

Overview:

Students create a 3-D model of a hypothetical island community. They make observations and use what they know about tsunami preparedness to create an emergency response plan for the community.

Targeted Alaska Grade Level Expectations:

Science

[5-8] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[6] SE2.1 The student demonstrates an understanding that solving problems involves different ways of thinking by identifying and designing a solution to a problem.

Targeted Alaska Cultural Standards:

[A5] Culturally knowledgeable students are well grounded in the cultural heritage and traditions of their community. Students who meet this cultural standard are able to reflect through their own actions the critical role that the local heritage language plays in fostering a sense of who they are and how they understand the world around them.

Objectives:

The student will:

- make generalizations about how to respond to a tsunami;
- learn local native language terms related to tsunami response;
- construct a topographic model of a hypothetical island community;
- observe features of the hypothetical community;
- identify areas and structures within the hypothetical community that are at risk of tsunami inundation;
- develop a plan to help the model community respond to a tsunami; and
- communicate the tsunami response plan to others.

Materials:

- 5 craft foam sheets (9 inch x 12 inch x 6 millimeter) or an equal quantity of cardboard per group
- Black permanent markers (fine tip, one per group)
- Sharp sturdy scissors (one per student)
- Glue sticks (one per group)
- Rulers (one per student)
- Drawing compass (one per student)
- Highlighters, yellow, orange, and blue (one set per group)
- STUDENT INFORMATION SHEETS: "Layer 1," "Layer 2," "Layer 3," "Layer 4," and "Layers 5-8"
- STUDENT INFORMATION SHEET: "About Beready Island"
- VISUAL AID: "Beready Island"
- STUDENT WORKSHEET: "Native Language and Tsunami Response"
- STUDENT WORKSHEET: "Planning a Response"

Whole Picture:

Most Alaska coastal communities do not have an approved community-wide tsunami readiness and response program in place. The National Weather Service has developed TsunamiReady™ to help communities prepare for tsunami emergencies. The activities students undertake in this lesson emulate those emergency managers must undertake to ensure their community is TsunamiReady™.

It is essential that coastal residents and people visiting coastal areas know how to respond to a natural or official tsunami warning. Natural warnings come in a variety of ways. These include: a strong earthquake that lasts 30 seconds or longer; a sudden rise in coastal water; ocean drawing back and revealing sea floor; and/or a roaring from the ocean. Official warnings also come in a variety of ways. These include: Emergency Alert Systems, Cable Overrides, NOAA Weather Radio announcements in public buildings, sirens and other systems. All tsunami warnings should be heeded immediately, lives may depend upon it.

Here is how to respond to a tsunami warning:

- Get to high ground (100 feet above sea level)! If there is no high ground, go at least one mile inland or to the top floor of a reinforced concrete multi-story building (use the stairs).
- Follow evacuation signs (if there are any).
- Go to the tsunami shelter (if there is one).
- Warn others as you go.
- Keep calm and listen to emergency officials.
- If you can see the tsunami, it is too late; tsunamis move faster than you can run.
- Expect more waves—a tsunami is a series of waves, not one single wave.
- Later waves can be bigger and more dangerous than the first wave. Later waves or the backwash from the first wave can be particularly dangerous since the water is now carrying debris.
- A tsunami may be small at one beach and giant a few miles away.
- Stay tuned to your radio, marine radio, NOAA Weather Radio or television.
- Keep emergency supplies at the ready. Prepare for power failures and water shortages.
- Wait for emergency officials to give the “ALL CLEAR.”

As students use their models to complete the STUDENT WORKSHEET: “Planning a Response,” remind them that the gentler the slope up from a beach, the higher the run-up can be. This means the greater the distance between the contours, the greater the danger and the farther inland a person will have to go to reach 100 feet above sea level.

The chart below contains several native language words related to tsunami readiness and response. Familiarize yourself with the language used in your area. If you are not familiar with the pronunciations, ask a local speaker to teach you how to pronounce the words in the chart. The dialect in your area may be different than what is listed in the chart. Ask a local speaker if there are additional or different translations.

English	Sugt’stun	Western dialect of Unangam Tunuu	Eastern dialect of Unangam Tunuu
be ready	Taqumaluni (he/she/it is)	aagasix (Literally: to make ready, prepare)	aᵗsaasa-lix (Literally: to prepare)
run away, get away, flee	qimagluni (he/she/it is)	aqi-lix	iqi-lix
high, tall, elevated	qertuluni also qus’igluni (he/she/it is)	qaya-lix	qaya-lix
climb, ascend	mayurluni or qulwarluni (Literally: go higher) (he/she/it is)	hanga-lix	hanga-lix also ayuᵗ-six
<i>Sources: Sugt’stun (Leer 1978, Drabek 2008), Unangam Tunuu (Bergsland 2001)</i>			

Activity Preparation:

1. Construct an island model to use as an example (see Activity Procedure step 3).
2. Ask a local native language speaker to read the words in the chart above. Find out if there are different or additional words with the same meaning in the local dialect. Add these words to the chart on the student worksheet before photocopying it for students.
3. Review TsunamiReady™ guidelines provided by the National Weather Service at: <https://www.weather.gov/tsunamiready/guidelines>.

Activity Procedure:

1. Distribute the STUDENT WORKSHEET: “Native Language and Tsunami Response” and ask students to work in pairs to practice the words, then complete the worksheet individually.
2. Divide students into teams of 2-4 and ask teams to look at each others’ posters and identify common and unique features. Discuss the posters as a class. How did students recommend that people respond to a tsunami? How did they illustrate the response(s)?
3. Explain students will work in groups to make a topographic model of Beready Island, a hypothetical community. Show them the example. Explain after creating the model, students will work in their groups to develop a tsunami response plan for Beready Island, and compare their response plan to those recommended by their peers and finally that recommended by emergency managers.
4. Provide each team of students with the STUDENT INFORMATION SHEETS: “Layers 1-8,” a black permanent marker, scissors (1 per student), a glue stick and 5 sheets of craft foam.
5. Ask teams to cut out each layer along the solid line, then trace the outline of the layer onto a sheet of craft foam using the permanent marker. Cut out each craft-foam tracing, then glue each paper cutout to its corresponding piece of foam. Finally, glue the layers together (with Layer 1 on the bottom and Layer 2 on top of it, etc.) so that a three-dimensional map results.
6. After all teams have completed their models, ask students to identify the areas most at risk of tsunami inundation. Explain in order to determine risk for an area, tsunami response planners must determine: a. the presence of tsunami hazard; and b. the population of the area. If the area is not coastal, or if no people live in or frequent the area, there is no tsunami risk. Ask students what people in these at-risk areas should do in the event of a tsunami.

Students will likely respond that the people should get to high ground as quickly as possible. This is correct. Ask students how long people should stay away from the beaches and how “high” is high ground.

7. Distribute the STUDENT INFORMATION SHEET: “About Beready Island.” Display VISUAL AID: “Beready Island” on an overhead projector. Ask students to carefully examine the visual, their own models, and to read about the island. Explain community emergency management officials help create tsunami response plans that meet the needs of individual communities. Students will be playing the role of the emergency managers for Beready Island. Ask the class to share the following:
 - a. On your model, by what routes should people evacuate?
 - b. Where should they go? How long should they stay there?
 - c. What buildings will serve as temporary tsunami shelters if the tsunami destroys or does significant damage to peoples’ homes?
 - d. Where should tsunami sirens be located?
8. Hand out STUDENT WORKSHEET: “Planning a Response” and explain students will create a plan using their models, the visual aid and the worksheet as a guide. NOTE: It is up to the teacher whether this activity is done individually or as a class. The lesson uses language directly from the National Weather Service TsunamiReady guidelines and may be overwhelming or confusing to younger students.
9. Once students have completed steps one through eight, either individually or as a class, allow students time to share their models with the rest of the class. If time allows, read the section on page three of planning worksheet titled, Further Information.

10. Follow up with critical thinking questions:
 - a. Did anyone place a tsunami siren on the side of the island that had no homes or businesses? Why or why not?
 - b. Why did you choose the evacuation route that you chose?
 - c. Where would you choose to hold a community meeting to talk about tsunami safety? Why?
 - d. If homes were damaged and electricity was out for a time after a tsunami, where might you set up a temporary shelter for displaced families?
 - e. If you were near the hotel and a tsunami siren sounded, would you try to follow an evacuation route up hill or would you head up to the second or third floor of the hotel? Why?

Extension Ideas:

1. Have students research the tsunami response in Samoa and New Samoa. In Samoa at least one school bus driver decided to drive the kids away from the school, which was deemed a tsunami-safe facility. The bus then got stuck in traffic and stuck in the inundation.
2. Have students use the same type of modeling to compare and contrast a local tsunami versus a distant tsunami.

Answers:

STUDENT WORKSHEET: “Native Language and Tsunami Response”

1. Answers will vary according to community.
2. Answers will vary but should reflect movement inland and uphill.

STUDENT WORKSHEET: “Planning a Response”

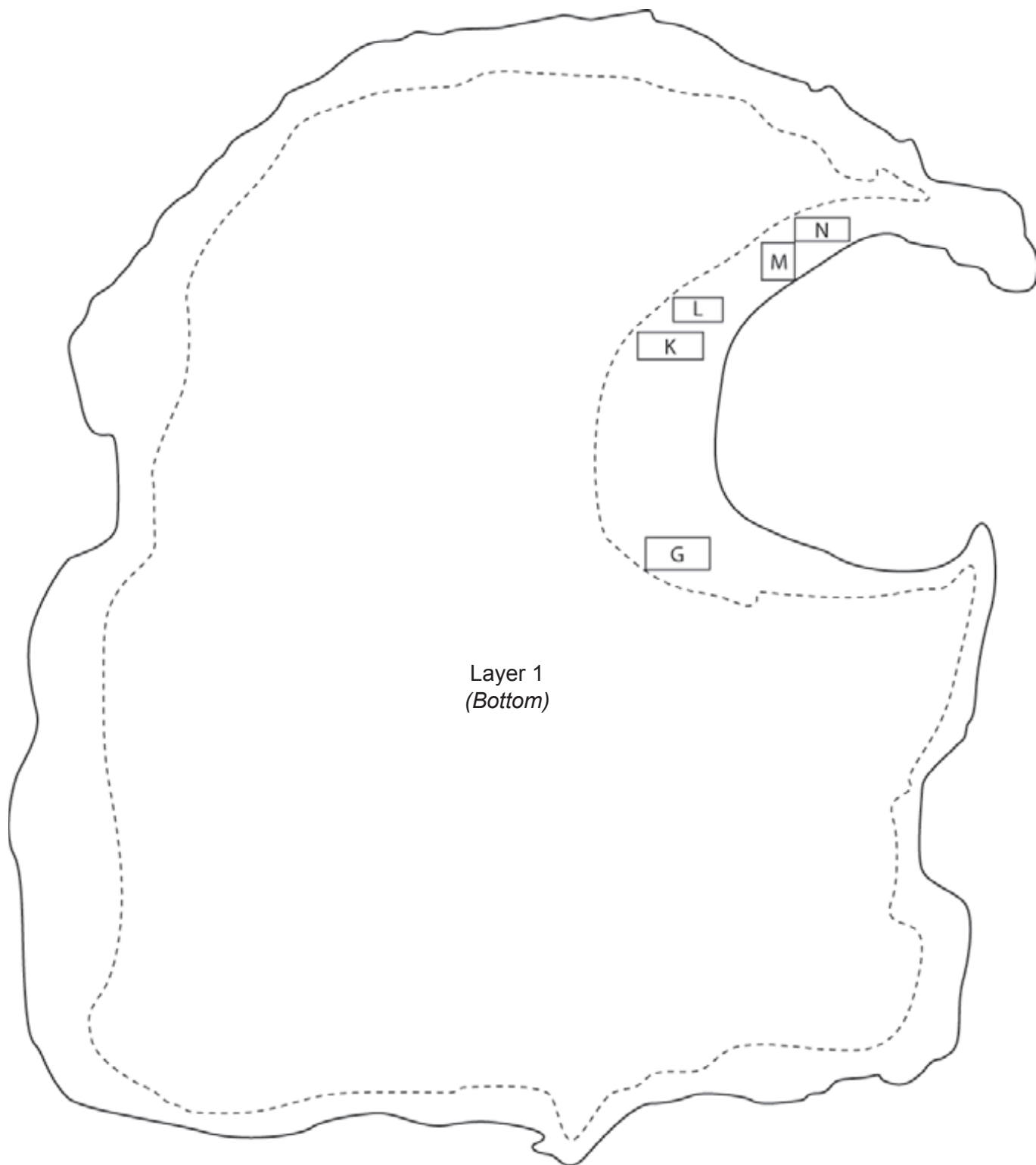
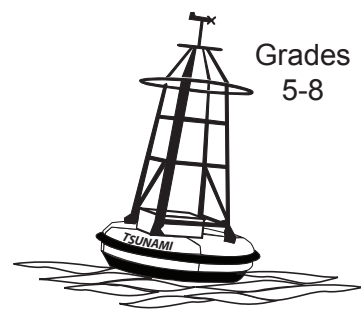
Answers will vary.

Lesson Information Sources:

- Bergsland, K. (2001). *Aleut dictionary = Unangam tunudgusii: An unabridged lexicon of the Aleutian, Pribilof, and Commander Islands Aleut language 2nd Edition*. Fairbanks, Alaska: Alaska Native Language Center, University of Alaska Fairbanks.
- Drabek, A. S. (2008). *Qik’rtarmiut Sugpiat Niugneret cali Patriitat: Kodiak Island Sugpiaq Words and Pictures*. Alutiiq Museum.
- Intergovernmental Oceanographic Commission. (2008). *Tsunami, The Great Waves, Revised Edition*. Paris, UNESCO, 16 pp., illus. IOC Brochure 2008-1 (English). Retrieved 4 May, 2009. <http://www.tsunamiready.noaa.gov/>.
- Leer, J. (1978). *A conversational dictionary of Kodiak Alutiiq*. Fairbanks: Alaska Native Language Center, University of Alaska.
- National Weather Service. (n.d.). *TsunamiReady Guidelines*. Retrieved 21, July, 2009. <http://www.weather.gov/stormready/tsunamiready/guidelines.htm>
- National Weather Service. (2009). *TsunamiReady™ Communities*. Retrieved 5 May, 2009. <http://www.tsunamiready.noaa.gov/ts-communities.htm>.
- West Coast & Alaska Tsunami Warning Center. (n.d.). *Tsunami Deadly Waters*. Retrieved 5 May, 2009. <http://wcatwc.arh.noaa.gov/deadlywaters.pdf>.
- West Coast & Alaska Tsunami Warning Center. (n.d.). *Procedure Chart*. Retrieved 15 June, 2009. <http://wcatwc.arh.noaa.gov/Procedures/ProcedureChart.gif>
- West Coast/Alaska Tsunami Warning Center. (n.d.) *West Coast/Alaska Tsunami Warning Center Tsunami Travel Time Maps*. Retrieved 15 June, 2009.
- West Coast/Alaska Tsunami Warning Center. (2007). History of the West Coast/Alaska Tsunami Warning Center. In *West Coast/Alaska Tsunami Warning Center Operations Manual* (Section 1.2). Retrieved 16 June, 2009. <http://wcatwc.arh.noaa.gov/thewcatwc/history.htm>
- West Coast/Alaska Tsunami Warning Center. (2006). Message Definitions. In *West Coast/Alaska Tsunami Warning Center Operations Manual* (Section 5.2). Retrieved 16 June, 2009. <http://wcatwc.arh.noaa.gov/definition.htm>

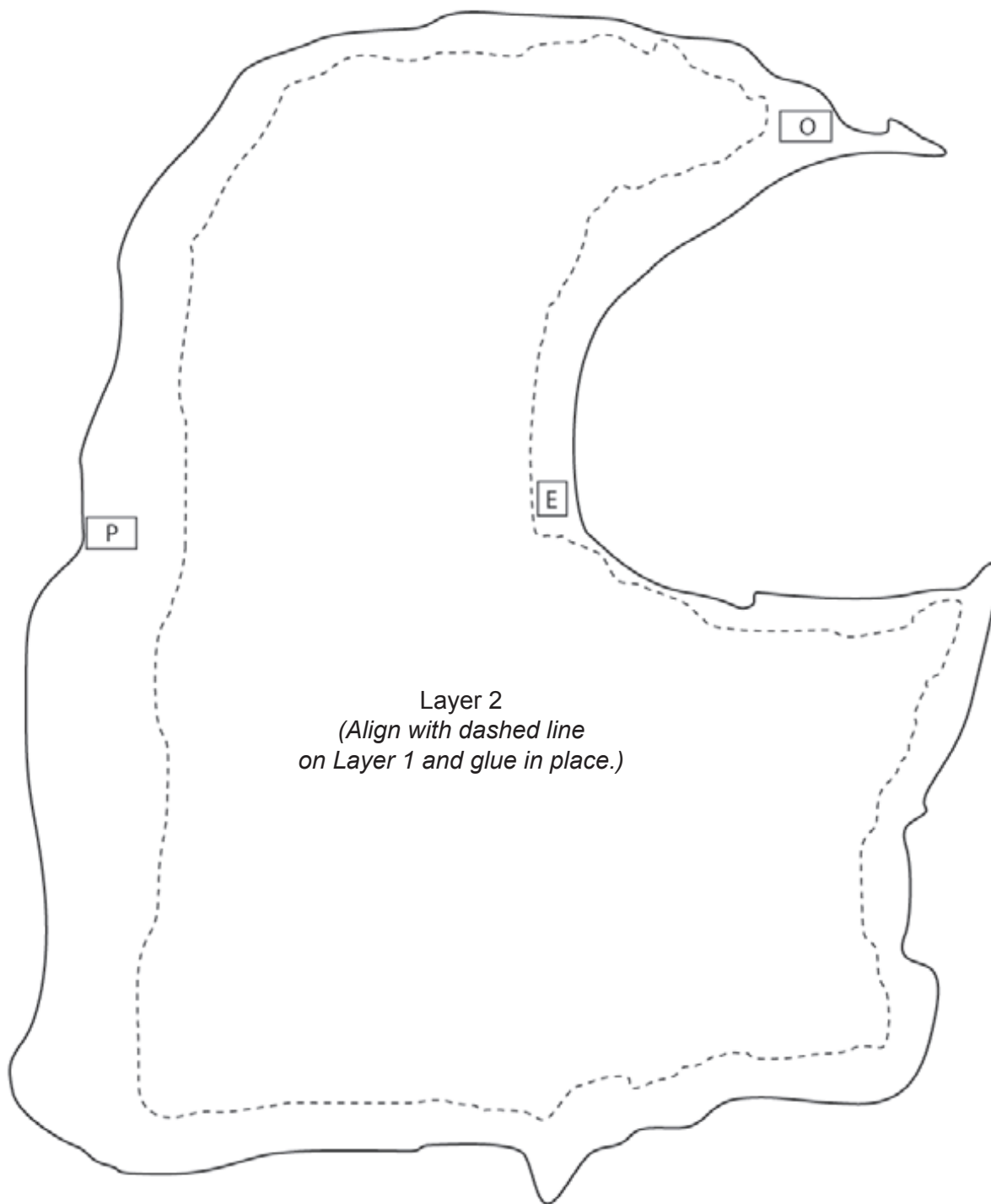
Layer 1

Student Information Sheet



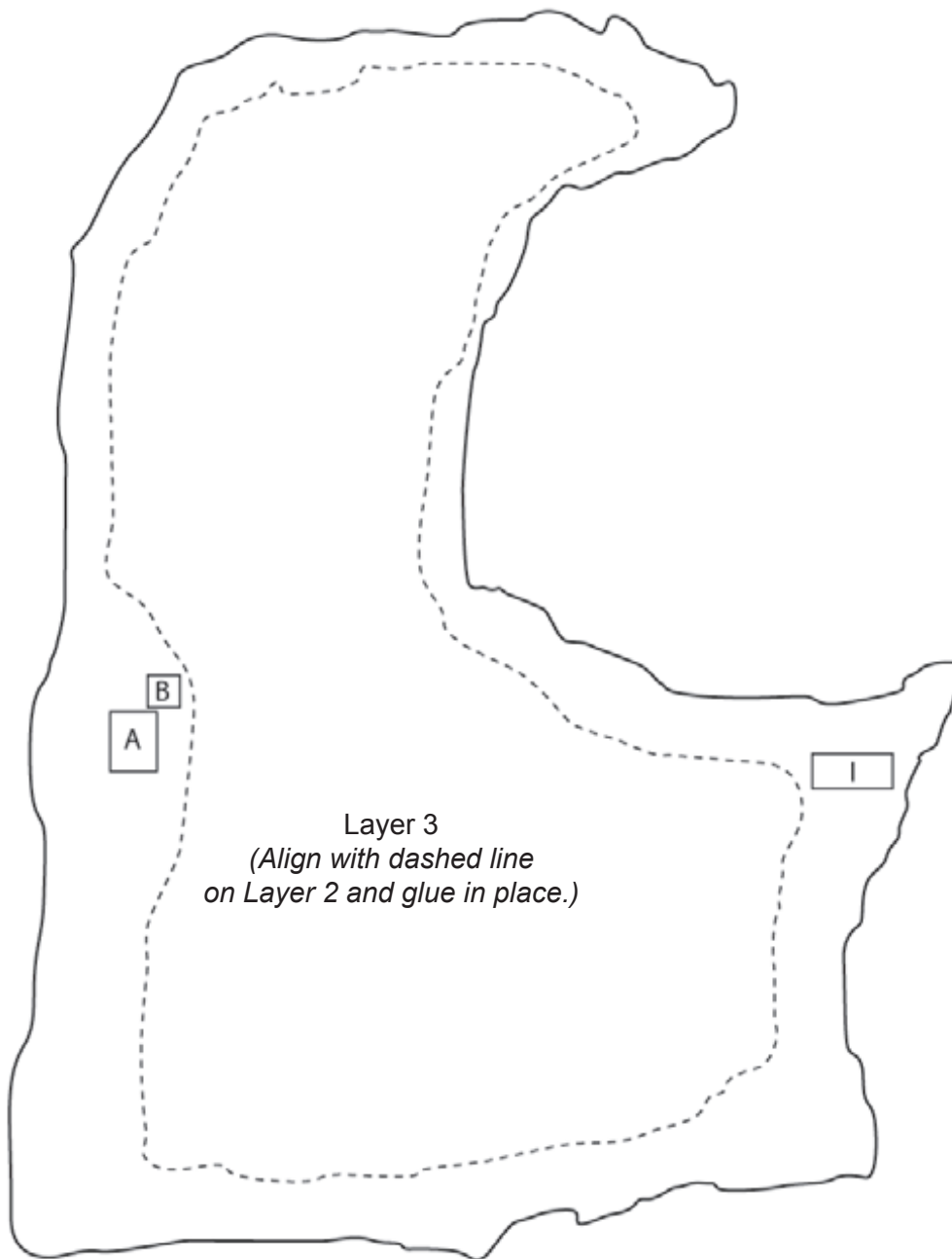
Layer 2

Student Information Sheet



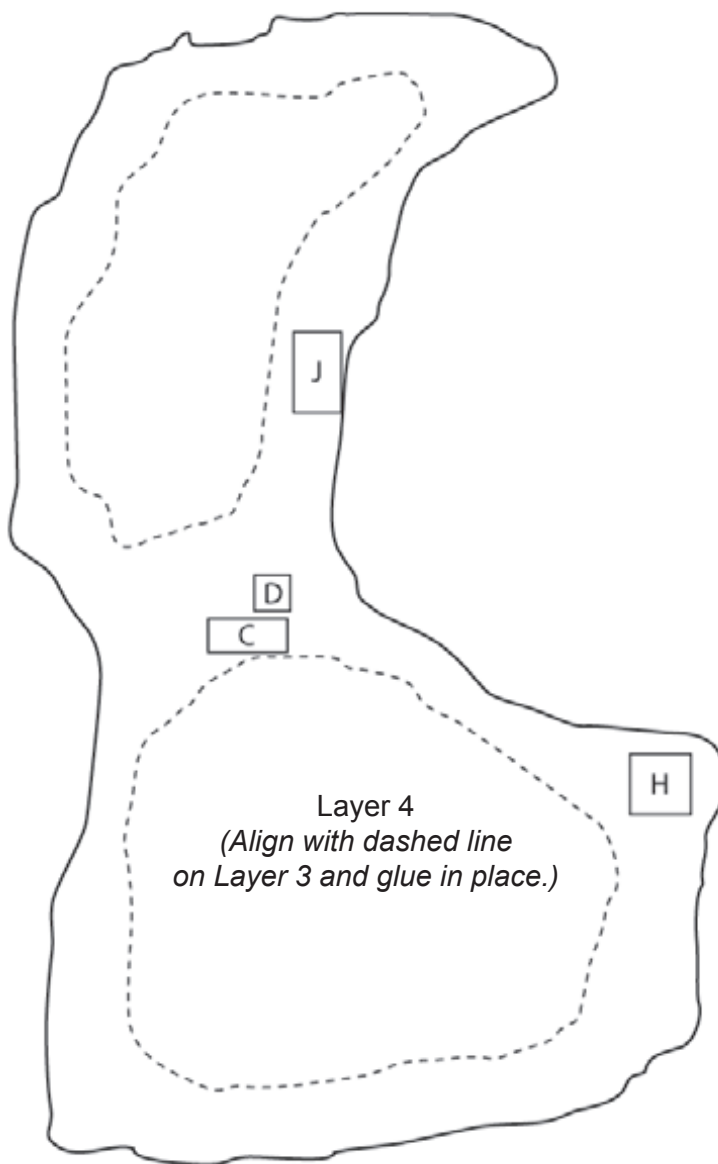
Layer 3

Student Information Sheet



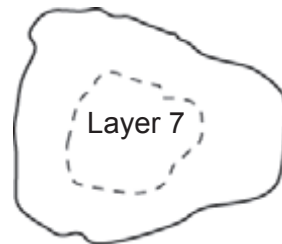
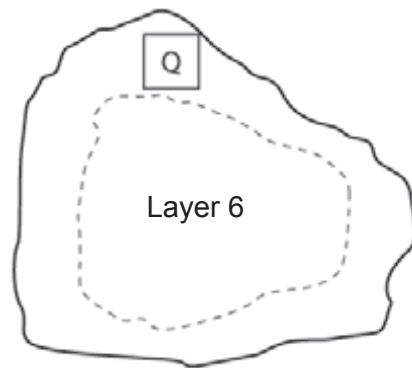
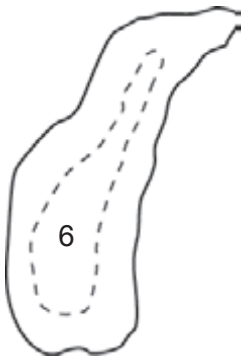
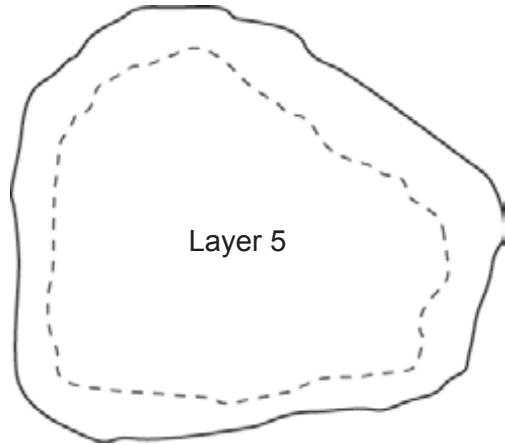
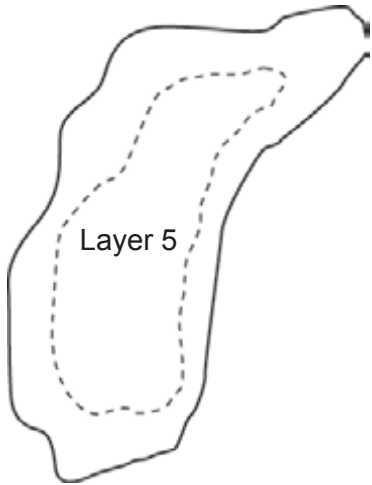
Layer 4

Student Information Sheet



Layers 5-8

Student Information Sheet

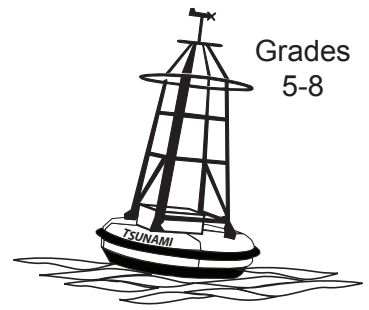


Align each layer with the dashed lines on the previous layer and glue in place.



Name: _____

Native Language and Tsunami Response Student Worksheet



Look at the chart below. Find the language that matches (or is closest to) that spoken in your community. Work with your group members to learn each word in your local language. Answer the questions below.

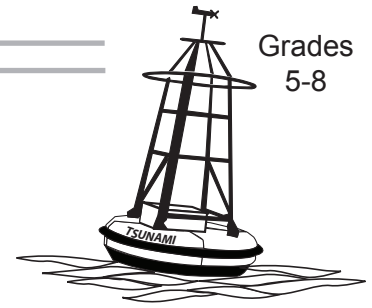
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be ready	Taqumaluni (he/she/it is)	aagasix (Literally: to make ready, prepare)	aḵsaasa-lix (Literally: to prepare)
run away, get away, flee	qimagluni (he/she/it is)	aqi-lix	iqi-lix
high, tall, elevated	qertuluni also qus'igluni (he/she/it is)	qaya-lix	qaya-lix
climb, ascend	mayurluni or qulwarluni (Literally: go higher) (he/she/it is)	hanga-lix	hanga-lix also ayuḵ-six

Sources: Sugt'stun (Leer 1978, Drabek 2008), Unangam Tunuu (Bergsland 2001)

1. What language (and dialect) is spoken in your community?

2. Draw a picture (below) that tells people what to do in the event of a tsunami. Label it with English words and Native language words.

Student Information Sheet (page 1 of 3)



Directions: Look carefully at your model. It shows the topography and community layout of Beready Island.

- Each layer of foam represents 50 vertical feet of elevation.
- The first layer of your model shows the land that is 0-50 feet above sea level.
- The second layer shows land that is 50-100 feet above sea level, etc.
- The horizontal scale for your model is 1 inch = $\frac{1}{2}$ mile.
- Beready Island is home to about 1,700 permanent residents. During the summer months, the population increases to about 2,400 on any given day due to tourism and the local fishing industry.

Look at the map on page 3. The lettered boxes represent the facilities listed below, each equipped with telephone service. You'll be using this information in your emergency response plan. The shaded areas represent residential areas and the black lines represent the main roads.

- A: Airport**—The airport caters to small passenger and cargo planes. It also serves as the local department of transportation, housing the city snowplow and other equipment. The airport has a NOAA Weather Radio receiver and dedicated connection to NOAA Weather Wire. An airport staff member monitors both NOAA and US Coast Guard Broadcasts to determine weather conditions for incoming and outgoing planes.
- B: Gas Station**
- C: Medical Clinic**—The clinic is open year round. It has two exam rooms, a waiting room, an office, and living quarters for the on-call health aid. The health aid has phone access to a physician on the mainland. Patients with major illness or injury are transferred to a hospital on the mainland via helicopter.
- D: Police and Fire Station**—The police and fire station is staffed 24 hours by a dispatcher and a skeletal staff of firefighters/EMTs who work in shifts. Two police officers and a secretary/dispatcher are employed at the police station. A NOAA Weather Radio receiver and an Emergency Management Weather Information Network receiver keep police and firefighters informed of dangerous weather conditions in the bay. The police officers and firefighters all carry pagers so they can be reached by the dispatcher during emergencies.
- E: Restaurant and Souvenir Shop**—Open only during the summer months, this hangout caters to cannery workers and tourists.
- F: Post Office and City Hall**—This building serves as the governmental center for the community. The mayor's office is located here. There is a television in the reception area, and all offices have internet connections.
- G: Community Center**—This building meets a variety of local needs, ranging from school board and city council meetings to bingo night. It is equipped with a commercial kitchen, two large meeting rooms and a reception area.
- H: High School and Superintendent's Office**—This school is equipped with 12 classrooms, a kitchen, a cafeteria, a library and a gymnasium. It also houses the district superintendent's office. The entire building is wired for internet and there are computers in all classrooms and offices.
- I: Elementary School**—This school is equipped with 12 classrooms, a kitchen, a library, and a multi-purpose room. The entire building is wired for internet and there are computers in the office and all classrooms.

About Beready Island


Student Information Sheet (page 2 of 3)


- J: General Store**—The store remains open and stocked year round, though high shipping costs to this remote location make food and supplies costly. Residents tend to stock up on supplies from the mainland then purchase perishables from the local store.
- K: Warehouse**—Temporary storage place for items that are barged in.
- L: Warehouse**—Winter boat storage.
- M: Fish Cannery**—The cannery is open during the summer months. Many locals are seasonally employed there, along with many out-of-town workers. The business office has internet access and a NOAA Weather Radio receiver.
- N: Cannery Bunkhouse**—The sheet-metal dormitory includes 80 double-occupancy rooms, two large kitchens, two entertainment rooms, locker rooms and bathroom facilities for cannery workers from out of town.
- O: Hotel**—The hotel is open year round. It is a relatively new four-story reinforced concrete building with a beautiful ocean view. It has 70 full-appointed rooms and a small conference area. Wireless Internet is available throughout the building and all rooms and reception areas are equipped with televisions and private phone lines. There is a restaurant on the ground floor.
- P: Power Plant**—This facility stores and distributes wind-generated power collected via the wind farm on the west side of the island. A backup coal burning generator provides power when wind production is low.
- Q: Water Treatment Facility**—There are a few private wells on the island. The city water plant pumps treated water to homes and businesses. Homes on the south end of the island usually haul their water from a cistern near the beach in that area, because city water and sewer service currently extends only as far south as the schools and airport.

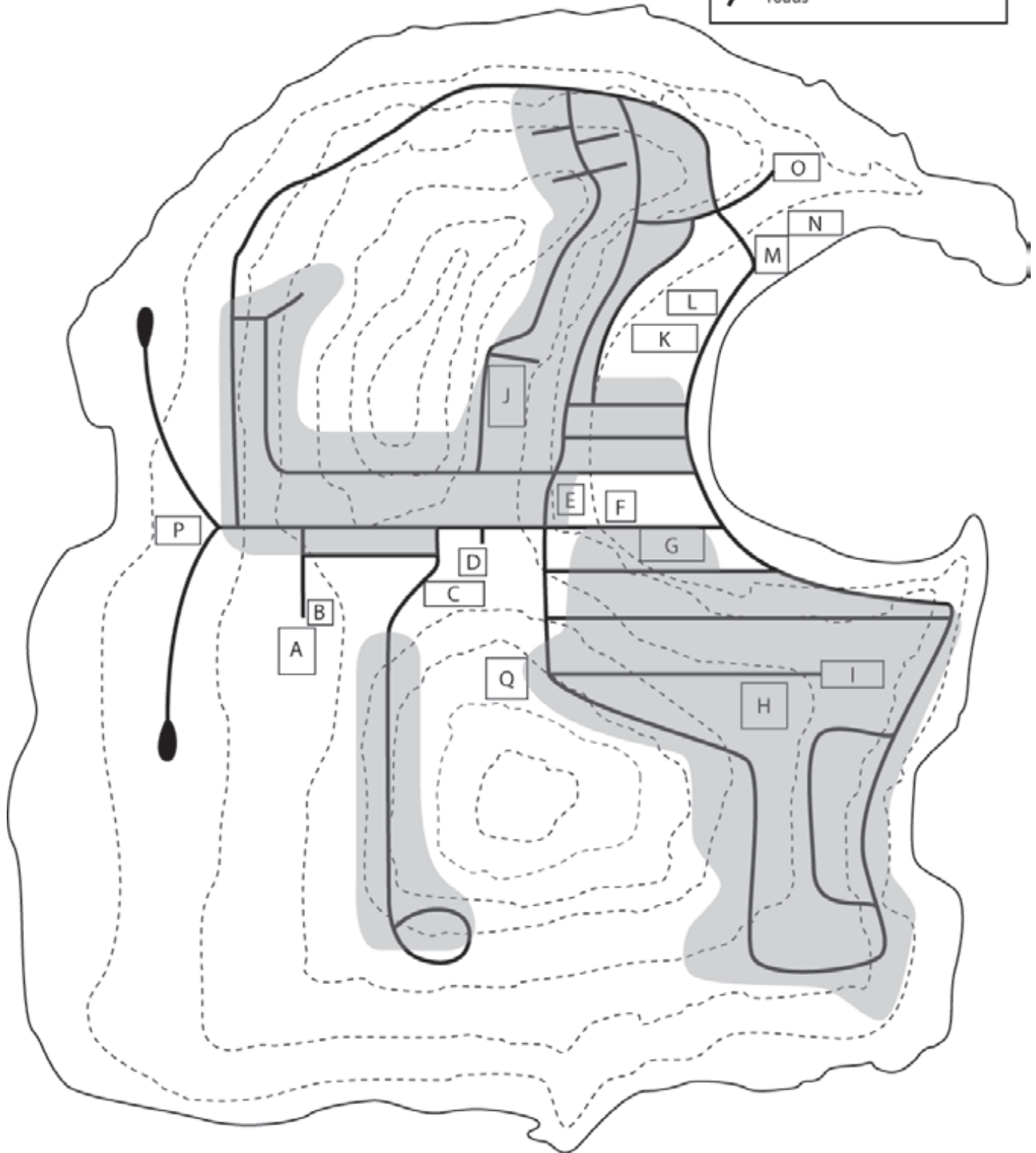
About Beready Island

Student Information Sheet (page 3 of 3)

A Lettered boxes represent businesses and public facilities

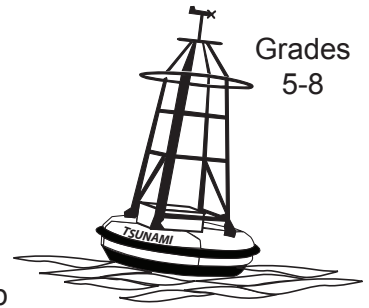
 Shaded area represents populated area

 Solid lines represent main roads



Name: _____

Grades
5-8



Planning a Response

Student Worksheet (page 1 of 3)

You will now play the role of emergency manager for Beready Island. Your job is to design a tsunami response plan. By completing each step below, you will make sure that Beready Island's tsunami response plan matches the National Weather Service's TsunamiReady steps to preparedness.

For each step you will first **READ** for information, then **DO** the task.

- READ** **Step 1:** Establish a 24-hour Warning Point (WP) to receive tsunami information and provide local reports and advice. the WP must have:
- 24-hour operations
 - Three ways to receive National Weather Service tsunami warnings
 - Warning communication capability
 - Ability and authority to activate local warning systems

- Step 2:** Establish an Emergency Operations Center (EOC). The EOC must have:
- Staff during tsunami events to execute tsunami warning functions
 - Three ways to receive tsunami warnings
 - Emergency management director or designee on staff
 - Ability to receive warnings and activate warning systems as well as or better than the Warning Point.
 - Ability to communicate with nearby EOCs/Warning Points
 - Ability to communicate with the local National Weather Service office.

Ways to Receive NWS Tsunami Warnings:

- NOAA Weather Radio receiver
- NOAA Weather Wire drop
- Emergency Management Weather Information Network receiver
- Statewide Telecommunications System
- Statewide Warning Fan-out System
- Dedicated NOAA Weather Wire Internet connection
- Direct link to NWS office (for example, amateur or VHF radio)
- E-mail from Tsunami Warning Center
- Pager Message from Tsunami Warning Center
- Radio/TV via Emergency Alert System
- US Coast Guard broadcasts
- National Warning System drop



Study the locations and features of the facilities on Beready Island. Select a facility to serve as a Warning Point and another to serve as an Emergency Operations Center.

A. Beready Island 24-hour Warning Point: _____

Why did you choose this location?

B. Beready Island Emergency Operations Center: _____

Why did you choose this location?

Name: _____

Planning a Response

Student Worksheet (page 2 of 3)



Step 3: Ensure the community has adequate methods for communicating tsunami warnings to citizens.

Beready Island has raised money to install six Outdoor Warning Sirens to be activated by the Warning Point or Emergency Operations Center. The sirens can be heard up to one mile away.

The TsunamiReady program requires that a NOAA Weather Radio receiver must be present in the following facilities:

- 24-hour Warning Point
- School Superintendent's Office
- City Hall
- Emergency Operations Center



A. On your model, please make an X at the recommended location for each of these six sirens. The scale for this map is 1 inch = 1 mile. There will not be enough sirens to reach all around the island. Choose your locations carefully to ensure safety.

B. Which facilities on Beready Island still need a receiver to comply with regulations?
Hint: Read about the facilities on the information sheet "About Beready Island."



Step 4: Identify critical public access buildings—places people must be able to get to in the event of a tsunami.



Using a yellow highlighter, shade the buildings on your model that are critical public access buildings.



Step 5: Public education is vital in preparing citizens to respond properly to tsunami threats. An educated public is more likely to take steps to receive tsunami warnings, recognize potentially threatening tsunami events, and respond appropriately to those events. To address this need, emergency managers must conduct or sponsor at least one tsunami awareness program per year. Possible locations may include schools, hospitals, fairs, workshops, and community meetings.



Using an orange highlighter, shade the building on your model that you would choose to hold a tsunami awareness program each year. It must have the ability to hold interested community members.

Name: _____

Planning a Response

Student Worksheet (page 3 of 3)



Step 6: Identify tsunami evacuation areas and evacuation routes, and install evacuation route signs.



Using a blue highlighter, draw at least two evacuation routes on your model. Along each route, mark each evacuation route sign by drawing a small blue circle with a wave in the middle. Draw the wave with a pencil or pen.



Step 7: Designate a tsunami shelter/area outside the hazard zone.



Decide on a place that would be safe for a shelter. (It should probably be at the end of an evacuation route.) Place a sticker on that spot labeled “shelter.”



Step 8: Provide written hazard information to all community members, including:

- Hazard zone maps
- Evacuation routes
- Basic tsunami information

These can be distributed through mailings, within phone books, and posted at common meeting points such as libraries and public buildings throughout the community.



Name three places on Beready Island where you would post hazard information:

1. _____
2. _____
3. _____

Further Information

To be considered TsunamiReady, a community must also fulfill the following requirements:

- Local schools must teach about tsunamis, have tsunami evacuation drills and have an earthquake plan.
- Local government must approve a tsunami-warning plan.
- A plan must be in place for activation of sirens, cable television override, and/or local systems activation.
- The community must practice what to do every year.