

Mudflat Inquiry

Theme: Mudflat Investigation

Grade Level: K-2

Goals:

- Students will make observations of nature in an outdoor setting.
- Students will use appropriate tools to make observations.

Objectives:

- Students will observe one natural item or living thing in an outdoor setting.
- Students will be able to use tools to explore their environment.
- Students will be able to record their observations in an age appropriate manner (pictures, numbers or writing).
- Students will be able to generate one question from their investigation.

ODE Science Content Standards:

K.1 Structure and Function: The living world includes living and non-living things.

K.3 Science Inquiry: Science explores the natural world through observation.

K.3S.1 Explore questions about living and non-living things and events in the natural world.

K.3S.2 Make observations about the natural world.

1.1 Structure and Function: Living and non-living things have characteristics and properties.

1.3 Scientific Inquiry: Science explores the natural world using evidence from observations.

1.3S.1 Identify and use tools to make careful observations and answer questions about the natural world.

1.3S.2 Record observations with pictures, numbers or written statements.

1.3S.3 Describe why recording accurate observations is important in science.

2.1 Structure and Function: Living and non-living things vary throughout the natural world.

2.3 Scientific Inquiry: Scientific inquiry is a process used to explore the natural world using evidence from observations.

2.3S.1 Observe, measure and record properties of objects and substances using simple tools to gather data and extend the senses.

2.3S.2 Make predictions about living and non-living things and events in the environment based on observed patterns.

2.3S.3 Make, describe and compare observations and organize data.

Ocean Literacy Principles:

Principle 5: The Ocean supports a great diversity of life and ecosystems.

Time: 90 minute (60 minutes for K)

Engage: 20 minutes

Explore: 10 minutes

Explain: 20 minutes

Elaborate: 20 minutes

Evaluate: 20 minutes

Background Information:

The Mudflats

What goes on in the mudflats?

Stretching brown and damp above the ebbing tide, mudflats appear empty compared to the dense vegetation of the salt marsh. But a closer, deeper look reveals the specially adapted organisms that thrive in the mud.

Bacteria in the mud breakdown detritus, processing it into food for plants. There are so many bacteria and they consume so much oxygen left below the fist inch or so of the mud—that's way the mud below the surface is so black. Once the oxygen is gone, some bacteria use other chemicals to decompose detritus. When they sulfate, the process releases hydrogen sulfide gas which smells just like rotten eggs.

Although not many kinds of animals can survive the mudflats' lack of oxygen and being flooded with seawater twice a day at high tide, those that live here occur in great numbers. One square yard of mudflat may contain as many as 400 cockles, 6,000 bent-nosed clams or even 20,000 snails.

Most mudflat invertebrates dig for protection from predators. With a single strong foot, clams pull their rounded shells below the surface of the mud. During high tide, the clams extend a two-tubed siphon—one tube to suck in water carrying food particles and oxygen, and a second to spit out wastes. Polychaete and ribbon worms slip through the mud hunting other invertebrates.

Animals that build burrows in the mudflats identify themselves by the type of hole they make. Little coils of sand around a hole reveal a lungworm home. As it digs, the worm digests food particles stuck on the sand it swallows and leave waste outside the back door. Ghost shrimps leave a hole the size of a pencil surrounded by a pile of sand and gravel. These little shrimp share their burrows with a pea crabs, scale worms, tiny clams and sometimes even gobies.

As the tide falls, hungry shorebirds flock to the mudflats. Dowitchers, sandpipers, curlews and other birds follow the receding water, probing with sharp beaks for invertebrates concealed in the sticky mud. There is plenty for all, since each species of shorebird has a beak of a different length and eats animals buried as deep as its beak is long.

At high tide, wading birds such as great blue herons and divers such as scoters and cormorants move onto the submerged mudflats. They feed well on sculpins, sanddabs and other fishes, as well as crabs and other invertebrates that come to the mudflats in search of snails, shrimps and worms. Harbor seals swim over the mudflats from time to time, following the fishes.

WHO LIVES IN THE MUDFLAT?

Fishes of the mudflats

- Pacific staghorn sculpin, *Leptocottus armatus*
- * shiner perch, *Cymatogaster aggregata*
- * speckled sanddab, *Citharichthys stigmaeus*
- * starry flounder, *Platichthys stellatus*

Birds of the mudflats

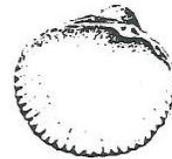
- cormorants, *Phalacrocorax* spp.
- dowitchers, *Limnodromus* spp.
- dunlin, *Calidris alpina*
- great blue heron, *Ardea herodias*
- green-backed heron, *Butorides striatus*
- gulls, *Larus* spp.
- killdeer, *Charadrius vociferus*
- long-billed curlew, *Numenius americanus*
- plover, *Pluvialis* sp.
- sanderling, *Calidris alba*
- scoters, *Melanitta* spp.
- whimbrel, *Numenius phaeopus*
- western grebe, *Aechmophorus occidentalis*
- western sandpiper, *Calidris mauri*
- yellowlegs, *Tringa* spp.

Mammals of the mudflats

- * harbor seal, *Phoca vitulina*

Invertebrates of the mudflats

- basket cockle, *Clinocardium nuttallii*
- bay mussel, *Mytilus edulis*
- bent-nosed clam, *Macoma nasuta*
- blue mud shrimp, *Upogebia pugettensis*
- * California mussel, *Mytilus californianus*
- common littleneck clam, *Protothaca staminea*
- gaper clam, *Tresus capax*
- ghost shrimps, *Callinassa* spp.
- lugworm, *Abarenicola* spp.
- Pacific oyster, *Crassostrea gigas*
- polychaete worms
- ribbon worms
- soft-shell clam, *Cryptomya californica*
- soft-shell clam, *Mya arenaria*



Basket, or heart, cockles

Tidal Channels

What goes on in the tidal channels?

Ribbons of water meander through mudflats, shining silver against the brown mud exposed at low tide. Always full, these tidal channels link the mudflats, eelgrass beds and upper marsh with the open water of the bay and, eventually the sea.

Flounder, lingcod and other marine fishes use these channels at high tide as pathways to food rich eelgrass beds. Seals, sea lions and many diving birds come to the tidal channels to hunt.

The shallow channels that cut through eelgrass beds and mudflats make ideal nurseries where the currents are gentle to sweep little animals away and the water is too shallow for large predators. Juvenile fishes thrive here with plenty of food to grow on, from tiny algae to shrimps and worms.

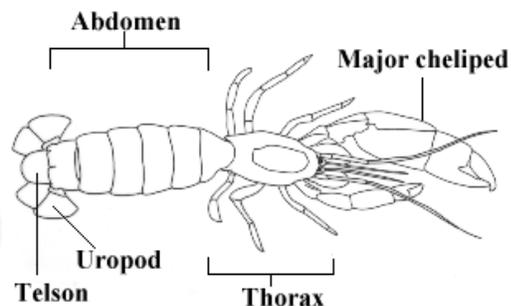
Fishes such as sturgeon, striped bass and salmon migrate up tidal channels from the sea to the streams where they lay their eggs. The bodies of the anadromous fishes slowly adapt to changing salt levels as they move from salt water to fresh. Adult salmon move quickly upstream to spawn, but the young fishes linger.

Ghost Shrimp

Neohypaea californiensis

Classification

Phylum Arthropoda
Class Malacostraca
Order Decapoda
Family Callinassidae



Related animals: Tidepool ghost shrimp

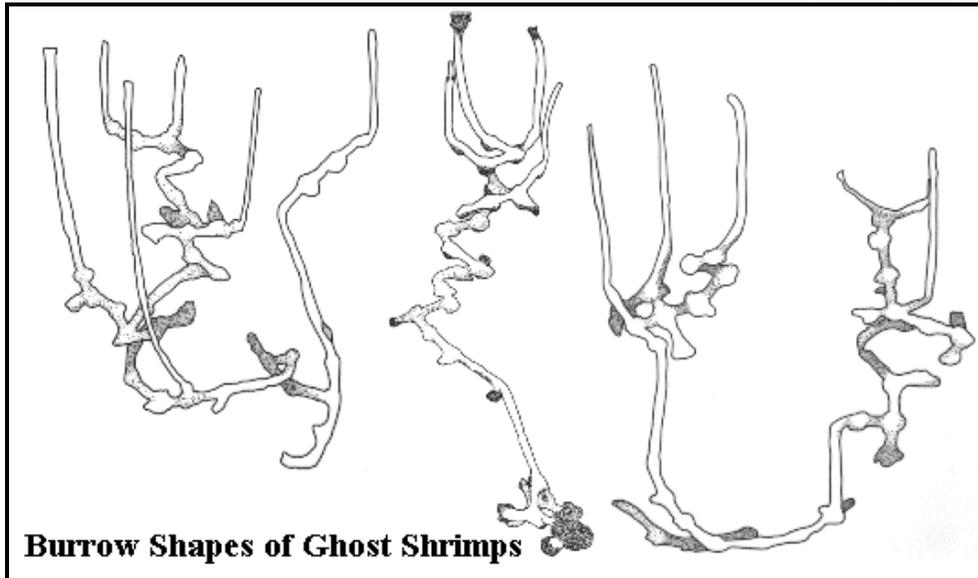
Visual description: The carapace is poorly calcified but covers the soft parts of the body. The soft body parts are pale in color. The claws are unequal, especially in adult males, where the master claws can reach 25 percent of the body weight. The claws on a female are smaller and closer in size. Tip of eyestalks are pointed. Claw is white but the body is overall orange, pink or yellow but almost transparent.

Size: To 4.8 inches (120mm)

Range: Mutiny Bay, Alaska to Baja California

Habitat: The ghost shrimp lives on the sandy and muddy bottoms of bays and estuaries.

Behavior: It creates multibranching, impermanent burrows in the sand and mud in the middle to low tidal areas. The burrows can reach to 30 inches (77cm) deep.



Diet: Feeds on organic material that it sorts from the sediment as it burrows. It filters the water that it forces through its burrow by its pleopods.

Reproduction: The ghost shrimp mates like most decapods; however, the male and female contact each other at a right angle. The female carries the developing eggs attached to hairs on the pleopods under her abdomen. When they hatch, the zoea (larvae) drift for weeks among other plankton before settling to the bottom.

Predators: Salmon and steelhead fishermen use them for bait. They are marketed for live bait along the Oregon coast. The zoea are eaten by predators in the plankton. The adults are eaten by shorebirds as they forage in the sand and mud.

Notes:

The ghost shrimp is considered a pest in oyster beds because its burrowing activities can bury and smother oysters.

It is prized bait for fishermen and is harvested in some areas for that purpose.

Sources:

Internet Fact sheet. Abstract of Lobodle, L.V. and A. R. Palmer. "Pronounced heterocholy in the ghost shrimp . . ." *Journal of Zoology*. 240:650-675.

Internet Fact Sheet. www.int-res.com/abstracts/meps/vol150/p121-136.htm.

Internet Fact Sheet. www.mov.vic.gov.au/crust/thalbiol.htm.

Jensen, pg. 78

Nielsen., pg. 67.

Materials:

- Rubber boots recommended
- Shrimp slurpers
- Buckets
- Shovels
- Racks
- Magnifying glasses
- Clipboards
- Paper
- Pencils
- Field Guides and Ocean Shore Picture Books
- Mudflat Posters if available
- Tide table

Preparation: Be sure to check the tides before planning a visit to the mudflats. The mudflats are most accessible at low tide or during a receding tide.

Introduction:

Engage: Bring in a tub of mud. (It doesn't have to be from the mudflats). Have students engage their senses by looking, feeling and smelling the mud. *What do you observe? Is there any evidence of living things in the mud?* Solicit responses.

Today we are going to be exploring the mudflats. I am going to draw a picture of the mudflats on this chart. Use a basic KWL chart with the mudflat picture as the K and L. What do you think you would find there? When we brainstorm like this I'll put down all your ideas. If something is not true, don't worry we will correct it when we find proof outside. Solicit responses. Draw the things that the students are describing, using labels as appropriate. Encourage the children to think about the animals and plants they would find in the mudflats. Also have your students use their senses to describe the mud itself. *What would the mud look like, feel like, and smell like? What new things would you like to learn about on the mudflats? Record a few questions on the chart.*

Ask the students to help make a list of things they would like to bring outside with them to help them explore. Responses might include buckets, shovels etc. Bring out all the tools that are available. In the classroom, have students describe how each tool is used and how it would help to explore. Review safety rules for the tools and procedure for sharing them. Break students up into groups. Make sure there are enough tools for students to share.

Activity:

Explore: *Now let's go out and explore the mudflats.* Describe how students will make observations. Have students explore freely for about 10 minutes, trading tools periodically.

Explain: After the free exploration, bring your students together as a big group. *What did you find?* Solicit responses. Possible responses might be shells, rocks, clams, ghost shrimps etc. Pass out clipboards, magnifying glasses, paper and pencils. Have your students focus on one thing. Encourage them to examine their “specimen” carefully with the hand lens. After a few minutes ask the students to record their observations on the paper on their clipboards, using age appropriate techniques (pictures, words or sentences). Encourage the children to explain their recorded observations to a buddy when they are done. Ask them to think of a question that might help them learn more about their “specimen”. Early finishers can always work on a second observation. When most of the children are done discuss what the children have found out during their careful observation. Share some recordings. During this stage teachers should clarify concepts and correct misconceptions. This can be done using the students’ observations and redirecting observations as needed.

Elaborate: *What did you learn from your observations?* Solicit responses. A possible answer might be: “I found a shell that was smooth and white. I could see lines with the hands lens.” *That’s very interesting. What questions do you have now?* Solicit responses. This might be hard for children not used to this process. You might need to model some questions. I.e. “*Now I want to find out if someone lives in this shell, or I wonder how it moves in the mud, etc.*” If there is time after your discussion, you can have your students use field guides to try to identify their “specimens”. This stage can be repeated many times to encourage new learning opportunities. After this stage it is time to come back to the classroom.

Conclusion:

Evaluate: After students have cleaned up, it’s time to review the trip out to the mudflats. Draw a new picture of the mudflats, on the L section of the chart, as a group. Have your students describe what should be included in the mudflat picture. Older kids can each draw their own picture first and then tell you what to add to your picture. Compare the before and after pictures. Take a look at the questions you wrote down before you went outside and see if your children can answer any of them based on their observations. If not, talk about where your students might do some research to find out the answers. Remind your students that scientists are always trying to learn something new. End with a few new big questions for a future investigation.

Extensions: This investigation can be done in a few stages if time allows. It can even be done over a few days if that suits your schedule. You can choose to do the Explain or Elaborate parts of the lesson in the classroom and return to the field, at another time, to do more focused observations. This can give you more opportunities to revisit your chart for accurate information, see what questions your students can answer after observations, and encourage practice of questioning skills.