
SHELL SORTING

FOR THE TEACHER

Discipline

Biology

Themes

Diversity, Scale and Structure

Key Concept

Shells come in many different shapes because each is made by a different kind of animal for use as a shell home.

Synopsis

Students work in groups to first sort shells into groups based on their own classification system, then into groups of actual related shells after some guided discovery and finally take a closer look at one particular shell to increase observation skills.

Science Process Skills

observing, communicating, comparing, ordering, categorizing

Social Skills

listening, sharing, cooperating

Vocabulary

bivalve, carapace, gastropod, mollusk, skeleton, "test", univalve, valve

MATERIALS

INTO the activities

- Pictures or posters of different kinds of ocean animals including those with shells, e.g. *"Mollusc and Crustacea Poster"*
 - Large piece of butcher or flip chart paper and markers
- optional
- Videotapes of ocean animals e.g. *"Ocean Symphony"*, *"Monterey Bay Aquarium Video Collection"* or others.

THROUGH the activities

- a variety of shells (10-20 individuals) for each small group of students.

Note: Try to have generally the same diversity of shells for each group to work with. A good diversity would include some of the following: "snails" such as cowries, whelks, abalone, limpets, turbans; chitons; clams, oysters, scallops,

mussels; and nautilus. Other animals with hard outer coverings include sea stars, sea urchins, crabs, barnacles, sponges and corals.

- Drawing paper and colored pencils or crayons for each student or pairs of students.

optional

- Shell books to use as references (*see BEYOND ACTIVITY for suggested books available for checkout from the MARE library*)

- Oyster Shells in matched pairs - enough for each student to have 1/2 of the matched pair or one valve, drawing paper and colored pens or crayons.

INTRODUCTION

Many people who go to the seashore are especially attracted to the brightly colored shells left strewn around on the beach by the receding tide, especially after a storm. There is a vast array of colors, patterns, shapes and sizes of shells and each has a story to tell about the animal that made and lived within it. Often people don't realize that these shells were once part of a living animal. Shells come from many different places within the ocean. Many of them belong to animals living among the seaweeds and rocks of the rocky seashore and on the continental shelf. These will often be found with their original occupants still living within, or with an animal like a hermit crab which has taken refuge in the shell after the original owner has died. Other shells found on the beach belong to burrowing animals like clams, which lived in the sand or mud and were brought to the surface by the force of the waves after they had died.

The rocky seashore has an incredible diversity of life and it requires each of the animals living there to be adapted to a great range of conditions. The main problems that they must contend with include drying out when the tide recedes and they are left high and dry; withstanding the pounding surf as the tide comes back in; breathing underwater or holding their breath until the tide returns; finding food and breeding. The shelled animals have managed to cope with all of these potential problems through modification of the structure of their shells, bodies and behavior. Looking at the structure of the shell can give us clues about how the animal actually lived.

Most of the animals which form shells belong to the group of animals called mollusks, one of the largest and most successful groups of invertebrates (the animals without backbones). Mollusks are soft-bodied animals which in most cases protect themselves by building a hard covering of shell. The shell is made up of a bone-like substance called calcium carbonate, the raw materials of which the animal extracts from sea water. The shell provides a place for attachment of muscles just as our skeletons do and the shells also are used for protection from predators and the forces of nature. The shell of mollusks is made by the mantle which is the soft smooth covering just on the inside of the shell. As the animal grows, the mantle secretes more shell material around the

opening of the shell where the head and foot protrude to increase the size of its home.

Mollusks range from limpets clinging to the rocks, to snails which crawl or dig or swim, to bivalves which anchor or burrow or bore, to cephalopods (squid and octopus) which torpedo through the water or lurk watchfully on the bottom. They vary in size from giant squids and clams to microscopic snails living between sand grains. The Phylum Mollusca contains over 50,000 species world wide, four Classes of which are common intertidally in California.

Mollusks are not the only animals which use a hard covering for muscle attachment and protection. Other invertebrate animals such as crabs, corals, sea urchins and sea stars also have hard outer coverings which are left behind after the animal dies.

INTO THE ACTIVITIES

Families

Lead a class discussion about the students relatives- aunts, uncles, brothers and etc. Include in the discussion the difference between a distant and a close relative or immediate family. You might want to display a family tree with close relatives in one color and distant relatives in another.

Put on the videotape (turn down the sound completely) and allow the students to quietly comment on the kinds of animals they see.

Brainstorm animals that live in the ocean. As the students give suggestions, write or illustrate them on the butcher paper or board in groups reflecting relationships, i.e. group the vertebrates, the animals with shells and etc. depending on how many ideas they have.

Talk about these groups as families, describing some of the characteristics each group shares with others in that group. Use an icon or drawing to represent each group, eliciting from the class what a good representation of the group would be. Ask the students who they think are the close relatives of some of the animals on the list and who might be distant relatives. What are some characteristics to look for when deciding? Circle close relatives in one color and distant relatives in another.

ASSESSMENT

Participation in class discussion and brainstorm
Teacher observation of listening and sharing

THROUGH THE ACTIVITIES

Animal Groups

Describe how scientists organize animals into groups based on characteristics they can observe. Some characteristics include shape and structure, presence or absence of a backbone or other body parts, warmblooded or coldblooded, lay eggs or give birth to live young, gills or lungs and etc. Elicit from students other ways they can think to separate groups of animals. Refer back to the original brainstorm and have students suggest reasons you put the animals in different groups. Remind students some of the ways scientists don't categorize i.e. size - they may just be different ages.

Tell the students that you have a collection of animals that need to be put into groups of related individuals. We don't have the living animal, just the hard parts that remain after the animal dies. What are some hard parts of animals? Have the students predict what sort of animals they expect to see in the collection they will work with.

Students Own Classification Schemes

Distribute the baskets of "shells" to each group and tell them their job is to put them into groups of animals related to each other in some way. **They are the scientists and they get to decide their own categories, however, they must place the shells in at least four groups, but a group can be as small as one individual.** *Remind them to spread all the shells out in the center of the table so everyone can see them and all must agree on the categories before they are done. Allow them to be creative - the important point is that they decide how they want to categorize the shells.*

Now distribute the drawing paper and have each student or pairs of students choose one of the categories to illustrate. They also need to come up with a name for their category that reflects a characteristic of that group that separated it from the rest. Display the pictures around the room.

Have one group show shells from one of their "families" to the rest of the class and have other students guess why they're all together in one group. Have students return all of the "shells" to the basket.

The "Real" Story: Scientists Classification Scheme

Describe 5 or 6 groups of "shells" to the students, placing the shells in categories scientists use to differentiate between them. As you compare and contrast the shells, teach a handsignal to correspond to each group. (See below for information on each group and the corresponding handsignal).

Have students again empty the basket of shells in the center of their desk and as you give a handsignal, they should hold up the corresponding shell. Make

sure each student gets a turn, although you will probably have more than one representative of each shell group so more than one student can participate at a time. Then have students return all the shells to the baskets.

Choose a few shells that you find of particular interest and tell a story about them, perhaps describing something about the animal's life history or why the shell is shaped in that special manner. Have students do the hand signal for that shell as you hold it up or describe it. (See BEYOND ACTIVITIES for suggested references of shell books).

PHYLUM MOLLUSCA

GASTROPODA (stomach-foot)

This is the largest group of mollusks - 80% of all mollusks are gastropods. These animals have a single shell (univalve), which is usually coiled and a sole-like muscular foot for crawling. "Snails" in this group can extend their head and foot out of the shell, but like all other molluscs with shells, are permanently attached within their shell and can never leave it. Other animals in this group include the limpets which have a volcano-like, uncoiled shell and the abalone which has a flattened shell with holes along one side. **Examples of gastropods with shells include conch, whelk, cowries, limpet, abalone, turbans.**

This is a very diverse group and your collection may have many different examples. Hand signal for the gastropods: one hand clasped in a fist to represent the single, spiral shell and placed on top of the other hand which has two fingers pointed straight to represent the tentacles.

BIVALVIA (two shells)

Bivalves have two shells (valves) hinged together with a ligament at the top. Scars on the inside of the shell show where muscles were attached to keep the shell tightly closed and hinge teeth keep the valves from slipping. Many clams are burrowers with their foot adapted for digging. Some bivalves such as scallops, mussels and oysters live on the surface. Oysters and mussels are firmly attached to one spot, but scallops can actually swim by clapping their shells together. **Examples of bivalves include clam, oyster, mussel, cockle.** *These are all animals with two shells, but many times the two halves or valves of the shells become separated so that it may not be obvious to your students at first that it is a bivalve. Hand signal: palms placed flat together with heel of hands held together to represent the hinge. Palms can open and close as the hinge stays together.*

CHITONS

The shell of chitons is made up of eight somewhat overlapping plates on a flattened, oval body which allows it to cling tightly to irregular surfaces. When dislodged from their rock, they can actually curl up into a ball for protection.

Handsignal: Intertwine your fingers with fingers and palms facing towards you, cup your hands and place your thumbs together to represent the mouth.

CEPHALOPODA (head-foot)

The shell of cephalopods has usually become reduced or internal (squid) lost (octopus) or chambered (nautilus). These animals have tentacles and move with jet propulsion. These are the most highly developed and fastest swimming invertebrates. **Examples of cephalopods include octopus, squid, nautilus.** *Most of these animals have reduced or absent shells so they will probably not be represented in your collection. You may however, have a cuttlefish bone, squid pen or a nautilus shell to represent the group.*

OTHER "SHELLED" ANIMALS

Sea stars, sea urchins and sand dollars are all cousins in the Phylum Echinoderm, which means "spiny-skinned". They all have a thin layer of epidermis overlaying the hard skeleton which is not actually called a shell, but instead it is referred to as a test. The epidermis disappears after the animal dies, causing the spines of the sea urchins to fall off of the test. All of these animals have tube feet for locomotion.

Handsignal: Hand raised, with fingers spread apart to represent the 5 arms of a sea star.

Crabs, lobsters and shrimp are all crustaceans in the Phylum Arthropoda, which means "jointed legs". This is the largest phylum of any animals - insects belong here! They all have a hard, crusty exoskeleton made of a material called chitin instead of calcium carbonate like in the mollusk shells. The crustacean exoskeleton is called a carapace.

Handsignal: Both hands formed into the shape of claws which can open and pinch shut.

Corals are in the Phylum Cnidaria along with the sea anemones and jellyfish. Hard corals build the huge reefs found in the tropics. The holes which are evident in the hard, bony skeleton was where the tiny sea anemone-like animals which made the reef lived.

Handsignal: Hold both hands with wrists touching, fingers pointing upright to represent the tentacles and hands cupped.

OPTIONAL ACTIVITY:

Oyster Shells and Observation Skills

Distribute a bag of oyster shell halves to small groups of students and instruct each student to pick one shell. (If you have matched pairs in the bag, then

students will be able to find their match at their table at the end of this activity).

Remind students of what an observation is and have the students study their shell very carefully so that they could recognize it again. Have students return all of the shells to the bag.

Gently shake the bag and again have the students empty out the shells on the table and find their own shell.

Distribute drawing paper and crayons and have students trace each side of their shell and color or label any distinguishing marks so that if someone else looked at their drawing, they would be able to pick out the shell described or shown.

Have two groups of students switch drawings and shells with each other and try to find the shells and drawings that went together. Talk about communicating observations - what observations helped and what didn't help?

Finally, have students find the match to their shell at their table. They will discover that oysters have one flat side (the lid to the shell) and one cupped side (the saucer) so that it can hold water when the tide goes out. Ask the students if they can figure out anything about the living animal by looking at its shell.

PORTFOLIO ASSESSMENT

Participation in group discussion

Participation in group classification of shells

Individual (or paired) drawing of one group of shells and presentation to the class

Teacher observation of student using handsignals to represent shells

Teacher observation of listening, sharing and communicating

BEYOND THE ACTIVITIES

Debriefing

Have students debrief their favorite/least favorite part of the activity. What did they learn the most from? What was a waste of time? How would they change the activity if they were the teacher?

Field Trips

Visit an aquarium store, aquarium like Steinhart Aquarium in San Francisco's Golden Gate Park, or the rocky seashore (see *MARE* Field Trip Guide) to see living mollusks and other "shelled" invertebrates like sea stars, crabs and

corals. You might want to visit a shell shop, but don't buy any of the shells - just look! Collectors have decimated many areas of the world in their hunt for shells and many millions of animals have been killed.

Shell Collections

Have students bring in any shells they might have at home to share with the class. Have reference books around for them to discover information about their shell. Remind the students and parents not to buy any new shells, ask for donations or loans from friends and relatives. Too many shells have already been collected in the world and when we buy shells we are condoning that practice.

What if?

Ask the students what would happen if everyone collected shells? What do they think about shell shops? Do they think they should buy shells from the shops? Where do the shell shops get their shells? Do they think the collectors wait until the animal has died before they take the shell?

Have students make up a story about a snail eaten by a predatory snail or sea star. What happens to the shell? Each student can contribute one line or action to make up a complete class story.

If you could turn yourself into an animal with a shell, what kind of animal would you be? How would you have to change? How would you escape from predators and shell collectors?

Live Animals

Keep a living clam, terrestrial snail, or hermit crab in your classroom to watch and document its behavior. Most are easy to take care of, but be sure to not buy anything exotic from a pet store that may not survive - often not enough is known about what it eats and how to keep it alive.

Class Play or Mini-drama

Read the story Pagoo by Holling Clancy Holling and have students dramatize some of the episodes to present as a class play. Make costumes and props and allow the students to make up their own script or improvise. Alternatively, Xerox parts of a chapter, and distribute pieces to small groups of students for them to read and dramatize to the rest of the class.

References for Student Research

Have students research the different kinds of shells in the collection - what is the name of the shell, what were the living animals like, where did they come from, what does it eat and who eats it? Students can make a book shaped like their shell to share with the class. Good young reader books to use for references include the following: *Snails* by Sylvia Johnson; *Mollusks Are Animals*, Concept Science by J. Holloway and C. Harper (also in Spanish);

Exploring an Ocean Tidepool by J. Bendick; *Where the Waves Break - Life at the Edge of the Sea* by A. Malnig; *The Magic of Sea Shells* by Fredlee, Windward Pub; *Shells* by Eyewitness Books (also in Spanish); and coloring books of shells such as *Shells of North American Shores* by Katherine Orr. Many adult shell books have excellent pictures that young students can match to the shells in their collection.