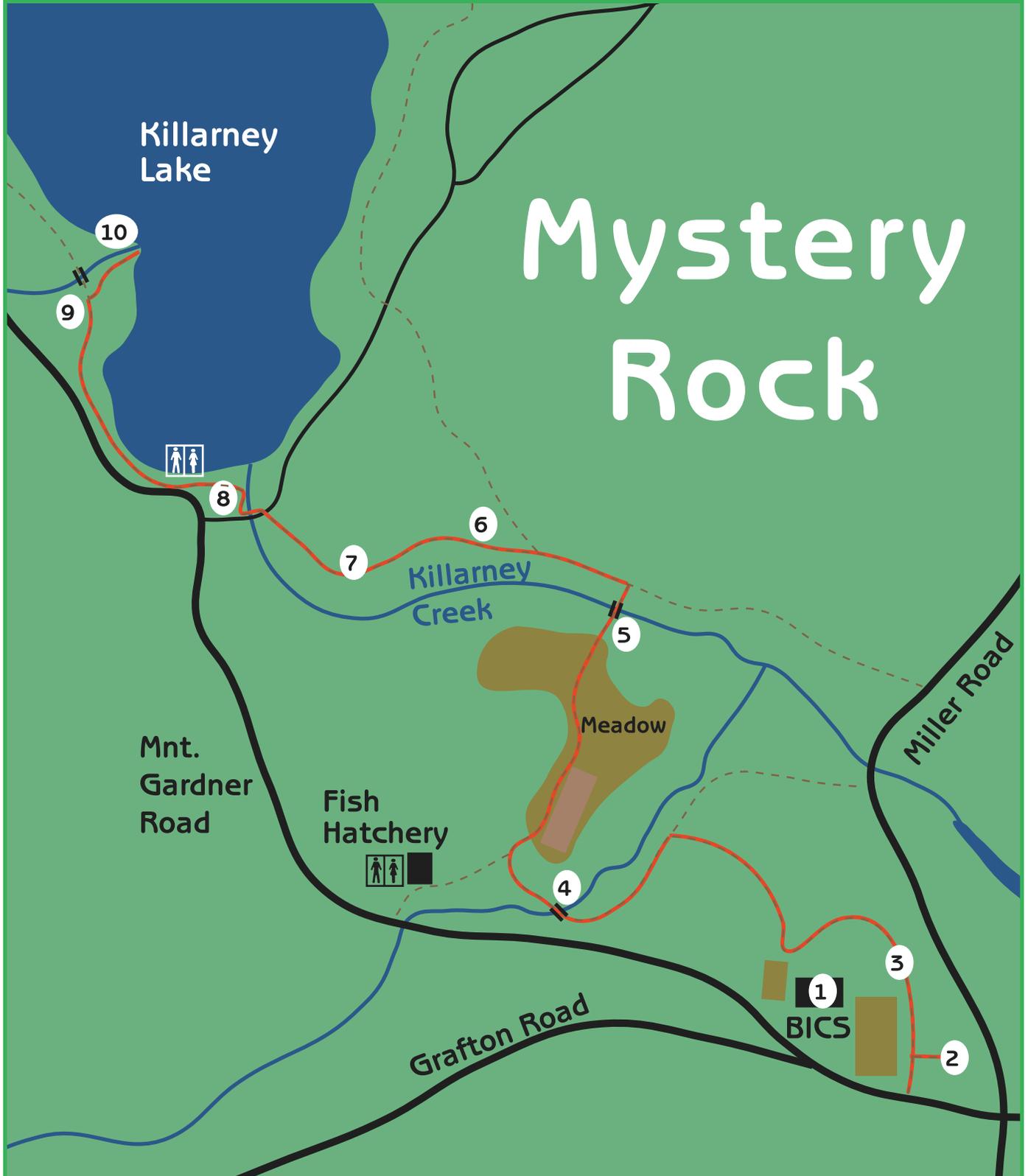


Map and Teachers' Guide



Mystery Rock

BICS
Teaching Trails

Mystery Rock

Mystery Rock Worksheet—Teacher's Version

Red italic text fills in answers and notes for you where they may be helpful. Detailed directions about finding the next activity stops are included as well. Students have these directions too, but not the map.

1. Mystery Rock Hypothesis

Where: Classroom

Assign students to groups, hand out one rock per group, and introduce the project, such as:

"These special black rocks were found here on Bowen Island, and there's a fascinating story about their origins. Where do they truly belong?"

"It's a mystery that you will figure out from clues along the trail. Use what you already know plus your observations to take a first stab at the answer. I'm going to give each group a mystery rock to refer to—just take 10 minutes to draft a hypothesis on your worksheet. I'll also need one person from each group to take on the role of rock-keeper, to make sure the rocks aren't left behind and that I get them back at the end of the day."

The Big Question:

What is the origin of your black mystery rock? Where does it belong?

Hypothesis:

Your best guess. Don't worry, this is just a starting point. You will check, revise and add to this statement as you collect clues and information along the trails. Use the extra lines below if you decide to write your hypothesis out again. *(Students have a whole front page for this.)*

Next Stop: Lookout for Bedrock and Mountain Clues



Cross the soccer field towards the big green metal box. Go through the gap in the fence and straight ahead, following the track up through the alder grove to the rock knoll.

2. Bedrock and Mountain Clues

Geologists have observed three kinds of bedrock on Bowen. Compare the exposed bedrock under your feet to your black mystery rock.

	Mystery Rock	Bedrock
Colour	<i>solid black</i>	<i>several colours</i>
Texture	<i>little holes</i>	<i>no holes</i>
Layers	<i>no</i>	<i>yes, evidence of mixed types</i>
Cracks	<i>no</i>	<i>yes, evidence of pressure</i>
Other		

Are there mystery rocks like yours here? **No.**

Look over at the North Shore Mountains, even if they are partly hidden by clouds. Ask others in your group to listen for clues to help solve the mystery as you read the following text out loud:

“Geologists have observed that the North Shore Mountains are formed of different rock types than Bowen Island bedrock. Squeezed and lifted by the slow, powerful movement of tectonic plates, the North Shore Mountains continue to rise to this day. Volcanoes have forced their way up through the mountains too along the edges of the moving plates. Mt. Garibaldi, for example, erupted near Squamish during the last ice age.”

Hypothesis Check

Make any changes or additions to your hypothesis using what you now know.

Next Stop: Sliding Rock



Walk back through the alder grove and turn right on the trail that runs beside the soccer field. Continue to the first rock outcrop on your left and make your way up to the top. The school will still be in view. The rock gets its name from the smooth slope that younger children sometimes use as a slide.

Mystery Rock

3. Sliding Rock Clues

Are there mystery rocks like yours here? **No.**

Can you see lines (not cracks) scratched into the rock's surface? **Yes.**

Do they point different directions, or approximately the same direction?

Approximately the same direction. These are scratches from rocks carried by the glacier ice that smoothed this outcrop.

What force could have smoothed this rock, other than the jeans of younger students?

Could it be the same force that flowed down from the higher mountains to carve the fjord that is Howe Sound?

Glacier ice and the rocks, gravel, sand and water inside and under the ice, grinding along.

Hypothesis Check

Turn back to page 1 and make any changes or additions to your hypothesis using what you now know.

Next Stop: Terminal Creek Bridge for Gravel Clues

Continue along the trails towards the meadow until you reach the bridge. Cross it, step off, and you are at the next stop, just at the base of the stairs.



4. Gravel Clues

Are there mystery rocks like yours here? **No.**

Are these rocks and gravel similar to other rock you have observed so far today? **No.**

There are some mystery rocks in the creek bed, but don't refer to them— hard to get down, it's hazardous for the banks, the kids and the fish in the creek, and you'll be looking at rocks in a creek later on.

How might this rock and gravel have got here? Could the mystery rocks have come the same way?

These rocks and gravel were carried here by truck from the mainland to armour the creek bank and harden the trail surface. The mystery rocks have not come the same way. They were carried here from the mainland too, but by glacier ice.

Hypothesis Check

Turn back to page 1 and make any changes or additions to your hypothesis using what you now know.

Next Stop: Root Hollow for Black Soil Clues



Turn right at the next T-junction and follow the trail through the meadow. Once you enter the trees, look for the lifted roots of a big blown-down alder tree on your left before you get to the next bridge. The soil exposed by the roots and in the ditch is the subject of the next stop.

5. Black Soil Clues

Are there mystery rocks like yours here? **No.**

Why is there more soil here in the valley bottom than at the sliding rock?

The creek just ahead has flooded many times in the past. The floodwaters have carried fine particles of mud and silt out onto the valley floor on this level ground. As these have settled out of the water, they have formed thick layers of dark, fine soils.

Hypothesis Check

Turn back to page 1 and make any changes or additions to your hypothesis using what you now know.



Mystery Rock

Next Stop: Green Culvert for Red Soil Clues



Continue, crossing the bridge and turning left at the T-junction. When the trail splits, take the lower left fork and begin to look for the edge of the green plastic culvert sticking out from under the right-hand edge of the trail. The exposed soil at the culvert is the subject of the next stop.

6. Red Soil Clues

Are there mystery rocks like yours here?

If the soil looks dark and not too different, pick up a stick and scratch it to see the raw red colour beneath. A few small ones may be noted. I wouldn't bother pointing them out, though—they are hard to see and distinguish.

What is different about this soil from the last spot? Why?

This soil is made of bits of coarse material (colluvial) that have been washed down hill but left behind here, while the fine muds and silts have washed down further to settle on the valley floor, as the dark fine (alluvial) soil at last clue site.

Read aloud to the others in your group:

"Rust gives the soil this red colour. Traces of iron in the soil and rocks are rusting (oxidizing) due to oxygen being constantly being carried past by water flowing through the soil on its way down the slope."

What else besides oxygen could the water carry?

The fine particles that ended up as part of the black soil on the valley bottom, and bigger particles, including small mystery rocks, can be moved during heavy rains.

Hypothesis Check

Turn back to page 1 and make any changes or additions to your hypothesis using what you now know.

Next Stop: Big Boulder



Continue along the trail. As it climbs, watch for two short but very stout nurse logs on the trail's edge to your right. Just past them is a big boulder, also on your right.

7. Boulder Clue

Is this rock type the same as your mystery rock?

No.

Is it similar to the bedrock from the first clue site? (Check your notes)

No. This rock has also been carried here from the mainland.

How might this boulder have ended up here, lying on the surface?

It was carried here by a glacier (glacial erratic), which let it down to rest here as the ice melted.

Hypothesis Check

Turn back to page 1 and make any changes or additions to your hypothesis using what you now know.



Mystery Rock

Next Stop: Tree Roots



Continue until the trail intersects with a gravel road. Turn left on the road and walk down. Turn right onto the next trail, and start watching for tree roots clinging to pale, exposed and broken rock on your left.

8. Tree Root Clues

Look at the rocks around the roots of trees on your left. Tree roots have been breaking the bedrock up by getting into tiny cracks and then growing bigger, forcing the rock apart.

Why might your mystery rock's edges be rounded and not sharp like those among the tree roots?
Mystery rock has had time to weather. It's been worn away and ground down.

Where have you seen rounded rocks on Bowen? _____

Where might you look next to find more mystery rocks?

- in soil creek beach soil's surface other
- (rarely)* *(yes)* *(yes)* *(yes, higher on Mt. Gardner)*



Next Stop: Creek Bed

Follow the trail through the picnic area and along the lakeshore. When you first catch sight of a bridge, step off the trail to the left to find the creek within a few feet. You may find a faint track to follow. If you overshoot and reach the bridge, just find your way a short distance upstream to a clear area without overhanging bushes.

9. Creek Bed Clues

Are there mystery rocks like yours here? **Yes!**

Introduce your mystery rock to others of its kind. Friends, at last!

Read aloud:

“The rocks here have rounded edges, partly from recently being tumbled with other rocks in the water as it flows down from the slopes of Mt. Gardner, wearing down those edges. Geologists think of creeks as creeks of gravel, with flowing water as the moving force that carries the gravel and rocks (bedload) along.

By the way, geologists have observed that the top of Mt. Gardner is not made out of rock like your mystery rock.”

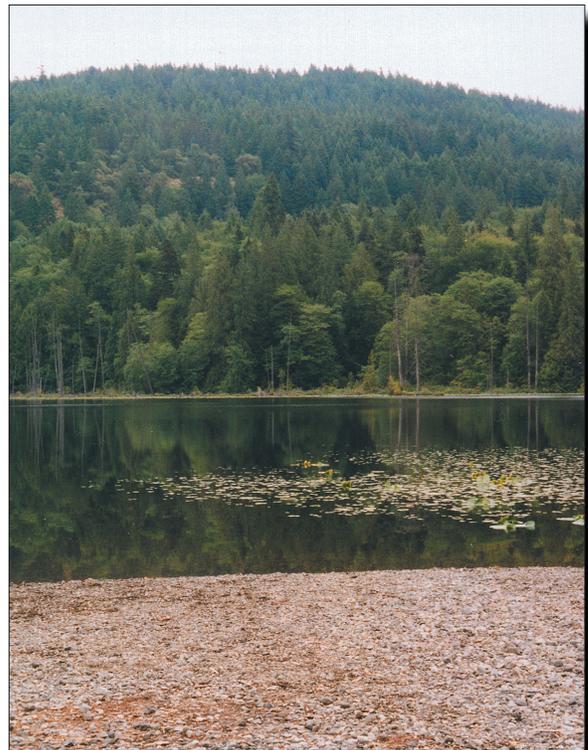
So where have these black rocks come from?

Last chance to revise your group’s hypothesis. Take some time to look back over all the clues to be sure that it describes the origin of the mystery rocks to the best of your knowledge. No need to be boring—the answer, to be revealed at the next and last stop, is surprising. Use the lines below to write it out fresh if you need the room.

The origin of the black mystery rocks is:

Next Stop: Rocky Beach for the Rock Show

You still don’t need to cross the bridge. Instead, head out to the lakeshore on the rocks and gravel.



Mystery Rock

10. Rock Show: Mystery Solved

Teachers—here's your chance to demonstrate the real story with a bit of participation fun thrown in. Gather your class on the beach.

"Ladies and gentlemen—the show is about to begin! Please gather round as the mystery of the black rocks is revealed.

Mark Bowen and Mt. Garibaldi Spots

"This is Bowen Island, where we are today. (Place a jacket or backpack on the stones.) And this, over here, is Mt. Garibaldi. (Put down another jacket or backpack about 15 feet away towards the lake, preferably a red or orange one.) Who remembers this clue from our first stop at the lookout? Right, Jack—it's the volcano near Squamish, further up Howe Sound. We don't think of it as a volcano today, but it erupted relatively recently, during the last ice age.

Glacier Ice

"Look up—there is solid ice above you reaching half-way up Mt. Gardner. It's 13,000 years ago, and glacier ice fills Howe Sound, flowing out from the high mountains beyond Whistler towards Vancouver Island like a slow, grinding river. Only the top of up Mt. Gardner is visible as the ice flows over Bowen Island, scratching those lines you may have seen back at the sliding rock.

Mt. Garibaldi Erupts

"That's when Mt. Garibaldi erupts, throwing molten lava into the air. Wow! It must have been quite a scene at night, with red light glaring out over sheets of pale ice, explosions and rumblings, and the cold dark sky above. Clouds of steam and smoke, too, I expect. Black pellets of lava fell onto the ice (lift a mystery rock from the Mt. Garibaldi jacket into the air). Did you notice the little holes that gasses had formed in the rocks as the lava cooled? I suppose the ice would cool them very quickly!

Lava Pellets Ride the Ice

"So now there are lots of little black lava pellets out there on the glacier's surface. Hold up your rocks too—way up, so that you can see some sky between your group's rock and Collin's Ridge on the other side of the lake. That's how high they were. Good!

Now it's time for them to travel. They ride the ice (move your rock gently through the air towards the Bowen jacket) slowly south, down Howe Sound, away from the volcano. It's as if the glacier was a giant conveyor belt. Did you notice how so many of those clues were about rocks or gravel being carried and moved?

Pellets Drop to Mt Gardner

"By the time they get to a spot above Bowen (bring your rock to a stop in the air), the ice age is ending, and the glacier stops moving. In fact, the glacier begins to melt, and lets the little black rocks down, far from home. Some others have passed by already and sink into Georgia Straight—that's you, Doug—or Howe Sound, if they erupted a bit later. I guess that must be you, Tina. Others settle onto Bowen, like yours, Jamie and Elizabeth (coax the other floating rocks into position), and carpet the lower slopes of Mt. Gardner like a bathtub ring or a wide collar as the ice rots away.

The Island Rises

"And now that the weight of the ice is gone, the rest of poor squashed Bowen Island begins to rebound from under the sea, where the weight of the ice had pressed it. So your rock, Alex, may have fallen onto the underwater parts of Bowen and been covered by marine sediments. As more of Bowen Island emerges from beneath the waves, some rocks, like Alex's, remain buried underground.

Pellets Move Downhill

But gravity and running water move some of them from Mt. Gardner further down the slopes, like the smaller soil particles we looked at. Smooth and rounded perhaps from their first days as a drop-like blob of lava hurled through the air, they wear down along their journey so that they are even smoother and rounder. Finally, they collect in creeks and on beaches lower on the island, where we find them today. The end.

Close to Hypothesis?

"How many groups had a volcano as part of their hypothesis? Who had these rocks pegged as lava? Great! How about a glacier as part of your

hypothesis? All those clues about rocks and soil materials on the move were supposed to hint at the idea of the mystery rocks coming to Bowen from somewhere else—did any groups include that idea in their hypothesis? How about Bowen rising higher out of the sea? If your hypothesis came close to describing the real events, congratulations!

Next Stop: Classroom

“Hold onto your worksheets. When we get back to the classroom, I’d like to see your original hypothesis and your final version, plus an explanation of your reasoning as you collected information on our walk today. So hang onto your thoughts as we walk back—and your rocks, because I’ll need to put them back into the Teaching Trails resource box.”

That’s it for the Mystery Rock excursion. Hope you enjoyed it!

