|  |
| --- |
| A picture containing rock, food, covered, fresh  Description automatically generated  Chapter 3. Beach Stones Have Stories to Tell  The Salish Sea Rocks!  Geobiologist: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  A drawing of a fish  Description automatically generated |
| Seashore stewardship pledge  I, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, do hereby solemnly pledge to be a good steward of the stream environment. This means that I will:   1. Listen to the instructors both in the classroom and in the field. 2. Walk on the shore with care to avoid hurting myself, others, and the stream life. 3. Treat all life forms (even rocks) with care and respect. 4. Use only wet hands to touch gently (using only two fingers) animals that I find. 5. Leave creatures attached to rocks because attempting to remove them can hurt them. 6. Not hold any aquatic life out of the water for more than one minute. 7. Leave no boulder overturned; I will carefully replace all rocks that I look under and I will only turn over rocks that are smaller than my head. 8. Return all organisms to their homes or where I found them.   Signed: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Dated: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  ORGANIZE YOUR EXPLORE TEAM  Salish Sea Explorers use teamwork to solve mysteries and save the day for sealife. Thank your last Teammates for their support and good ideas. Form a team and select one of these equally valuable roles, then start to explore!  Team Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   |  |  | | --- | --- | | **Chief Scientist**  Research manager  -suggests research projects  -ensures proper scientific protocol  Project manager  -ensures each team member has a job and stays on-task, motivates team with positive encouragement  -Ensures project completion  Assists all other positions as needed | **Research Associate**  Conducts background research online, in books, interviews, videos, or magazines  Methods manager  -ensures research procedures are legit.  Recorder  -records and enters data in data tables  -records summaries of team’s work  Assists all other positions as needed | | **Field/Lab Technician**  Materials manager  -gets supplies and makes sure they are in  working order  Keeps workstation organized  Infographic artist  -creates graphs from data table content  Assists all other positions as needed | **Science Communicator**  Reporter  Graphic artist  Presentation manager  -slideshow, poster, video, etc.  Translates complex science into words the general public can understand  Assists all other positions as needed | | **Cultural Liaison** (for 5 person groups)  Researches and records input and perspectives of members of the local Coast Salish Tribe (US) and/or First Nations (Canada). Finds Indigenous stories, songs, art, or knowledge keepers who can teach us about keeping Salish Sea ecosystems balanced. | For long-term projects, switch roles every 4 weeks  **GO TEAM!** |  A close up of a sign  Description automatically generatedLook at the journal cover photo.Describe and/or draw what you see.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Knowing that the fish in these eggs need just the right size of beach rocks to survive, what does this photo make you wonder?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Could beach stones reveal clues to how they came to be there? Ready to rock some mystery-solving? Let’s explore! Write our Essential Question Here: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Ch. 3 Beach Stones have Stories to Tell-inspired thoughts  What did this Explore chapter bring to mind? Use this space to free-write and/or draw your thoughts, ideas, questions, and clues. |
| GEOLOGY VOCABULARY  Circle or highlight unfamiliar words and add your own. Return to define them in words and/or pictures as you figure them out through use.   |  |  | | --- | --- | | Geology Words | Definition | | Geologist  Geosphere  Sediment  Hydrosphere  Sea level rise  Erosion  Glacier  Physical weathering  Rock cycle |  |   https://static1.squarespace.com/static/5ad57fbf8f513006a1fadc53/t/5c7d751dee6eb03f802df45f/1549926130994/study.png?format=300w DOING SCIENCE VOCABULARY  Circle or highlight unfamiliar words and add your own. Return to define them in words and/or pictures as you figure them out through use.   |  |  |  | | --- | --- | --- | | Geology Words | Definition | | | Research question  Investigate  Data  Analyze  Interpret  Reason  Explain |  | | | Successful spawning beach characteristics | | Unsuccessful spawning beach characteristics | | | **A picture containing object, mirror  Description automatically generated**From Photos  A picture containing icon  Description automatically generated  From Traditional Knowledge | |  | |   https://static1.squarespace.com/static/5ad57fbf8f513006a1fadc53/t/5c7d751dee6eb03f802df45f/1549926130994/study.png?format=300wA moon in the sky  Description automatically generated with low confidence***Nature Detective Activity:***  Sediment Grain Size Survey  Estimate the percent of your site covered by each of the following sediment grain sizes in your Explore Team’s site. Research Associates will communicate your data to other teams for comparison.   * Place your quadrat (square) or hula hoop in your designated site. * Observe the sediments inside of this frame only. * Use calipers or a metric ruler to measure grains of sediment until familiar. * Starting with the smallest grain size category, estimate how much of your square or hula hoop is covered by each size category. Example: If half of the sediment in your site is less than 0.06mm, write ***50%*** under Clay/Silt. Record data in table.   **Data table**:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Site number** | **% Clay/Silt** <0.06mm | **% Sand** 0.06-2mm | **% Pebble** 2.01-64mm | **% Cobble** 64-256 mm | **%Boulder** > 256 mm | | Site 1 |  |  |  |  |  | | Site 2 |  |  |  |  |  | | Site 3 |  |  |  |  |  | | Site 4 |  |  |  |  |  | | Site 5 |  |  |  |  |  | | Site 6 |  |  |  |  |  |     If your site were a forage fish spawning beach, does it have the right size of sediments for surf smelt? How about for sand lance??  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  ***Nature Detective Activity:* Forage fish beach comparison**   |  |  | | --- | --- | | Claim  • What are the characteristics of successful spawning beaches?   * What are characteristics of unsuccessful spawning beaches? | Evidence 1  • What do the photos show? | | Evidence 2  What do the graphs show?  Grainsize:  Shade and armoring | Reasoning  • **E**xplanation – why do you think this is so? |   ***Shape  Description automatically generated with low confidence Model It!*** Design a forage fish Dream Beach, then build it  A picture containing sign, dark  Description automatically generated Model Presentation Notes   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Beach Model Rubric | Checkmark with solid fill  Checklist | Components to remove | Components to revise | Components to keep as is | | Beach Model Design diagram with labels for each beach feature |  |  |  |  | | Sediment grainsize |  |  |  |  | | Upland structure |  |  |  |  |   ***Shape  Description automatically generated with low confidenceModel It:*** Beach Erosion  Use supplies available to model forces that might remove sediments from your forage fish spawning beach. Write and/or draw to record your observations below.  What were the “natural” forces that eroded sediments from your beach?  ***Shape  Description automatically generated with low confidenceModel It:*** Beach Deposition (building)  Use supplies available to model forces that might deliver new sediments to your  forage fish spawning beach when others are eroded away. Write and/or draw to record your observations below.  What was the source of beach sediments that replaced those eroded away?  What were the “natural” forces that delivered new sediments to your beach?  ***Nature Detective Activity:*** Rock Rainbow  Beach stones really do have stories to tell. They can tell how and where they formed. Do you notice any characteristics that might help you tell these rocks apart?  \*Figuring it out \*What to do:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | \*Can you see individual specks of color in your rock?  \*What makes up the colors in your rock?  \* What might the colors and textures tell you about how your rock was formed? | 1. Select a rock. Choose carefully! You might just get attached.   |  |  | | --- | --- | | Draw your rock here, using color | List of features | | Give your rock a name 😊 | What can you tell about how it formed? | |   ***Nature Detective Activity:*** Rock Detective  \*Do you know: \*What to do:   |  |  | | --- | --- | | A dichotomous key is a list of clues and characteristics that help you classify an object or organism. | 1. Gather materials:   * dichotomous key * magnifying glass * piece of glass (for scratch test) * steel nail * white vinegar in a dropper bottle * plastic pipette or eye dropper (if vinegar is not in a dropper bottle)   2. Answer questions # 1 – 22 in your dichotomous key.   * You will do a scratch test if you are directed to # 6 or # 20. Be very careful.   Does your rock leave a scratch mark on glass? \_\_\_\_\_\_   * You will scratch the rock with a nail if you are directed to # 11.   Can you scrape grains of sand off the rock? \_\_\_\_\_\_\_  3. Put together all of your clues and identify your rock.  My rock is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(rock ID)    It is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ rock (igneous, sedimentary, or metamorphic)  4. Was your original hypothesis about the type of rock correct?  I hypothesized that my rock was a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ rock. I discovered it is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_! |   **A picture containing object, mirror  Description automatically generated*Nature Detective Activity:*** Clues to the Past   |  |  | | --- | --- | | \*Remember how density differences set the ocean in motion?  \* And how warm water rose to float on cold?  \*And how fresh water was buoyed up on salt water?  \*How could this apply to the Earth? | A close up of a map  Description automatically generatedWhere in the Earth was your rock born? Use a magnifying glass or dissecting scope to view your own rock, looking for clues to its origin.  Did your rock form from molten lava or magma? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  CLUES \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Did your rock form from ***sediments,*** eroded bits of other rocks and shells, cemented together in a sea or lake bed? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ CLUES \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Did your rock form from heat and pressure squishing and twisting other types of rocks deep in the earth? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  CLUES \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | |

Diagram

Description automatically generated***Nature Detective Activity:*** Rock Cycle Cookies

Take turns narrating the story of the formation of the rocks of the Salish Sea. Bold names are the characters in this rock cycle story. Numbered steps are instructions to follow. Place the ingredients one at a time onto a paper plate to be “eroded” into the glass bowl.

*Option*: make up your own erosion events for each layer of sediments in the sedimentary rock.

**Glacier:** *Snows piled high, and glaciers grew. Their heavy weight made them move downhill, scouring the Georgia Depression, scraping rock from mountains and grinding it into silt and clay as they went*

1. Scrape the “clay” (butter or coconut oil) into the bottom of the bowl with a “glacier” (ice cube or block), then smooth it evenly on the bottom.

**Mechanical Weathering 1:** *Freezing temperatures turned water in the mountain peaks to ice, which cracked stones that the glaciers ground to dirt, sand, and silt, and then bulldozed into the lowlands.*

2. Scrape the “dirt” (brown sugar) into a layer on top of the butter, using the ice.

**Mechanical Weathering 2:** *Winds blew these sands into the lowlands and temperatures started to rise.*

3. Blow the “sand” (white sugar) into a layer on top of the brown sugar, using a fan or hair dryer.

**Glacial Tilly:** *Glaciers receded, melting back north and eastward, leaving great piles of sand and gravel, called glacial till. Dirty meltwaters filled the basin that would become the Salish Sea.*

4. Pour in the egg or applesauce. Add the vanilla.

**Salty:** *Salts stored in rock dissolved and washed downhill into the basin, adding salt to the newly-forming sea.*

5. Sprinkle the salt into the bowl.

**Rainy:** *Heavy rains and streams weathered ancient seashells from the top of the mountains that used to be under the ocean and eroded them into the new sea below.*

6. Pour a tablespoon of warm water into the baking soda, stir, and sprinkle it into the bowl.

**Glacial flour:** *Temperatures dropped and glaciers returned, grinding stone into powder, then melting away again, delivering glacial flour into the newly-forming sea.*

7. Pile the flour onto the paper plate mountains and push it into the bowl with the ice block.

**Sedimentary Rocky:** *The layers of sediments reacted with minerals in the water and hardened over time, like cement. This became* ***sedimentary rock****.*

8. Place a tray onto the flour and press the layers of “sediments” together.

**Plate Tectonic:** *The Juan de Fuca plate slid beneath the N. American plate, causing earthquakes that broke up mountainsides into boulders. Some tumbled into the sea. This shaking broke up the sedimentary rock and mixed the sea.*

9. Pour in the chocolate chip boulders and mix all ingredients together.

10. Place the silicone or parchment paper onto the cookie sheet and pour 1 c. of dark chocolate chips into a pile in the center. Spread the “sediment” (raw dough) evenly over the cookie sheet, covering the pile of chocolate chips.

**Subduction Zone:** *The rock of the Juan de Fuca plate was heated as it slid into Earth’s oven in the process of subduction.*

11. Slide the sheet into the “subduction zone” (oven). Bake at 375°F for about 10 minutes. 2-3 Teams can “subduct” at a time, if there is just one oven.

\*This is a good time to do the rock cycle dance and get some wiggles out.

**Metamorphic Rocky**: The sedimentary rock went deep into the earth where extreme heat and pressure twisted, compressed, and deformed it, making it into ***metamorphic rock.***

12. Remove cookies from oven and while still hot, press, twist, and smear the cookie. Watch how the chips stretch and smear, like the sedimentary rocks, limestone turning to marble, or shale turning into slate.

**Vulcan:** The subduction melted a great chamber of magma, releasing steam and building pressure. The pressure could not be contained, made its way to the surface, pushing up mountains on its way and exploded in a volcanic eruption.

13. Poke a hole into the cookie over the mound of chocolate chips and press down, letting the lava squirt and ooze over the surface of the cookie.

**Igneous Rocky:** The lava hardened, becoming ***igneous rock.***

14. Allow the cookies to cool and the chocolate: lava: to harden.

**Earthquake:** Earthquakes caused by moving plates continued to break up the Earth’s crust in this part of the Ring of Fire.

15. Slide a spatula beneath the parchment paper or silicone sheet and lift to break up the hard cookie into pieces.

Enjoy “weathering and eroding” your cookies in your mouths! Rocks never tasted so good! 😊

**A picture containing object, mirror

Description automatically generated*Nature Detective Activity:*** Clues to the Past

Draw and/or describe what moving your ice block “glacier” down your “mountain” did to the mountain sediments

what story does your beach stone have to tell?

Write, draw, or cartoon the story this ancient stone has to tell, from its birth to its discovery by you.

A picture containing sign, dark

Description automatically generated Model Presentation Notes

What we tried to allow for sediment deposition (beach building)

What we observed

What we tried to protect shoreline buildings

What we observed

**Model Suggestions from Peers**

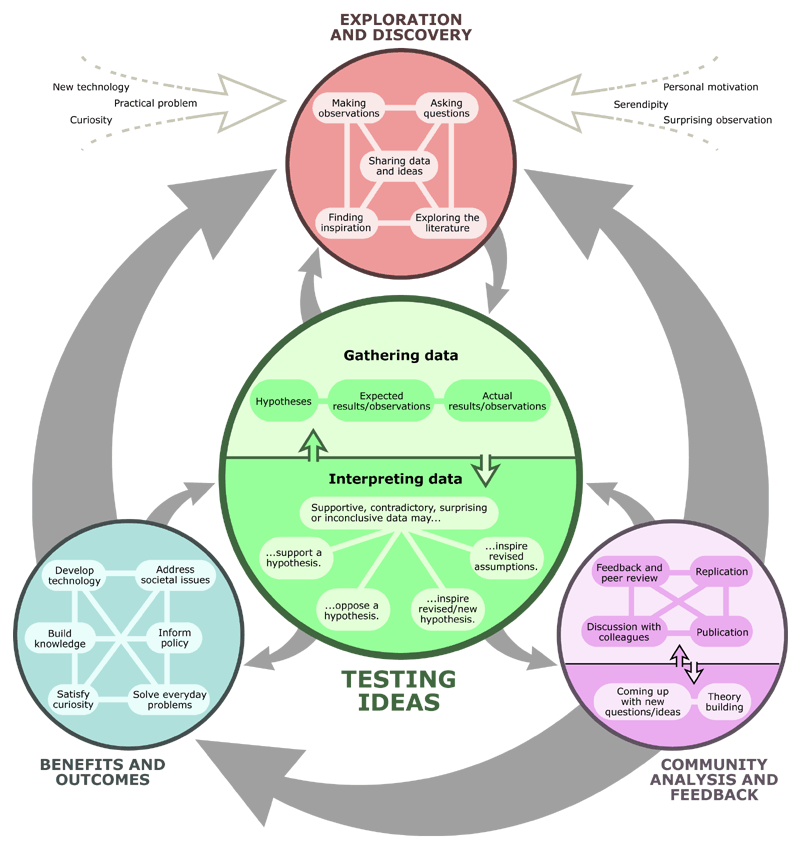
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Beach Model Rubric | Checkmark with solid fill  Checklist | Components to remove | Components to revise | Components to keep as is |
| Beach Model Design diagram with labels for each beach feature |  |  |  |  |
| Sediment grainsize |  |  |  |  |
| Upland buildings and structure protection |  |  |  |  |

***A close up of a logo

Description automatically generatedTeam Read:*** When is erosion a good thing for fish?

|  |  |
| --- | --- |
| \*Forage fish support much of the web of life in the Salish Sea. They are eaten by salmon, sea birds, seals, and porpoises.  \*Surf smelt are one type of forage fish. They spawn at high tide on sand and gravel beaches where shade from trees protects their eggs from the sun and wind.  \*Surf smelt need just the right size of sediments for their eggs to survive.  \*Sand and pebbles deposited by glaciers is just right habitat for surf smelt spawning. | Team Read the article, “Surf Smelt need sand and gravel beaches.” By dividing it between your Explore Team members.  NOTES:    2. Summarize your part of the reading here:    \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  3. Write your summary in your corner of the Team Read poster |

**HOW SCIENCE WORKS**



 ***Put Science to Work*** SPAWNING SURVEY

Research Title: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Research Question:** Focus and simplify your research by beginning your question with one of these sentence starters: **Is, Are, Do, Does, Will…** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Choosing Variables:**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

one **changed/manipulated/independent** variable (what you will compare) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

one **measured/responding/dependent** variable (what you will count/measure)

1\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Hypothesis/Prediction** (not all research is hypothesis-driven, so this step may be skipped, if yours is a survey or collection of interviews with elders:

We predict that if \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ then\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Diagram:** Draw a labeled illustration of the experiment or survey. Show all materials in action.

**Procedure:** Number step- by-step directions for how to do the experiment.

1. Tell how you will set up the experiment.
2. Tell how you will change the manipulated variable.
3. Tell how you will measure the responding variable.
4. Tell how many times you will take and record measurements.
5. Tell how many times you will repeat each test/observation.

**RESULTS**

**Data table: Sediment grainsize survey:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Site number | % Clay/Silt <0.06mm | % Sand 0.06-2mm | % Pebble 2.01-64mm | % Cobble 64-256 mm | %Boulder > 256 mm |
| Site 1 |  |  |  |  |  |
| Site 2 |  |  |  |  |  |
| Site 3 |  |  |  |  |  |
| Site 4 |  |  |  |  |  |
| Site 5 |  |  |  |  |  |
| Site 6 |  |  |  |  |  |

**Data table: Shade and armoring**

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| --- | --- | --- | --- |
| Site number | % Shade | Sea wall Y/N | Notes (trees, buildings, type of sea wall) |
| Site 1 |  |  |  |
| Site 2 |  |  |  |
| Site 3 |  |  |  |
| Site 4 |  |  |  |
| Site 5 |  |  |  |
| Site 6 |  |  |  |

**Data table: Forage Fish Survey**

|  |  |  |  |
| --- | --- | --- | --- |
| Site number | # of Live eggs | # of Dead eggs | Notes |
| Site 1 |  |  |  |
| Site 2 |  |  |  |
| Site 3 |  |  |  |
| Site 4 |  |  |  |
| Site 5 |  |  |  |
| Site 6 |  |  |  |

**Graph:**

1. Label axis (x-axis = changed, manipulated, or independent variable, y-axis = measured, responding or dependent variable) and Title
2. Number the y-axis (use > half the graph, use even intervals, consider scale)
3. Plot data

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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y-axis title \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

x-axis labels \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

x-axis title \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Notes:**

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|  |  |
| --- | --- |
| Claim  • State what you think is the answer to your research question, according to your data. | Evidence 1  • What does the graph show? |
| Evidence 2   * Do the math, what are the numerical differences between the two measured (responding or dependent) variables? *Example*: How many more live eggs on a natural beach vs. a built beach on average? | Reasoning  • **E**xplanation   * Why you think you got the results that you did, and possible errors that may have changed your results. |
| Implications  • What does this information mean for the wildlife, ecosystem, your community, the wider world? | Applications  • How should this new knowledge be applied to change human behavior, change public policy, and/or improve the ecosystem?  • What are your science and/or traditional knowledge-based recommendations? |

These stamps certify achievement of the following:

Rock Detective

Geobiology Genius

Glaciologist

A close - up of a robot

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Description automatically generated

Research Scientist

Forage Fish Friend