SNOLAB underground? Circle all the right answers.

- To keep workers warm
- To block space particles
- To make experiments with better results
- It costs less money to do science underground
- To stop radiation from the surface

3

Why do scientists at SNOLAB need to shower before going into the lab?

4

Draw and label two pieces of personal protective equipment (PPE) that needs to be worn underground.



INTRODUCTION TO SNOLAB

Name: _____

1 SNOLAB is a science lab located 2 km underground. Explain one reason why this location is useful for research.

2 Match the unique SNOLAB condition to the example by drawing a line between them.

Higher pressure

Scientists pass through an air shower and change their clothing before entering the lab.

Fewer cosmic rays

A detector can observe rare particle interactions without interference from space signals.

Class 2000 cleanliness

Nearly 2 km of rock sits above the lab, pressing on the surrounding rock and structure.

3 Identify two pieces of personal protective equipment (PPE) and briefly explain why they are important during underground travel.

PPE #1:

PPE #2:

Explanation:

Explanation:

INTRODUCTION TO SNOLAB**1** What is SNOLAB? Circle the best answer.

- a) A zoo for rare animals
- ☒ b) An underground science lab where scientists study tiny particles
- c) A weather station in Northern Ontario that tracks snow
- d) A hospital for astronauts

1 point

2 Why is SNOLAB underground? Circle all the right answers.

To keep workers warm 3 points

☒ To block space particles☒ To make experiments with better results☐ It costs less money to do science underground☒ To stop radiation from the surface**3** Why do scientists at SNOLAB need to shower before going into the lab?

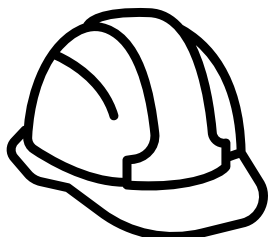
They need to shower to get rid of the dust and particles from the mine that may have got on their skin and clothes on the way underground, which keeps the lab super clean.

2 points

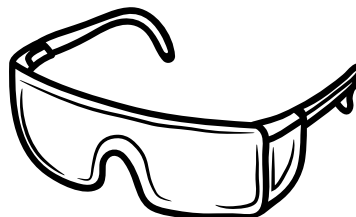
4 Draw and label two pieces of personal protective equipment (PPE) that need to be worn underground.

Answers may vary. See example below.

2 points



Hard hat



Safety goggles



Name: TOTAL: 9 points

INTRODUCTION TO SNOLAB

1 SNOLAB is a science lab located 2 km underground. Explain one reason why this location is useful for research.

Answers may vary. EXAMPLE: SNOLAB is located underground because the deep layers of rock filter out certain space particles, so that scientists can study specific ones like neutrinos.

2 points

2 Match the unique SNOLAB condition to the example by drawing a line between them.

Higher pressure

Scientists pass through an air shower and change their clothing before entering the lab.

Fewer cosmic rays

A detector can observe rare particle interactions without interference from space signals.

Class 2000 cleanliness

Nearly 2 km of rock sits above the lab, pressing on the surrounding rock and structure.

3 points

3 Identify two pieces of personal protective equipment and briefly explain why they are important during underground travel.

Answers may vary.

PPE #1: Hard hat

Explanation:

Hard hats are used underground to protect our heads from uneven rocks in the mine.

PPE #2: Safety goggles

Explanation:

Safety goggles are used to protect our eyes from chemicals and dust in the drift and in the lab.

4 points



SNOLAB POSTER ACTIVITY

MATERIALS

- Large paper or cardstock (11" x 17")
- Scrap or GOOS paper
- Pencils and erasers
- Colouring supplies
- Rulers
- Laptop (for accessing SNOLAB website)
- Projector
- Poster rubric and/or submission form

INSTRUCTIONS

1. As a class, spend some time looking at the SNOLAB website for inspiration. Focus especially on the Education section and any images, videos, or student resources to show what SNOLAB does
2. Briefly discuss what SNOLAB is and the type of science it supports (quantum science, particle science, etc.)
3. Explain the goal of the task. Students will create a poster to promote SNOLAB science to kids at other schools in Canada
4. Have students begin brainstorming ideas on blank/GOOS paper
5. When their rough draft is complete, students can begin working on their final copy
6. Students create their final poster using colour, images, and text
7. The poster must include:
 - a. A clear title promoting SNOLAB science
 - b. At least one visual representation of SNOLAB or underground science
 - c. A message or slogan
 - d. Something that represents science being done (dark matter, neutrinos, space, etc.)
8. Encourage students to use creativity to show things that cannot be seen
9. Display posters around the classroom and/or share them with E&O at SNOLAB!

DISCUSSION QUESTIONS

- Why do scientists choose to build a laboratory deep underground?
- What images or symbols did you choose to represent SNOLAB, and why?
- What is one thing you learned about SNOLAB from this activity?
- If you could improve your poster, what would you change or add?
- What science or experiment does your poster show? Why did you choose it?
- How did using art help you show science at SNOLAB?

CURRICULUM CONNECTIONS

- Language Arts: A1.2, A3.1, B1.1, B1.2, D1.2, D1.4, D2.1, D2.6, D3.1, D3.2
- Science & Technology: A1.1 - A1.5, A3.1, A3.2
- The Arts: D1.1, D1.3, D1.4, D2.2, D2.4



POSTER CHECKLIST

Name: _____

Poster Title: _____

- ☐ I completed a brainstorming draft.
- ☐ My poster has a clear title.
- ☐ I included a picture or drawing.
- ☐ I included a slogan or message.
- ☐ I showed a SNOLAB science topic.
- ☐ I used colour to make my poster stand out.
- ☐ My poster is neat and organized.
- ☐ I checked my work before handing it in.

Self-reflection

a) One thing I learned about SNOLAB is: _____

b) The best part of my poster is: _____

c) One thing I could do better next time is: _____



SNOLAB POSTER RUBRIC

Student name: _____

Poster title: _____

Criteria	Level 1: Beginning	Level 2: Approaching	Level 3: Proficient	Level 4: Exceeding
Understanding of SNOLAB science	Shows a limited understanding of SNOLAB science. Some information is missing and/or incorrect.	Shows some understanding of SNOLAB science. Most information is present and/or accurate.	Shows a good understanding of SNOLAB science. The information is accurate and/or relevant.	Shows a thorough understanding of SNOLAB science. The information is accurate, detailed, and insightful.
Communication of message or slogan	Message is missing and/or is difficult to understand.	Message is somewhat clear and understandable.	Message is clear and appropriate for the audience.	Message is highly effective and memorable for the audience.
Visual design and creativity	Uses none or few design elements to support the message.	Uses some design elements to support the message.	Uses design elements to effectively communicate the message.	Uses creative design elements to strongly communicate the message.
Required components	Includes few of the required components.	Includes some of the required components.	Includes most of the required components.	Includes all required components.
Planning and presentation	Work shows little to no planning and organization.	Work shows some planning and organization.	Work is well-planned, organized, and neat.	Work is very well-planned and highly organized.

Comments

SNOLAB POSTER SUBMISSION FORM

If you would like to send your poster to SNOLAB to get comments from us, fill out this form with the help of your teacher or parent/guardian. When complete, send your poster and this form via email to outreach@snolab.ca. The posters will be reviewed by SNOLAB staff and we will send back comments!

Student information

Name: _____

Age: _____ Grade: _____

School: _____

Teacher: _____

Contact email: _____

Poster information

Poster title: _____

Tell us a bit about your poster: _____



SIGNAL SEEKERS

MATERIALS

- Dice
- Calculators
- Writing utensils
- Signal seekers worksheet

INSTRUCTIONS

1. Divide students into groups of 3-4 students and distribute all materials
2. Explain that each roll of a die represents a particle event being detected by a scientific instrument
3. In their groups, students take turns rolling a die until they have completed a total of 50 rolls
4. Students record their results (from each roll) on the worksheet
5. A roll of the number 6 represents a "rare signal event" and all other numbers are "background noise". Students should tally their numbers for each.
6. After completing all 50 rolls, students create a graph to represent their results:
 - a. Grade 4-5: Create a bar graph showing the frequency of each number rolled
 - b. Grade 6-8: Create a line graph and calculate the percentage of signal events compared to background noise
7. Optional: As a class, combine the data from all groups to create a whole-class dataset
8. Analyse the class data and discuss whether the larger sample provides a clearer picture of the results
9. Discuss how this activity relates to the work conducted at SNOLAB. Emphasize that scientists often search through large amounts of background noise to identify rare signal events. Just as rolling a 6 was uncommon in this activity, neutrino interactions are extremely rare and can be difficult to detect. Scientists collect large amounts of data over long periods of time to increase the chances of finding these rare events
10. Have students write a brief conclusion describing what they learned about collecting data, identifying patterns, and detecting rare events

DISCUSSION QUESTIONS

- Which number appeared the most? The least?
- Did your results match what you expected? Why or why not?
- Why do you think different groups got different numbers of signal events? Do you think this happens in real-life experiments at SNOLAB?

CURRICULUM CONNECTIONS

- Language Arts: A1.2, A3.1, B1.1, B1.2
- Science & Technology: A1.1 - A1.5
- Mathematics: C4, D1.1, D1.2, D1.3, D1.6, D2.1,



SIGNAL SEEKERS

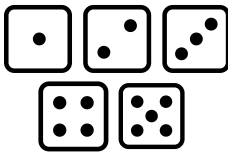
Name: _____

Background

At SNOLAB, scientists look for tiny particle interactions that are hidden among background signals. In this activity, each roll of a die represents a particle event. Your challenge is to collect data, analyze patterns, and search for rare signal events hidden within the background noise. As you work, you'll discover how data and probability help scientists make sense of the world around us.

Event key

Use the following key to help you complete the activity:



A roll of 1-5 represents
background noise



A roll of 6 represents a
rare particle signal

Predictions

a) How many signal events (6s) do you think your group will detect in 50 rolls?

b) Do you think every number will appear the same number of times? Explain.

Data tally

Keep a running tally of your results in the space below.



Results

Add up your tallies from the first page and put the results in the correct spot below.

Background noise (1-5s) _____

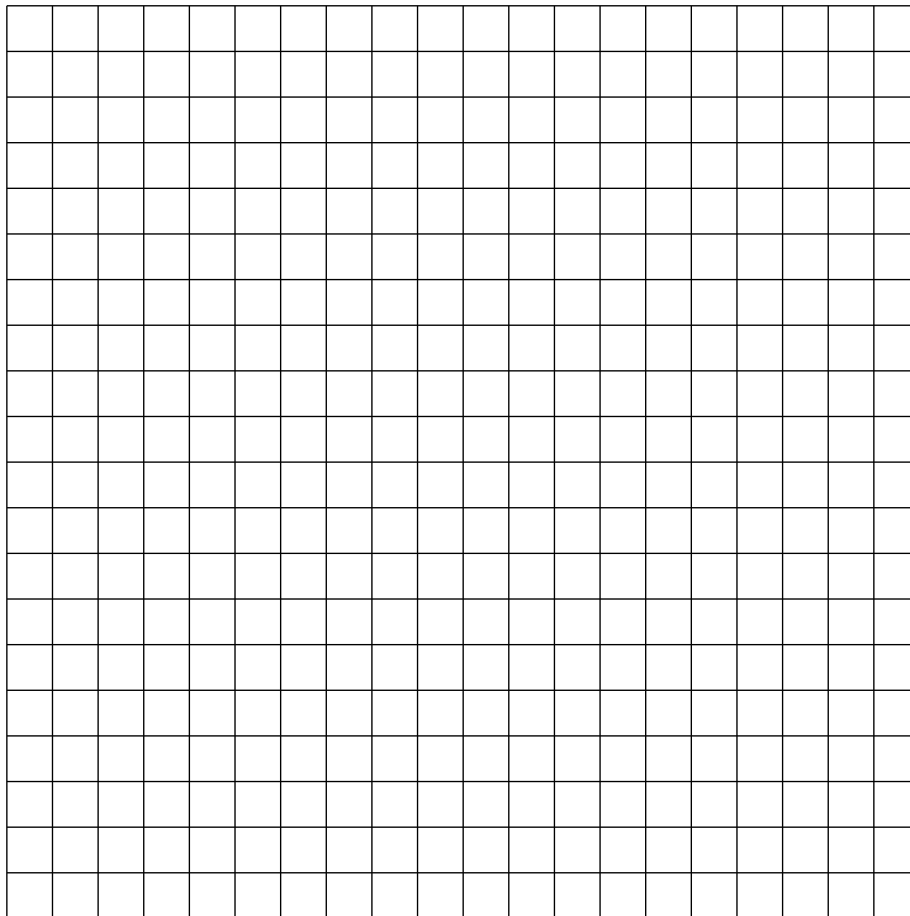
Rare particle events (6s) _____

Grades 6-8 ONLY: Calculate the percentage of each result above and put your answers on the lines below.

% Background noise (1-5s) _____

% Rare particle events (6s) _____

Graph your data



Analyse your data

- a) Which number appeared most often? _____
- b) Which number appeared least often? _____
- c) How many rare particle events did your group detect? _____
- d) Did your results match your predictions? Why or why not?

- e) Was it easy or difficult to find particle events among the background noise?

Conclusion

What did this activity teach you about data, probability, and the rare science at SNOLAB?
