

TODAY'S CREATURE FEATURE-THE HORSESHOE CRAB

MASTER TEACHER Helen Mebane

GRADES 5 - 8 SCIENCE

OVERVIEW

Students will be introduced to "living fossils" which have been around even before dinosaurs roamed the earth. These harmless creatures are called the horseshoe crabs, or *Limulus*. They are not really crabs but are related to spiders in the phylum Arthropods. They are in their own classification Class Merostomata. Students will view a video showing their interesting anatomy, life cycle, and unique blood properties which are used for pharmaceuticals and in the medical field. Students will be given the opportunity to both observe a live and preserved horseshoe crab.

KEDT EDUCATIONAL TELEVISION SERIES

Wonders Under the Sea- 404 Horseshoe Crabs

LEARNING OBJECTIVES

Students will be able to:

- *observe and draw the dorsal and ventral parts of a preserved horseshoe crab
- *observe a live horseshoe crab
- *state the life cycle of a horseshoe crab
- *state the scientific uses for a horseshoe crab

MATERIALS**per student**

Activity sheet with 23 questions taken from the video

per three or four students

one preserved horseshoe crab

*Preserved horseshoe crabs may be purchased from Carolina Biological Supply Company:

AA-22-5360, 8 inches + body length, plain color injection, \$5.25 each, Carosafe package

AA-22-5361, 6-8 inches in body length, plain color injection, \$5.25 each, Caropak Single

AA-22-5370, 6-8 inches in body length, single color injection, \$6.95 each, Carosafe

AA-22-5371, 6-8 inches in body length, single color injection, \$6.95 each, Caropak Single

AA-22-5381, 3-6 inches in body length, plain color injection, \$4.30 each, Caropak Single

AA-22-5390, 2-3 inches in body length, plain color injection, \$3.40 each, Carosafe

AA-22-5400, 1-2 inches in body length, plain color injection, \$2.55 each, Carosafe

Horseshoe crabs are available in odorless Carosafe or in damp-packed Caropak, plain color injection means no color injection, and single color injection means the circulatory system is injected with a colored latex. Their address is P.O. Box 6010, Burlington, NC 27216-6010 and their toll free fax number is 1-800-222-7112.

*Preserved horseshoe crabs may be purchased from Frey Scientific, A Division of the Beckley Cardy Group:

S22650, 6 to 8 inches in length at \$6.75 each,

S22651, 3 to 6 inches in length at a cost of \$39.60 for a bucket of ten

S22652, 2 to 3 inches in length at a cost of \$24.55 for a bucket of ten.

Their address is 100 Paragon Parkway, Mansfield, Ohio 44903 and

their toll free fax number is 1-888-454-1457 and their toll free phone is 1-888-222-1332.

**Live horseshoe crabs may be purchased from Aqualand Pet Center at a cost of one for \$6.95 or a pair for \$12.50. Their address is P.O. Box 55-7365, Miami, Florida 33255-7365 and their telephone number is 305-823-1266 and their fax number is 305-823-1202.

VOCABULARY

horseshoe crab a marine animal with a large oval shell and a stiff, pointed tail that is more closely related to spiders.

omnivores animals which get their energy from eating both plants and animals.

endangered species animals whose population is so small that it is in danger of extinction.

spawning the behavior of the female to release large number of eggs into the water or sand.

bulk head a man-made barrier between water and land usually to prevent erosion.

living fossils the name given to trilobite larvae. Example: Baby horseshoe crabs

pheromones a chemical stimulant. Example: A perfume to attract the opposite sex horseshoe crabs.

satellite males the other males which mate with the female during mating season.

trilobites the name given to the horseshoe crab after they hatch and up

to one year of age.

molting in animals, the periodic shedding and replacing of the old body covering, such as the exoskeleton.

exoskeleton on all arthropods, the hard, external skeleton of an animal.

Example: a grasshopper

rudder the limb used by the animal to steer with while in the water.

nanobase the mouth of the horseshoe crab.

gizzard the muscular, digestive organs used to grind up the food.

fertilizer the food (nutrients) necessary for plant growth.

pharmaceutical medicines or the science of drug preparation, uses and composition.

endotoxins the poisons inside of a cell.

protein granules the small bits or chunks of protein.

prosoma the part of the body covered by the shell and includes the head.

hemalysate the copper-based blood of the horseshoe crab.

PRE-VIEWING ACTIVITIES

Ask the students, "What is a horseshoe crab? Where would you go to find one? Do these animals live in freshwater or saltwater? Today, we will see a video on horseshoe crabs learn how scientists use their blood to test medical equipment."

FOCUS FOR VIEWING

Say, "As part of our study of marine animals, we will view the external parts of a preserved horseshoe crab and learn how they are helpful to man." To give the students a specific responsibility while viewing say, "As we view this video, find some fascinating facts that will be answered from the handout-Activity Sheet. Record your answers as the tape is viewed. Activity Sheet is due at the end of the lesson."

VIEWING ACTIVITIES

Begin the tape where Kate Brown introduces Tom Schmid from the Texas State Aquarium. Tom is talking to a group of children who have several questions about horseshoe crabs. **Pause** the tape where you see a boy wearing a blue cap and after you hear, "They are mostly related to spiders." This is the answer given to the first child's question, "Why don't horseshoe crabs look like other crabs?" On the Activity sheet, review the first question on the handout. (The truth is they are not really crabs; they are in Phylum Arthropods. They are more closely related to spiders.)

Resume the tape. **Pause** the tape where you see a girl wearing a black cape and after you hear, "Atlantic coast." This is the answer to the second child's question, "Where do horseshoe crabs live?" On the Activity sheet, review the second question on the handout. (They live all along the Atlantic coast from Maine to Florida. They are found in the Gulf of Mexico to the Yucatan peninsula, and off the coast of Texas.)

Resume the tape. **Pause** the tape where you see a boy wearing a red cap and after you hear, "omnivores." This is the answer to the third child's question, "What do horseshoe crabs eat?" On the Activity sheet, review the third question on the handout. (They are called omnivores because they eat anything that they come across such as clams, worms, dead fish or algae on the bottom of the ocean.)

Resume the tape. **Pause** the tape where you see a girl with a yellow cap and after you hear, "**they are not endangered.**" This is the answer to the fourth child's question, "Are horseshoe crabs endangered?" On the Activity sheet, review the fourth question on the handout. (They are not endangered but there's not as many as there was in the past. They come to the beach to spawn and if there is no beach, a bulk head, or some type of erosion there is no place for the animal to spawn. They have been used as bait or chicken feed. We have to watch their numbers because they may become endangered.)

Resume the tape. **Pause** the tape where you see a boy with a black cap and after you hear, "**...two feet in diameter.**" This is the answer to the fifth child's question, "How big do horseshoe crabs get?" On the Activity sheet, review the fifth question on the handout. (They may be 2 feet in diameter when they mature.)

Resume the tape. **Pause** the tape where you see a girl wearing a blue cap and after you hear, "**...chicken feed.**" This is the answer to the sixth child's question, "What are horseshoe crabs used for?" See the Activity sheet, review the sixth question on the handout. (At one time they were used as chicken feed but when they were ground up and eaten by the chickens, the eggs tasted like fish so the poultry farmers don't do that anymore. Fishermen used them as bait. Presently, scientists use their very special blood to run tests on medical equipment to make sure it's safe. They also have very unusual eyes, similar to our eyes, so scientists are now researching that.)

Resume the tape. **Pause** the tape where you see Kate with both her hand with palms up and after you hear, "**survivor that dates back several hundred millions of years.**" This is the answer to the next question by Kate to Julie Galbraith. Kate asks, "Why are horseshoe crabs known as the living fossils?" On the activity sheet, review the seventh question on the handout. (The horseshoe crab is a survivor that dates back several hundred million years, even before the dinosaurs roamed the earth.)

Resume the tape. **Pause** the tape where you see Kate cup her hands together and after you hear, "...four species." This is the answer to the next question by Kate. She asks, "How many species of horseshoe crabs are there?" On the activity sheet, review for the eighth question on the handout. (There are four species, three live in the southeast Asia-Vietnam, Thailand, and Japan.)

Resume the tape. **Pause** the tape where you see several horseshoe crabs swimming in shallow water and after you hear, "come to the beach each spring." This is the answer to the next question by Kate. She asks, "How do horseshoe crabs mate?" See the Activity sheet, review the ninth question on the handout. (They come to the beach each spring. Nesting occurs at night. The males wait for the females to release the pheromones-a chemical stimulant. It's horseshoe crab "perfume" to attract the males. One male climbs on the female and she drags him to the coastline. The female digs five or seven shallow nests and begins to lay a couple of thousand eggs in each nest for a total of 20,000 eggs. Then the attached male and satellite males, other males that gather around fertilize the eggs as they are laid by the female. The males mate with several females during the spawning season.)

Resume the tape. **Pause** the tape where you see a black bird pecking at the shoreline and after you hear, "Birds like the eggs." This is the answer to the next question by Kate. She asks, "Do the birds eat the eggs?" On the activity sheet, review the tenth question on the handout. (Spawning usually occurs at night because the birds like to eat the eggs. Birds consume 320 tons of horseshoe crab eggs. Some birds, up to as many as twenty species, can't store enough energy to fly to the Arctic nesting grounds. They increase their weight two to three times during their vacation on the beaches.)

Resume the tape. **Pause** the tape where you see one female horseshoe crab digging into the sand and after you hear, "...two to four weeks." This is the answer to the next question by Kate. She asks, "How long does it take for the horseshoe crabs to hatch?" On the Activity sheet, review

the eleventh question on the handout. (If everything goes as plan, then the sun keeps the eggs warm and the tides keep them moist, the crabs hatch in two to four weeks later.)

Resume the tape. **Pause** the tape where you see Julie holding a one inch horseshoe crab and after you hear, "**year old trilobites.**" This is the answer to the next question by Kate. She asks, "What do baby horseshoe crabs look like?" On the Activity sheet, review the twelfth question on the handout. (Actually, these are year old horseshoe crabs which are called "trilobite larvae". They are 1/8 inch across and in a few days they begin to resemble the horseshoe crab. It takes 9 to 10 years for them to reach maturity and they grow to two feet in length. They molt to grow. They have an exoskeleton (hard outer skeleton) which opens up on the front edge and the crab crawls out forward to increase in size. After each molt they will increase 25 % in size. When they mature, they only molt once a year.)

Resume the tape. **Fast forward** the tape through the "Marine Science and You" segment with Natalie Jenkins which shows the "Ocean in Motion." **Resume** the tape. **Pause** the tape where you see Julie holding a five inch horseshoe crab with a moving tail and after you hear, "**...nasty tail.**" This is the answer to the next question by Kate. She asks, "Is the horseshoe's tail dangerous?" On the Activity sheet, review the thirteenth question on the handout. (Its nasty tail is harmless. It's used to right itself, flip itself right side up, used as a rudder, and to dig in the sand.)

Resume the tape. **Pause** the tape where you see Julie holding her hands together and after you hear, "**...claws are harmless.**" This is the answer to the next question by Kate. She asks "Are the claws dangerous?" On the Activity sheet, review the fourteenth question on the handout. (The claws are located at the ends of the five pairs of walking legs. They are harmless. They are only used to grasp food and begin to break it up.)

Resume the tape. **Pause** the tape where you see Julie pointing at the center area of a horseshoe crab and after you hear, "**they have no teeth.**" This is the answer to the next question by Kate. She asks, "Do horseshoe crabs have teeth?" On the Activity sheet, review the fifteenth question on the handout. (They have no teeth, only claws to break up the food. Their nanobase is at the center of the walking legs. The food is shredded and then sent to the muscular gizzard to be ground further. Horseshoe crabs can't poke, poison, pinch or bite you.)

Resume the tape. **Pause** the tape where you see Kate look at the camera and laugh and after you hear, "**They are useful for...**" This is the answer to the next question by Kate. She asks, "How are horseshoe crabs useful?" On the Activity sheet, review the sixteenth question on the handout. (1. They are a limited source of food in some parts of the world. 2. In the past, they've been used as fertilizers. 3. Also in the past, they've been used to feed chickens and hogs, but that has been eliminated. 4. They've used as bait for conches, lobsters, and eels. 5. They've used for pharmaceuticals and in the medical field because of their unique blood.)

Resume the tape. **Pause** the tape where you see a blue screen with blood cells and after you hear, "**...horseshoe crab blood.**" This is the answer to the next question by Kate. She asks, "What is so unique about their blood?" On the Activity sheet, review the seventeenth question on the handout. (Horseshoe crab blood has a clotting mechanism that causes it to clot when it comes in contact with endotoxins. Protein granules, present in blood cells, clump together and begin to fuse surrounding plasma. This protects the horseshoe crab because the ocean water is full of endotoxins. If the shell is injured, it allows the blood clot to form quickly.)

Resume the tape. **Pause** the tape where you see the technician flip the test tube upside down and after you hear, "**...pharmaceutical and the medical field.**" This is the answer to the next question by Kate. She asks, "How is the blood beneficial to pharmaceutical companies and the

medical field?" On the Activity sheet, review the eighteenth question on the handout. (Intravenous drugs should be tested for endotoxins. Scientists used to use the "rabbit fever test" where the contaminated solution was injected into the rabbit. If the rabbit developed a fever it meant there was a bacteria or a contamination in the solution in its body. Using blood from the horseshoe crab was quicker, more accurate, and live animals (rabbits) were not needed anymore.)

Resume the tape. **Pause** the tape where you see the technician place the horseshoe crab into the rack and after you hear, "**horseshoe crabs were taken to the lab.**" This is the answer to the next question by Kate. She asks, "How is the blood extracted from the horseshoe crabs?" On the Activity sheet, review the nineteenth question on the handout. (The horseshoe crabs were taken to a lab and inserted in racks where a needle was placed in the membrane between the abdomen and the prosoma. A small amount of solution is removed which is the horseshoe crab's blood. It is a blue, copper-based blood called hemalysate. The healthy, mature live crabs used are from the Northeast of the United States. After a small amount of blood is drawn, they're trucked back to the coast which is not harmful to the crabs. After 3-4 days, the plasma volume of the crab returns to normal and in 3-4 months, the blood count is back to normal. Horseshoe crabs can be identified as having already donated blood by the small scar where the needle was inserted. Horseshoe crabs are not used twice during the same season.)

Resume the tape. **Pause** the tape where you see Kate point both her hand toward her chest and after you hear, "**...protect the horseshoe crab.**" This is the answer to the next question by Kate. She asks, "What can we, the ordinary citizen, do to ensure their survival rate?" On the Activity sheet, review the twentieth question on the handout. (We, the ordinary citizen, can protect the horseshoe crab by not spoiling the coastline, never picking them up by the tail, and not bothering them at the beach.) Fast forward through the "Creature Feature" segment with Mike Peyton on blue crabs. Pause at the end of the segment.

Resume the tape. **Pause** the tape where you see at the bottom of the screen 1-800-799-7901 and after Kate introduces Karen Ryan and you hear, "...**Nine years for males.**" This is the answer to the next question by the first caller. He asks, "How long does it take for the horseshoe crabs to be fully grown?" On the Activity sheet, review the twenty first question on the handout. (It takes nine years for the males and ten years for the female. She produces eggs which is hard work.)

Resume the tape. **Pause** the tape where you see Karen holding a model of a horseshoe crab and after you hear, "...**male and female horseshoe crabs.**" This is the answer to the next question by Kate. She asks, "How do you tell the differences between the male and female horseshoe crabs?" On the Activity sheet, review twenty second question on the handout. (You can tell the difference because the males have a more pronounced forehead; it's bigger. The first set of walking legs have claspers to hang on to the female to get a free ride to the coastline).

Resume the tape. **Fast forward** the tape though all these questions where Sams asks, "Do horseshoe crabs shed their shells even though they are like Arachnids?" Next, Jenny asks, "Why are horseshoe crabs called crabs even though they are not crabs?" Next, Blake asks, "What do horseshoe crabs eat?" Next, Zachary, "Are horseshoe crabs and spiders related to trilobites?" Next, Austin, "Why do horseshoe crabs look like manta rays?" **Pause** the tape after Austin's question is answered. **Resume** the tape. **Pause** the tape to where you see Karen holding the horseshoe crab upside down (like a frying pan). You will hear, "**some places hold them upside down.**" This is the answer to the last question by Kate. She asks, "How would you eat them?" (Some places hold the horseshoe crab upside down by the tail and roast over a fire. Then they pick the meat out of the shell and put in a spicy stew. Others eat the abdomen and the tissues that hold the tail.)

Stop and eject the tape.

POST-VIEWING ACTIVITIES

Explain, "Now you have a better understanding of the external anatomy of the horseshoe crab, their life cycle, and unique scientific uses. Let's observe these preserved horseshoe crabs and label their parts. Use the handout adapted from the National Aquarium in Baltimore- 1997. The website is <http://www.aqua.org/education/teachers/horseshoe.html>

ACTION PLAN

Students could either take a field trip to the Texas State Aquarium or invite a Marine Biologist from the Texas State Aquarium to your classroom. Ask her questions: Are horseshoe crabs easy to care for? Is it true that they go a year without eating? How do they swim? How do they breathe? Do they have good eye vision like we do? What is the latest research using the horseshoe crabs? Also visit the Wonders Under the Sea website at www.televentures.org for more material on marine science topics.

Note: The Texas State Aquarium is located at 2710 North Shoreline, Corpus Christi, Texas 78402-1097

Have students visit the following website that have more information on horseshoe crabs:

<http://www.faseb.org/opar/poster/crab.html>

<http://www.enviroweb.org/oceanwatch/news/crfr2.html>

EXTENSIONS

Science

Students may visit the website of the Texas State Aquarium at <http://www.txstateaq.com> for more information on the horseshoe crabs. Students may use the horseshoe crab anatomy guide to review the animal's dorsal and ventral anatomy provided from the National Aquarium

in Baltimore website. It's very useful as the students observe the preserved horseshoe crab provided by the teacher.

Math

Remember, after each molt, horseshoe crabs will increase 25 % in size. Problem #1-Using a calculator and ruler, estimate how many times they would molt until they become fully grown adults. Remember, they grow from an 1/8 of an inch to 24 inches (from the tip of the tail to the front end of the carapace) in 9 years for males and 10 years for females. Also, they only molt once a year when they are mature. (16 molts on an average) Problem # 2-Using calculator or a ruler, determine the molting (growth) sizes in problem #1 in centimeters.

Art

As stated in the post-visit activities from the National Aquarium in Baltimore website, teachers could enlarge the pictures of the horseshoe crab body parts using the school copy machine. If it can't do this then it is suggested you make a transparency of the horseshoe crab. Then use an overhead projector to trace the parts onto a poster board. Then cut out each part and laminate or use clear contact paper to make a model of a horseshoe crab. The students could then make their own model labeling body parts and explaining their functions to each other in their group.

Language Arts

Research information of the websites given or read these books below. Write your own short story or poem about horseshoe crabs.

Teachers Resources

Fotheringham, Nick and Brunemeister, Susan. Beachcomber's Guide to Gulf Coast Marine Life. Houston, Texas: Gulf Publishing Company

Berrill, N.J. and Jacquelyn. 1001 Questions Answered about the Seashore. New York: Dover Publications.

Meinkoth, Norman A. The Audubon Society Field Guide to North American Seashore Creatures. New York: Alfred A. Knopf.

Miner, Ray Waldo. Field Book of Seashore Life. New York: G.P. Putman's Sons

Children Resources

Cook, Joseph J. The Curious World of the Crab. Dodd, Mead & Company. 1970.

McClung, Robert M. Horseshoe Crab. William Morrow and Co. 1967.

Mars, W. T. The Crab from Yesterday: the Life Cycle of a Horseshoe Crab. Frederick Warne and Co., Inc. 1970.

Tate, Suzanne. Harry Horseshoe Crab. Nags Head, NC: Nags Head Art. 1991.

Social Studies

By using a overhead projector, draw a huge world map which may cover a wall outside your classroom. Draw the outline of horseshoe crabs about two inches in length and find all the geographic distributions of all four species of horseshoe crabs. Glue an outline of all the areas the horseshoe crabs may be found. Next, hot glue your story or poem (which you wrote in your Language Arts class) all around the world map for the student body to read.

Activity Sheet

Answer these questions to the best of your ability.

1. Why don't horseshoe crabs look like other crabs?

2. Where do horseshoe crabs live?

3. What do horseshoe crabs eat?

4. Are horseshoe crabs endangered?

5. How big do horseshoe crabs get?

6. What are horseshoe crab used for?

7. Why are horseshoe crabs known as "living fossils"?

8. How many species of horseshoe crabs are there?

9. How do horseshoe crabs mate?

10. Do the birds eat the eggs?

11. How long does it take for the horseshoe crabs to hatch?

12. What do baby horseshoe crabs look like?

13. Is the horseshoe crab's tail dangerous?

14. Are the claws dangerous?

15. Do horseshoe crabs have teeth?

16. How are horseshoe crabs useful?

17. What is so unique about their blood?

18. How is the blood beneficial to pharmaceutical and the medical field?

19. How is the blood extracted from the horseshoe crabs?

20. What can we-the ordinary citizen do to ensure their survival rate?

21. How long does it take for the horseshoe crabs to be fully grown?

22. How do you tell the difference between the male and female horseshoe crab?

23. How would you eat them?
