BIVALVE BOOKLETS

FOR THE TEACHER

Discipline
Biological Science

Themes
Evolution; Scale and Structure

Key Concept
Each animal has evolved unique structural and behavioral adaptations to survive within their habitat.

Synopsis
Students learn about the structure, biology, and natural history of bivalve mollusks by creating a clam booklet and observing a real clam.

Science Process Skills
observation, communication, comparing, measuring, organizing, relating.

Social Skills
Teacher observation of Checking for Understanding and Cooperation

Vocabulary

invertebrate	Pelecypoda	siphon	
bivalve	plankton	mantle	
valve	veliger	shell midden	larvae
wetlands	mollusk	habitat	

MATERIALS

For INTO the Activities:
field guides or coffee table books on shells
butcher paper for group brainstorming
optional:
- shell collection
- Audiotape of ocean sounds

For THROUGH the Activities:

For each student:

one set of clam activity sheets
scissors
• crayons
• pencil

For each table:

• white glue/glue sticks
• stapler
• one fresh clam**

For teacher:

• one completed clam book for reference
• one fresh clam**
• bamboo skewer or toothpick to use as dissection probe
• optional:
  overhead transparencies of clam activity sheets

**(note-clams can be purchased fresh in most grocery stores or seafood markets. Make sure they are closed tightly when you buy them. To prepare, place in microwave oven just until they begin to open. Do not over-cook or they will be difficult to examine. To open, carefully pry the shells apart and use a butter knife to cut the two muscles holding the shells together.)

INTRODUCTION

Clams are members of the Phylum Mollusca, one of the oldest and largest groups of invertebrates (animal without backbones). Most mollusks have hard shells and a soft unsegmented body. There are four major classes within the mollusks including such interesting and diverse animals as the squid, snails, nudibranchs, and oysters.

There are approximately 20,000 different species of fresh and saltwater clams. Most of these live in a marine habitat. Clams, along with oysters, mussels and scallops, are bivalve mollusks (animals with two shells). The shells are made up of 2 halves called valves. The shells serve to protect the soft-bodied animals that live within. Clams belong to the Class Pelecypoda, meaning “hatchet foot”. Unlike their sedentary relatives the oysters, which are cemented to a hard substrate like a rock, these animals can use their fleshy foot like a plough to burrow through the mud.

Clams and other mollusks begin their lives as part of the microscopic plankton world. As veliger larvae, they drift in the water for several weeks until they are ready to settle into their home on a muddy or sandy bottom. The clam extends a straw-like siphon up through the mud and into the water in order to feed. The siphon sucks in water through the body of the clam, taking in food and oxygen. Clams feed on plant and animal plankton, filtering food from the water with a pair of gills.

Clams have a well-developed respiratory system. Their gills not only assist in food getting, but also for absorbing oxygen and releasing carbon dioxide. They have a heart, liver, and kidney, as well as a digestive system complete with a stomach and intestines. On the inner surface of each valve is a soft membrane layer called the mantle. The mantle surrounds the animal and actually creates the shell as well as coats sand grains that may be caught between the body and the shell to form a pearl. We know from shell middens (early kitchen garbage dumps) in Europe, North America and Asia that clams have been widely harvested by humans since prehistoric times. Oysters have been cultivated or farmed for several thousand years, first by the Romans as early as 97 B.C. and continuously by many cultures since that time. Clams and oysters were very important food resources for Native American people of the Pacific Northwest. Some Native populations have also used clam shells as a form of currency. Today the health of the wetland habitats where these animals live is threatened with destruction, decreasing the amount of available habitat . We need to ensure the welfare of these and other living creatures by taking care of the wetland habitats where they live.

INTO THE ACTIVITIES

Shell Museum

Create a display of different kinds of shells by asking students and parents to bring in their shell collections to share with the class. Have field guides or coffee table books on shells available for student use. Have a tape of ocean sounds available for background music.

Silent Mingle

• Where have you seen shells before? • Have you ever seen animals living in the shells? • What do the animals that live in shells look like? • What do animals use their shells for? • What do you want to know about shells and the animals that make them?

Individual Recording

Each student jots down at least 3 items (print or pictures) s/he can recall from the Silent Mingle.

Interdisciplinary Shell Observations

Give students several interdisciplinary opportunities to observe the shells in your classroom collection. • As a math station ask them to sort shells according to color, shape, size, weight, etc. • As a social studies station have them brainstorm about the various ways in which people have used shells and shelled animals, i.e., for food, currency, ornamentation, as tools, etc. • As an art station have them draw pictures of what a shell looked like with the living animal inside it. Have them compare their drawings to pictures of the real

animals in field guides. • As a language arts activity give groups of 4 or 5 students each a different type of shell and ask them to make a list of at least 10 descriptive words that could be used to identify their shell. See if other students can locate their shell out of the shell collection using only the clues that have been listed. • As a science station have them speculate about the kind of animal they think made them and what habitat they might have lived in.

Class Brainstorm and Cluster Diagram:
Write the word SHELL on the board or large sheet of paper. Have collaborative groups brainstorm words/phrases/pictures that have something to do with shells.

Once the groups are done brainstorming, have them group their words/phrases/pictures according to which seem to go together.
Have students try to come up with names for their groupings. These now become their categories. Have students share their cluster diagrams with the class as you do a class cluster diagram based on their ideas.

Portfolio Assessment
Teacher observation or student self assessment of participation in each activity
At least 3 items recorded on Individual Recording Sheet
Written or pictorial product from at least 2 of the Interdisciplinary Shell Observations
Group Cluster Diagrams, Group Poster

THROUGH
THE ACTIVITIES

Give each student individual materials and pass out the clam sheets A-F one at a time as you progress through the activity. Project the transparency sheets A-F one at a time and have students use them as a guide during this activity. Use the Guide Sheet as necessary. Have students follow along with you as you give these instructions orally:

<u>Drawing A</u>
Look carefully at the clam shells on drawing A. This sheet shows the outside of the clam shell. Look at the outside of the real clam at your table. Each half of the shell is called a valve. On your sheet, write the word "valve" on each half of the shell. What do you notice about the shell lines? (the lines show growth-similar to the growth rings on a tree) What do you notice about the color of the clam? (it is the same color as the mud or sand that it lived in) Why would a clam need a hard shell? (to protect it from being eaten) **Color the valves light brown.** Cut out the drawing. Be careful not to cut the shell apart!

Drawing B

Drawing B shows the inside of the valves or shell. Put your fingers on the circular lined areas near the top and bottom of each valve. These are scars that show where the muscles were attached. Look inside the real clam at your table and observe where the muscles were attached before it was opened by your teacher. On some clams the muscles might still be attached to the shell. What does the clam use these muscles for? (helps them to tightly close their shells to help keep them safe from predators) **Color all four muscle scars yellow.**

The "hinge" is a dark rubbery ligament that attaches the two halves of the shell together. It is similar to a hinge on a door that allows it to swing open and closed. Why does a clam need a hinge? (to be able to open and close its two shells) Below and to the side of the hinge are the "hinge teeth". This is a tooth and socket arrangement that allows the shells to close very tightly. Locate the hinge and the hinge teeth on your real clam shell.

Look at the bumps just below where the hinge is located. These are called the "umbos". This is the oldest part of the shell and shows where it actually began to grow. Find the umbos on your real clam. **Color the umbos gray or very light black.** Cut out drawing B taking care not to cut the two halves of the shell apart.

Now you are ready to glue side A to side B. Lay side A face down with the blank side up. Place side B on top with the letters right side up. Make sure that the umbos and hinges are aligned. When someone has checked that you have your clam positioned correctly, glue A and B together and set it aside to dry.

Drawing C

Drawing C shows the inside body of the clam. The view is of the body of the clam cut in half lengthwise. The first part of the clams body lines the inside of the shell and is called the "mantle". **Color the mantle area light purple.** The mantle is the soft membrane layer that takes calcium out of the water and actually makes the shell. The dark lines between the two circular muscle scars are where the mantle was attached to the shell and are called the "pallial lines". Look at the mantle on your real clam. What might happen if a grain of sand was trapped between the shell and the mantle? (the mantle might secrete hard calcium layers around the sand to make a pearl)

Remember the muscle "scars" from drawing B? Now locate the four circular muscles themselves. The muscles go through the entire body of the clam. **Color the muscles yellow**. Locate the muscles on your real clam. See how they go from one side of the clams body to the other side, attaching each half of the shell to each other.

Find the short tubes called “siphons” at the top of the clam drawing and put your fingers on them to show that you have located them. **Color the siphons pink.** The siphon has two sides to it. One side of the siphon acts like a straw and sucks water into the clam. This is called the ”incurrent” siphon. It brings food and oxygen-laden water directly into the clam so that it can feed and breathe. The other side or “excurrent” siphon pushes water carrying waste and carbon dioxide out of the clam. Some clams are very efficient and can filter up to a quart of water an hour through their body! Locate the siphon on your real clam. It will look much smaller than it appears in the drawing, but when the clam was alive it could extend at least 2-3 inches out of the shell. How do you think a clam can feed when its body is buried in the mud? (by extending the siphon up into the water column)

Cut out drawing C taking care not to cut the two halves of the shell apart.

Drawing D

As you did in drawing C, **color the mantle purple, color the muscles yellow, and color the siphons pink.**

Find the lined section between the muscles. These are the gills. **Color the gills red.** The gills do two important things. They absorb oxygen and release carbon dioxide in the breathing process. They also help catch food particles and move them to the clam’s mouth. What would be small enough for clams to eat? (microscopic green plants called phytoplankton) Find the gills on your real clam. The gills are a thin delicate double layer located on both sides of the body between the mantle and the inside body of the clam.

Below the letter D on both sections are two finger-like projections called "palps". They sort particles - separating food from other material before being passed to the mouth. **Color the palps blue.**

Cut out drawing D. Lay side C face down, blank side up. Place side D on top of C with the letters right side up and the siphons matching. When you’ve had your clam checked to make sure its correctly positioned, glue C and D together and set it aside to dry.

Drawing E

As you did in drawings C and D, **color the muscles yellow.**

Find the wedge or hachet-shaped sections along the outer-most edge. This is called the “foot”. **Color the foot orange.** The foot is a strong muscle that can stretch out and push or pull the clam around in the mud. Since the clam can feed by sucking water into its body why does it need to move at all? (to relocate to a better feeding place or to escape predators)
Locate the foot on the inside of your real clam. This is the “meat” of the clam. It is one of the parts that you cook when you make clam chowder.

Cut out drawing E taking care not to cut the two halves apart.

Drawing F
As before, **color the muscles yellow and the hachet-shaped foot orange.**

Drawing F shows a cross section of the internal organs of the clam. It has a stomach, intestines, kidney, heart, and other internal organs. The heart has three chambers instead of four like yours and other mammals. The heart is the oblong circle to the right of the hinge. **Color the heart red.**

The stomach is the cross-hatched area just above the lower muscles (see chart). **Color the stomach green.** The stomach is surrounded by the tube-like intestine. Within the stomach is a rotating crystalline "style" that releases a substance that helps to break down the clam's food. Why do you think that the clam's stomach contents are often green? (because the clam's food source is green phytoplankton) Locate the dark area within the clam's body that looks like the gut or stomach. Snip it open (your teacher may want to do this for you) and look at the stomach contents of your clam.

Cut out drawing F

Constructing Your Bivalve Booklet
1) Place A-B with the B side up.
2) Place C-D on top of A-B with the D side up.
3) Place E-F on top of D with the F side up.
4) Make sure that the hinges of your clam line up. Fold the three drawings in the middle and staple along the hingeline. The pages should turn like this: A, B, C, D, E, F, E, D, C, B, A.

Portfolio Assessment
Teacher assessment or student self assessment of participation in each activity
Labeled and colored Bivalve Booklet

BEYOND THE ACTIVITIES

Extended Activities
1. Have students make shell print scenes. They can paint a background habitat scene using a watercolor-wash technique, and then using clam, scallop, or other shells, make prints over the dry watercolor picture.
2. If you have extra shells, have students make shell mobiles using driftwood collected from a beach field trip.
3. Have students make clam chowder and have a seafood luncheon.

4. Bring in menus from seafood and various ethnic restaurants (i.e., Japanese, Thai, Cambodian, French, Italian, Caribbean, etc.). Have students look at the menus and make a list of all the shelled animals that are included as ingredients. On a world map, have each group locate the countries represented. Have each group create a menu using as many "mollusk" dishes as possible. They should be reminded to choose at least one dish from each category; hors d'oeuvres, first course, main course, vegetable, salad, dessert, beverage. They can create an invitation to dinner, illustrating it appropriately.
5. Bring in a cameo and share it with your students. Cameos are carved from shells. Locate some information on how cameos are made in Italy from your local library.
6. Buy a live clam from a local seafood market (see **note on page 2 of this activity) and keep it in a classroom aquarium. If it is a saltwater clam you will need to keep it in seawater or make a seawater solution by purchasing some "Instant Ocean" from a local aquarium store. Add a little sand to the bottom of your aquarium and your students will be able to observe the digging foot of the clam. Ask your local aquarium store what to feed it. Brine shrimp would be one inexpensive possibility.
7. Brine shrimp in the classroom offers the opportunity to have a plankton lab with your students. Brine Shrimp can be observed with a hand lens or under a low-power microscope. Have students draw what they see and attempt to label the various parts.

Group Reports
Have collaborative groups of 5-6 students research an animal from one of the four main classes of mollusks. Research can include pictures or "biological illustrations" of the animal(s) as well as a written or oral report on the subject. Have groups share their reports with the entire class and possibly even another class.
Choices could include:

- Bivalves or Pelecypods (two-shelled animals including clams, oysters, scallops, mussels)
- Gastropods (snails, limpets, conchs, moon snails, nudibranchs or sea slugs)
- Polyplacophora (animals with 8 overlapping plates-chitons)
- Cephalopods (squid, octopus, nautilus, cuttlefish)

Field Trips
1.Plan a field trip to a local seafood market (Asian markets are great) to see the various mollusk (as well as other marine life) representatives. Arrange for students to have an opportunity to talk to the seafood manager to discuss where the mollusks came from and how they are kept alive or fresh.
2. Visit an aquarium with a tide pool touch tank or other marine life exhibits. Have students give particular attention to members of the mollusk group. Wild California and the Steinhart Aquarium in the California Academy of Sciences,

Golden Gate Park, San Francisco or Monterey Bay Aquarium have excellent exhibits.
3. If available, arrange a field trip to a local rocky and/or sandy beach, wharf piling or wetland habitat. Each habitat has various mollusk representatives living there. Also look for “evidence” of these creatures by combing the beach for shells.
4. Visit an “oyster farm” on Tomales Bay, California. Students can see how oysters (and in some cases mussels) are cultivated for food.
5. Visit a jeweler that specializes in pearls. Ask them to talk to your students about how and where they are cultivated.

Debriefing
1. Have cooperative groups discuss what helped them accomplish their tasks successfully and what were the road blocks to their progress.
2. Have students make a class list or chart with visual representations of "helpers" and "road blocks".