

# TOPIC 4.4

## How do geological features and processes affect where and how we live?

### Key Concepts

- The geological history of British Columbia helps shape our lives.
- We use our knowledge of geological processes to help keep us safe.

### Curricular Competencies

- Demonstrate a sustained intellectual curiosity.
- Make observations about the natural world.
- Transfer and apply learning to new environments.
- Communicate ideas and findings using scientific language.
- Express and reflect on a variety of experiences and perspectives of place.

**T**he Gwaii Haanas Legacy Pole commemorates the 20th anniversary of an agreement between the Haida Nation and the Government of Canada that created the Gwaii Haanas National Park Reserve and the Haida Heritage Site. Shortly before completing it, carver Jaalen Edenshaw decided to add the figure of Sacred-One-Standing-and-Moving near the top of the pole. A story tells of this being holding Haida Gwaii steady with a tall pole on his chest, but now and then a pine marten races along the pole, creating vibrations that cause earthquakes. After the legacy pole was finished, a reminder of this story occurred. In 2012, a 7.7 magnitude earthquake stopped the flow of hot water to the hot springs of Hotspring Island on Haida Gwaii. Some promising signs of return were observed three years later. But it is not known how tectonic activity “shut off” the flow in the first place or whether the springs will ever recover fully.





# Starting Points

Choose one, some, or all of the following to start your exploration of this Topic.

- 1. Identifying Preconceptions** Tectonic activity can have an impact on local as well as more distant areas.
  - a) Describe at least three ways an earthquake or other tectonic event could affect the environment where it occurs.
  - b) Describe at least three ways an earthquake or other tectonic event could affect people who are many kilometres distant from where it occurs.
- 2. Considering First Peoples and Other Ways of Knowing** Hot springs are places where ground water that is warmed by the thermal energy of Earth's interior is released.
  - a) Use your scientific knowledge to develop an explanation for how hot springs form. How do you think an earthquake might cause hot springs to go dry?
  - b) Assume you have no scientific knowledge about Earth. Now develop an explanation that would explain how hot springs form and how an earthquake could cause them to go dry.
- 3. Experiencing and Interpreting** Take a walk in a place where you live or go to school.
  - a) How does what you see affect how you think and feel about yourself?
  - b) How could you honour or show respect for a place that is special to you?

## Key Terms

There is one key term that is highlighted in bold type in this Topic:

- **geohazard**

Flip through the pages of this Topic to find this term. Add it to your class Word Wall along with its meaning. Add other terms that you think are important and want to remember.

## CONCEPT 1

# The geological history of British Columbia helps shape our lives.

### Activity

#### Reflecting on Connections



How are you connected to where you live? How would you feel if you had to move? What places would you miss? Why would you miss them?

**Connect** to Investigation 4-H on page 326

**P**late tectonics explains British Columbia's geological processes. And those processes have quite literally shaped the landscapes—the places—that each of you knows, walks, and visits. Specific features of the landscape such as soil quality, salmon spawning areas, river deltas, mineral deposits, and hot springs have influenced the patterns of settlement that have taken place over the history of British Columbia, and long before it was given that name. **Figure 4.21** shows a small sample of the present-day effects of the province's geological history.

### Activity

#### Your Place, Your Province

Pick one of the regions outlined in **Figure 4.21**. Learn about its population, the geological and other features that have brought people to it, and distinctive expressions of the peoples and cultures that call the region home. How can you connect with other classes in the province to create your own unique version and vision of the peoples and places of British Columbia?

#### Before you leave this page . . .

1. You have been asked to write a 30 second Internet ad that describes your part of B.C. What features would you focus on? Explain why you chose them.



**Figure 4.21** The geology of different parts of the province has a powerful impact on the economic, social, and cultural characteristics of a region.



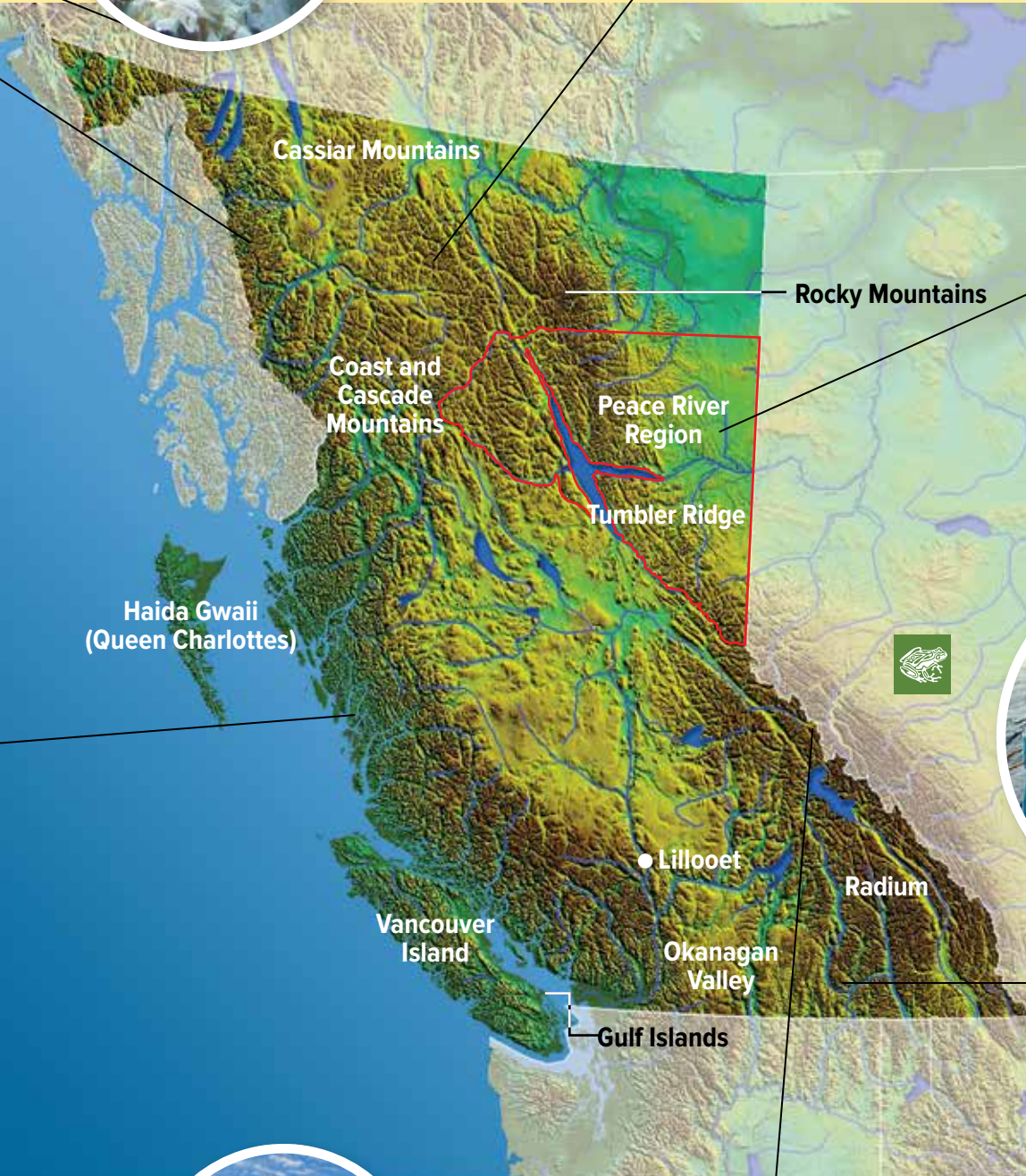
The coast includes the Coast and Cascade Mountains, as well as Haida Gwaii, Vancouver Island, and the Gulf Islands. Much of this region experiences earthquake activity, and there are mountains of dormant volcanoes. Great numbers of tourists are drawn here each year to discover and/or re-experience what the millions who inhabit the region have known for thousands of years.



In the northern interior, glaciers from the last Ice Age have carved out the many lakes that dot the landscape and have left behind nutrient-rich soils for farming. The Cassiar Mountains have rock from ancient ocean crust that collided with the North American plate more than 200 million years ago. The oceanic rock contains deposits of valuable jade.



The northeast includes the Peace River Region. Its soils, so rich for farming, were once the bottom of an ancient glacial lake. The area also has deposits of natural gas, oil, and coal. In addition to waterfalls, caves, and other scenic splendours, Tumbler Ridge also boasts fossils of marine fish and reptiles that date back over 200 million years ago. And nine of the fourteen known tyrannosaur tracks in the world are found here.



The southern interior includes steep-walled canyons with flowing rivers. Near Lillooet, the Bridge River and Fraser River meet to create an important fishing site for the St'át'imc First Nations. The Okanagan Valley is most known for its lakes and agriculture. The architecture of many towns reflects the wealth that came from silver, gold, and copper mines.



The Rocky Mountains run through the southeast and extend toward the north end of the province. Mount Robson, found here, is Canada's highest peak. And North America's longest mountain valley, The Rocky Mountain Trench, runs along the west side of the Rockies. Water rises at faults in Earth's crust in this valley, producing world-famous hot springs such as those at Radium.

# We use our knowledge of geological processes to help keep us safe.

## Activity



### Do you think...

- you could outrun a landslide or an avalanche?
- you could keep your balance if you were caught in a flash flood?

### Do you know...

- what kinds of events can trigger a slide of land, mud, or snow?
- what to do in the event of a natural hazard such as an earthquake or landslide?

**geohazard** a destructive event that results from geological processes

Millions of people all over the world live in places that can experience natural hazards such as earthquakes and landslides. These are examples of **geohazards**, which are destructive events that result from geological processes. Such events pose threats—short term, long term, or both—to people, property, and the environment. **Figure 4.22** shows an example.

Many factors combine to make British Columbia vulnerable to geohazards. These factors include the substantial amounts of rain and snow that fall each year, its geological makeup, and large amounts of sediments laid down by glaciers. And, of course, the province is located in an active tectonic region.

**Figure 4.22** In 2007, about 500 000 cubic metres of rock, sediment, and vegetation poured down a mountain slope into Chehalis Lake, near Chilliwack. The resulting waves pounded the shoreline with scouring force and threatened nearby areas with flooding.

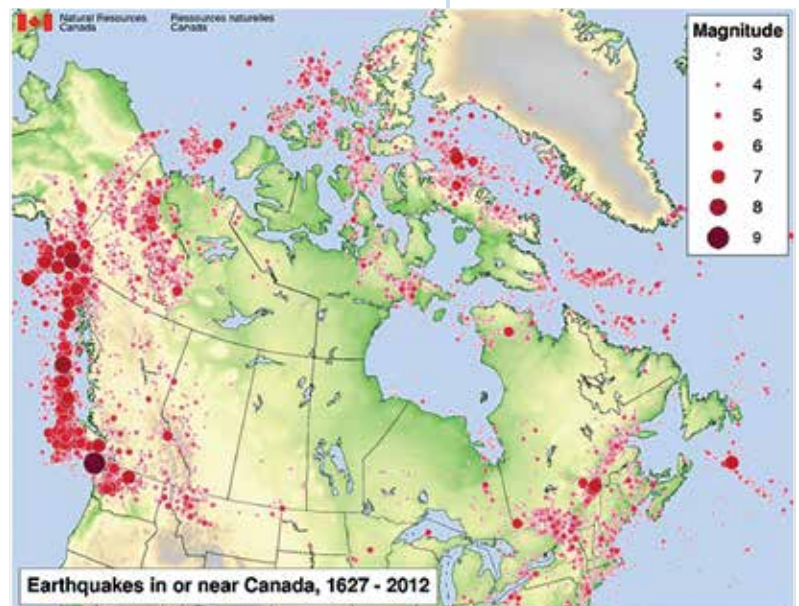


## Being Aware, Being Prepared

At the start of this unit, you saw a photo of the Neskowin Ghost Forest, which showed the aftermath of the last time that two plates of the Cascadia subduction zone suddenly slipped. The resulting powerful megathrust earthquake not only wiped out villages along the Pacific Northwest coast, but also sent 3-storey waves on a 10-hour journey across the ocean to Japan, where they damaged homes on Honshu Island.

The map in **Figure 4.23** marks earthquake activity in Canada in recent history. You can see that the most active region is in southwestern B.C. and off the coast. At this time, there is no reliable way to accurately predict when and where the next earthquake or other geohazard will happen—in B.C. or anywhere else in Canada or the rest of the world. But awareness leads to preparedness.

**Figure 4.23** Western and southwestern British Columbia experiences more than 300 earthquakes each year. Most are so small that they only register on sensing equipment. But devastating, large magnitude earthquakes have happened before, and they will happen again.



**Connect** to Investigation 4-I on page 327

### Activity

#### How Can You Stay Safe in the Places You Live?

Describe a geohazard that has affected where you live and/or could affect your region in the future. Consider how the presence of human communities can affect the impact of a hazard. What is your responsibility, and that of other community members, during such an event? Develop a safety plan for your family to follow if the hazard happens. Assign specific tasks to each member of your family.

### Before you leave this page . . .

1. What is a geohazard? Give an example of a geohazard in your area.

# Make a Difference

How can we make the places we live safer?

**M**ost of the damage that results from earthquakes is caused by the collapse of buildings, bridges, and other structures. The damage may happen as a direct result from the ground shaking, or it may occur later due to tsunamis, flooding, or fires caused by the event.

The provincial and federal governments have apps, websites, and publications aimed at helping people stay safe in the event of a geohazard. Depending on where you live in B.C., you may have special drills that you practise each year. Still, many people remain unprepared for an emergency.

## Question and Plan

1. Think about how you might prepare for an earthquake or other geohazard in your own home. What questions do you need to consider?
2. Develop an emergency plan for your home and family.

## Communicate

3. How can you make sure that everyone at home understands and will follow your emergency plan?

## Apply and Innovate

4. Think beyond your home. How can you modify your plan so that it is suitable in your community? How will questions change? What can you do to get the message out to a larger number of people spread out over a larger area?



# Check Your Understanding of Topic 4.4

QP Questioning and Predicting  
 PC Planning and Conducting  
 PA Processing and Analyzing  
 E Evaluating  
AI Applying and Innovating  
 C Communicating

## Understanding Key Ideas

- Why do people who live in British Columbia need to be especially aware of geohazards? Provide two reasons to support your answer. PA E
- Describe a geohazard that has happened or may happen in the area you live. How prepared are you to deal with its effects? What can you do to increase your level of preparedness? AI C
- Give two examples of how geological processes have influenced the region where you live. PA E C

## Connecting Ideas

- In planning to be prepared for a geohazard, describe what you think the responsibilities are for the following people.
  - individuals and their families
  - local city or town government officials
  - emergency response personnel
  - provincial and national assistance agencies E AI C
- In 2016, the provincial government spent or committed about \$2 billion to upgrade or replace 214 out of 342 schools that had been identified as being at risk in the event of an earthquake.
  - What factors do you think governments should consider when deciding how to fund projects like these, which are informed by reliable scientific information?
  - What ideas do you have that could provide funding for all schools that are at risk? QP E AI

- Use a table like the one below to describe the different impacts geohazards can have. Include at least two geohazards. PA E AI C

Economic Impact	Social and Cultural Impact	Environmental Impact	Political Impact

## Making New Connections

- The Celtic poet and philosopher, John O'Donohue, reflecting on the connections between people and places, once wrote: "Is it not possible that a place could have huge affection for those who dwell there? Perhaps your place loves having you there. It misses you when you are away and in its secret way rejoices when you return. Could it be possible that a landscape might have a deep friendship with you? That it could sense your presence and feel the care you extend towards it?"
  - Express your views on this passage.
  - In what ways does this passage express ideas that are similar to First Peoples ways of thinking about place and identity? E AI C
- Re-read the first sentence of Concept 2. Why might people choose to live in places where there is a demonstrated history of geohazards? What features of land, culture, and/or economy could override the potential risks? PA AI



**Skills and Strategies**

- Questioning and Predicting
- Planning and Conducting
- Processing and Analyzing
- Evaluating
- Applying and Innovating
- Communicating

## A Sense of Place

In this investigation, you will consider the place in which you live and the features that make it special or unique to you.

### Procedure

1. Think about the area that you live in and why it feels special to you.
2. Make a list of geologically related features of the area that you feel a connection with or that make the place unique. Also list other features about where you live that you feel make it special. This could be the history, culture, family members, plants, or animals of the area.
3. Plan how you want to represent these features. For example, you can collect items, take photographs, and draw maps.
4. Think of how you want to communicate your sense of place. For example, you could develop a display of these features in a display case that you make.
5. Have your teacher approve your plan before you start collecting the materials.
6. Carry out your plan.

### Analyze and Interpret

1. Present your display to other classmates. Write down the different ways that your classmates represented their sense of place. How did it compare with yours? How different or similar are they? Why do you think there are differences, even though you live in the same area?

### Conclude and Communicate

2. A person's sense of place develops from identifying himself or herself in relation to a landscape or area. How does the place you live influence how you think about yourself?

**Skills and Strategies**

- Questioning and Predicting
- Planning and Conducting
- Processing and Analyzing
- Evaluating
- Applying and Innovating
- Communicating

**What You Need**

Possible materials:

- toothpicks
- straws
- pieces of foam
- stir sticks
- pieces of polystyrene
- cardboard
- scissors
- tape
- glue
- metric ruler

## How Earthquake-Proof Is Your Structure?

Engineers spend a great deal of time designing buildings, bridges, roads, and other structures that can withstand seismic waves from earthquakes. The model structures are tested using shake tables. Shake tables model seismic waves under controlled conditions. In this investigation, you will design and build a structure, then test the structure's stability using a shake table.

**Question**

How earthquake-proof is a model structure?

**Procedure**

1. In a group, design a model building or other structure that is at least 0.3 m high. Your goal is to design a structure that can withstand a 1-minute imitation earthquake on a shake table.
2. Decide how you will rate the level of stability of your structure.
3. Draw and label your design.
4. Make a list of materials you will need and have your teacher approve them.
5. Build your model.
6. Test your model using a shake table. Make any improvements to your structure before testing it for 1 continuous minute on the shake table.

**Analyze and Interpret**

1. Describe what happened to your building when you tested it. Why do you think this happened?

**Conclude and Communicate**

2. Compare your structures and results to those of your classmates. Which structures tested the best? Which structures were the least stable? Why do you think some structures were more stable than others?

# Make a Difference

## Who Should Bear the Responsibility?

**T**here are many ways that people can find themselves in danger. Perhaps they have gone hiking, skiing, or sledding out of bounds. Maybe a geohazard or other natural disaster is occurring, and people are told to leave or to be prepared to leave on short notice.

### Who Should Pay the Cost of Being Rescued?

The ropes barring access to the ski hill sent a clear message: stay out. But a family of six, enjoying a day of skiing at Sun Peaks Resort in 2016, ignored the warning, and soon found themselves in need of help from Kamloops Search and Rescue. The family later made a donation to the search and rescue operation to express gratitude and to acknowledge that heading out of bounds in the first place was a mistake.

The official position of the B.C. Search and Rescue Association is that it will not charge for people who need the services of its nearly 2500 volunteers.

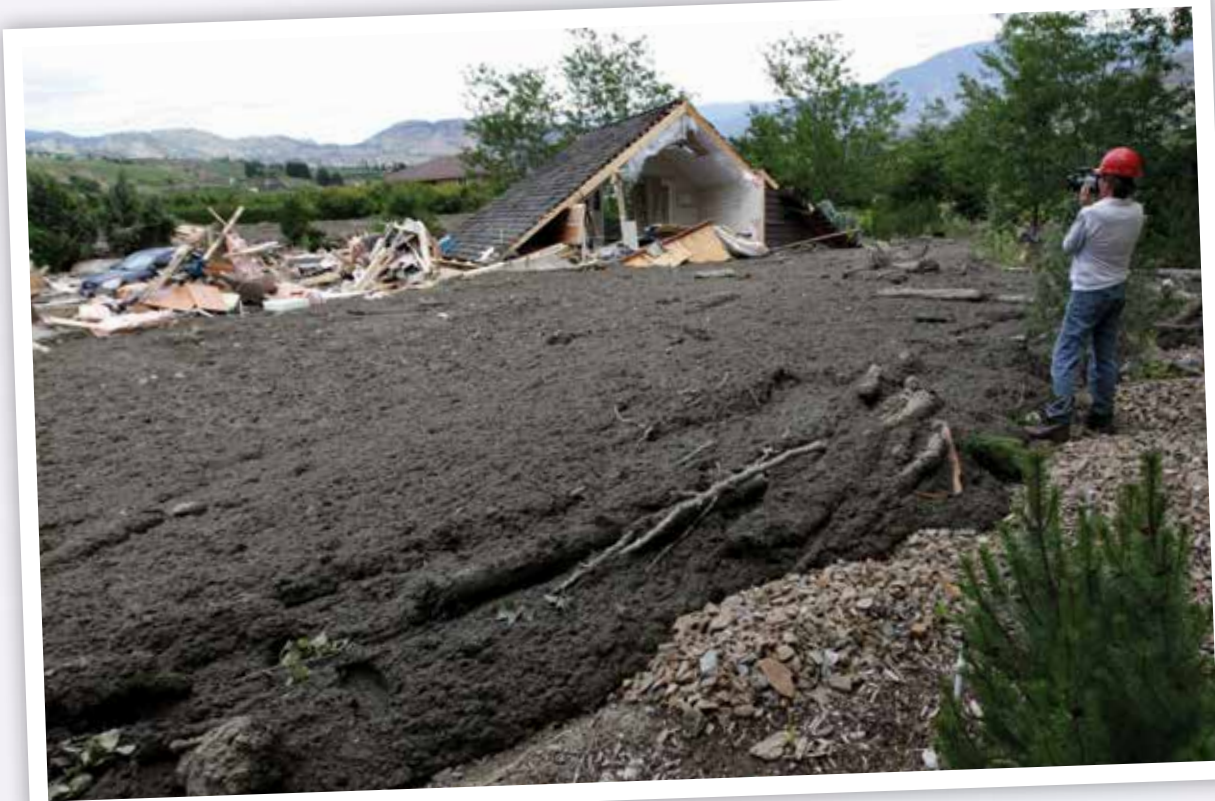
The British Columbia Search and Rescue Association (BCSARA) believes that the perceived or actual belief that a lost or injured person or their loved ones will be charged for a search and rescue response could directly affect the decision as to if or when a call for professional help will be made....The BCSARA will conduct search and rescue missions when requested to do so by the authorized tasking agencies for persons in danger or distress in the province of BC without charge. We will do so regardless of the reason they have found themselves requiring our assistance.

### Who Should Be Responsible for Personal and Community Safety?

A disaster is occurring or looming. Earthquake, tsunami, fire, flood, mudslide—whatever the cause, you have been given an evacuation order. This means you have been told that you are at risk and must leave the area

immediately. What if you choose to stay? *Can* you choose to stay—to ignore the order? The B.C. government began to consider changes to the current Emergency Program Act in January of 2016.





While the Act provides authority for local governments or the Ministry to make an evacuation order and “cause the evacuation” of people from an affected area, it says little of anything about how such an order is to be understood and carried out to ensure people are out of harm’s way. There is currently no authority under the Act or in other legislation to compel competent adults to leave their private property after an evacuation order is made—emergency responders warn people of the imminent risks of remaining in an area subject to evacuation, but ultimately rely on people to [voluntarily] evacuate.

### **Question and Analyze**

1. Two types of situations are presented here. What do they have in common? In what ways are they different?

### **Evaluate and Communicate**

2. Reflect on the questions used as titles for this feature. What are your views? Why do you hold them? What additional questions and/or information would either help you be more certain of your views or make you consider changing them?
3. Hold a class debate about a question or issue related to the matter of personal and/or collective responsibility in dangerous situations.