Lesson 1: Starting to learn about manatees with *Sam the Sea Cow*

**Objectives:** Students will raise questions about manatees and discuss what they already know. Students will start to learn about manatee biology.

**What you will need:**
- Posterboard or electronic way to prepare a KWL chart that can be referenced later in the school year
- A copy of *Sam the Sea Cow* worksheet for each student

**Strategy:**
1. Create a KWL chart. Have students suggest items to fill in under K and W (L will be completed later in the school year.) Post this chart in the classroom to refer to during future manatee lessons.
2. Either have students read *Sam the Sea Cow* individually, or read it to the class as a group.
3. Have students complete the *Sam the Sea Cow* worksheet.

**Standards addressed:** CCSS.ELA-Literacy.3.RI.4; CCSS.ELA-Literacy.3.RF.4a; CCSS.ELA-Literacy.3.W.10


**Sam The Sea Cow**

Worksheet

1. Sam is a Sea Cow.
   Another word for Sea Cow is M___ ___ ___ ___ ___.

2. Even though Sam lives in the water what does he need to breathe? ______________ (Hint: What do you need to breathe?)

3. What do we call a baby manatee? ______________

4. When Sam was a tiny baby, what did his mother feed him? ________________.

5. Sam’s tail is called his P ____ DD ___.__.

6. Sam’s arms are called FL ___ PP ___ ____ S.

7. Sam lives at the Seaquarium for a year. He is then let go in a river. Many manatees go to this river in the winter. What is the name of the river? ________________

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This activity is available online at http://stjohns.ifas.ufl.edu/sea/manatees.html
Sam The Sea Cow

Answer Key

1. Sam is a Sea Cow.
   Another word for Sea Cow is MANATEE.

2. Even though Sam lives in the water what does he need to breathe? ___AIR_____ (Hint: What do you need to breathe?)

3. What do we call a baby manatee? ___CALF_____

4. When Sam was a tiny baby, what did his mother feed him?
   ___MILK___________.

5. Sam’s tail is called his PADDLE.

6. Sam’s arms are called FLIPPERS.

7. Sam lives at the Seaquarium for a year. He is then let go in a river. Many manatees go to this river in the winter. What is the name of the river?
   ______CRYSTAL RIVER_______________________________
Lesson 2:  Reading Rainbow—*Sam the Sea Cow*

**Objective:** Students learn about threats to manatees

**You will need:**
- A copy of the Reading Rainbow DVD, *Sam the Sea Cow*
- A copy of the student worksheet for each student
- A copy of *Sam the Sea Cow* teacher’s guide (optional)

**Strategy:**
1. As a class, watch the Reading Rainbow DVD, *Sam the Sea Cow* (30 minutes.)
2. Have students complete the student worksheet while watching the DVD.
3. Have a class discussion about the answers (also refer to the *Sam the Sea Cow* teacher’s guide for discussion ideas.)

**Standard addressed:** CCSS.ELA-Literacy.3.L.4

This activity is available online at http://stjohns.ifas.ufl.edu/sea/manatees.html
Reading Rainbow—*Sam the Sea Cow*

As you watch the movie, look and listen for the answers to the following questions.

1. Who reads the story *Sam the Sea Cow*?
   a. Francine Jacobs
   b. Laura Kelly
   c. LeVar Burton
   d. Jason Robards

2. Where does baby Sam get his milk?


3. What part of the body do manatees use to steer themselves through the water? __ __ __ __ __ __ __ __

4. How old is Sam when he leaves his mother? ______________

5. When people rescue hurt manatees, what do they often use to take the manatee out of the water?


6. How much do male manatees weigh?
   a. 500 pounds
   b. 1000-1200 pounds
   c. 2500 pounds
   d. 5000 pounds

7. Are female manatees bigger or smaller than male manatees?


This activity is available online at http://stjohns.ifas.ufl.edu/sea/manatees.html
8. What animal have manatees evolved from?

9. Which word best describes manatees?
   a. Vegetarian
   b. Carnivore
   c. Omnivore
   d. Predator

10. What body part do manatees use to grab their food?

11. Why do some manatees have scars on their backs?

12. How much did Barnacle Bill grow in the 18 months between the time he was rescued and the time he was released into the wild?

13. How many people does it take to carry Bill to freedom? ______

14. What is the largest animal on earth? _____________________

15. How long have manatees been around?

This activity is available online at http://stjohns.ifas.ufl.edu/sea/manatees.html
Reading Rainbow—*Sam the Sea Cow*
ANSWER KEY

As you watch the movie, look and listen for the answers to the following questions.

1. Who reads the story *Sam the Sea Cow*?
   a. Francine Jacobs
   b. Laura Kelly
   c. LeVar Burton
   d. Jason Robards

2. Where does baby Sam get his milk?
   _____from under his mother’s flipper_______

3. What part of the body do manatees use to steer themselves through the water?  **FLIPPER**

4. How old is Sam when he leaves his mother?  ____2 years old____

5. When people rescue hurt manatees, what do they often use to take the manatee out of the water?
   __Fishing nets___________________________________

6. How much do male manatees weigh?
   e. 500 pounds
   f. 1000-1200 pounds
   g. 2500 pounds
   h. 5000 pounds

7. Are female manatees bigger or smaller than male manatees?
   ____bigger________________________________________

8. What animal have manatees evolved from?

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This activity is available online at [http://stjohns.ifas.ufl.edu/sea/manatees.html](http://stjohns.ifas.ufl.edu/sea/manatees.html)
This activity is available online at http://stjohns.ifas.ufl.edu/sea/manatees.html
Lesson 3: Manatee Adaptations!

Objective: Students will learn about what an adaptation means and how manatees are adapted to their aquatic environment.

Vocabulary: adaptation, habitat, carnivore, herbivore, omnivore

You will need:
- The ability to show a powerpoint presentation (LCD projector or smartboard)
- Manatee Adaptations (Lesson 3) powerpoint presentation. [Make sure to also download the lesson 3 video file and save it in the same folder as the powerpoint file.]

Strategy:
1. Divide students into groups of 3-4 students.
2. Use the Manatee Adaptations PowerPoint to get students thinking about adaptations. Each slide on the PowerPoint has a question. Have the groups discuss each question for 1-2 minutes, then use the teacher guide below to guide the class discussion and provide answers to the questions.

Manatee Adaptation Lesson - Teacher Guide to PowerPoint Slides:

Slide 2 – What is adaptation?
Students:
- Have the students explain what they think an adaptation means.

Teacher:
- The true definition is that it is a trait or characteristic that improves an organism's ability to survive and reproduce in its environment.
- An example – Animals' teeth are different depending on their diet. Lions and sharks, which are carnivores, have razor sharp teeth good for tearing meat while cows, which are herbivores, have teeth that are good for grinding plant material. Humans are omnivores so they eat both plants and animals, thus they possess both razor sharp teeth and grinding molars.

Slide 3 – Do manatees breathe under water?
Students:
- Have the students discuss whether or not manatees breathe underwater like a fish or if they hold their breath.

Teacher:
- Manatees breathe air just like humans, so they hold their breath. Their special adaptation is that they can close their nostrils so that water does not get into their
lungs; just like we hold our nose when we dive underwater. In the two pictures on the slide, one shows the nostrils open, and the other shows them closed. When manatees surface to breathe, only their nose has to come out of the water so that they can open their nostrils and gulp in a breath of air.

- Manatees can hold their breath for up to 20 minutes, while the average person can only hold their breath for 30-45 seconds.

**Slide 4 – What are manatee whiskers for?**

**Students:**
- Have the students explain what five senses a person possesses.
- Have the students discuss what they think manatee whiskers are used for.

**Teacher:**
- Manatees use their whiskers as a sensory organ, much like a cat does. They can feel things (sense of touch) with their whiskers. The whiskers are actually more sensitive than the tips of our fingers.

**Slide 5 – How do manatees swim?**

**Students:**
- Have the students explain what body part of the manatee is shown in the slide.
- Have the students discuss how they think the manatee swims through the water.

**Teacher:**
- The manatee moves through the water by moving its tail up and down.
- On average, manatees swim at about 3 to 5 mph. This is about the same speed that people can walk. However, they have been known to swim at almost 20 mph in short bursts.

**Slide 6 – A manatee in motion.**

**Teacher:**
- Play the movie showing how a manatee swims through the water. Explain to the students that this manatee is swimming quite fast! Encourage them to watch the tail pumping up and down. Point out that because the tail is wide, it generates a lot of power. Compare the speed of a person swimming with bare feet to that of a person swimming with swim fins or flippers. Who can swim faster?

**Slide 7 – What is my flipper for?**

**Students:**
- Have the students explain what manatees use their front flippers for.

**Teacher:**
- Manatee front flippers help manatees steer and change direction when they are swimming. Point out that students probably noticed this in the movie clip.
- Point out to the students their toenails, which are similar to those on an elephant’s feet.
- Manatees can use their flippers (and toenails) to help them collect the plants that they like to eat, and to get the plants into their mouths.

**Slide 8 – What does a manatee use his lips for?**

**Students:**
- Have the students discuss why they think a manatee’s snout looks like an elephant trunk.

**Teacher:**
- A manatee’s snout allows them to collect food easily. They can eat plants that are underwater or floating on the surface. Their lips are muscular and can actually be used to grab plants and move the plants into the manatee’s mouth.

**Slide 9 – Do baby manatees use their lips to get food?**

**Students:**
- Have the students discuss what a mother manatee provides for her calf.

**Teacher:**
- A manatee calf nurses from under their mother’s flipper, so even baby manatees use their lips to help them get food—in this case, to get milk from the mother manatee!

**Slide 10—What kind of teeth do manatees have?**

**Students:**
- Have the students discuss which of their teeth most resemble a manatee’s teeth.

**Teacher:**
- Humans have different types of teeth because we eat many different types of food (we are omnivores—we eat both meat and plants.) Our incisors are used to cut food. Our canine teeth (cuspids) are used for tearing food. The bicuspid behind the canines are used for crushing food. Our molars are used for grinding food.
- Since manatees are herbivores (they only eat plants), they only have molars, which they use to grind up the plants before they swallow them.
- Unlike us, manatees grow new teeth in the back of their mouths all the time. As their older teeth get worn down, from chewing those tough and sometimes sandy plants, they fall out. The rest of the teeth actually move forward in the jaw and new teeth start to form in the back. We say that manatees have “marching molars.” Manatees never have to worry about running out of teeth!

**Slide 11– How many manatee adaptations can you list?**
- See how many groups of students can list all 5 adaptations mentioned in the presentation. How do manatees use their nose, whiskers, lips, flippers and tail?

**Sunshine State Standard addressed:** SC.3.N.1.1
Lesson 4: Manatees are mammals; they are closely-related to elephants.

Suggestion: Perhaps use this activity when teaching students classification—either to introduce or reinforce characteristics of mammals.

Objective: Students will learn characteristics of mammals and will use observation skills to list similarities and differences between manatees and their close relative, elephants.

Vocabulary: mammals, vertebrates, warm-blooded, mammary glands, flipper

You will need:
- Copies of animal photographs (included in this lesson plan)

Strategy:
1. Either introduce or ask students to help you list characteristics of mammals (what’s special about mammals that makes them different from other types of animals such as reptiles, amphibians, fish and birds?)
   a. Mammals have hair
   b. Mammals give live birth (with some exceptions: duck-billed platypus and spiny anteater lay eggs)
   c. Mammals nurse their young (mothers feed their babies milk from mammary glands)
   d. Mammals are warm-blooded
   e. Mammals generally only have two sets of teeth throughout their life (manatees are an exception!)

2. What other characteristics are shared by mammals (but may also be shared by other groups of animals)?
   a. Mammals are vertebrates
   b. Many other possible answers (eyes, ears, skin etc.)

3. Show students pictures of manatees (laminated handouts or projected). Ask them to look closely at the pictures to see if they can tell what group of animals manatees belong to. Have them explain why they choose the answer that they give.
   a. Correct answer: Mammals (pictures show hair around manatee’s mouth; baby manatee nursing from mother)

4. Show class pictures of elephants. What group of animals do elephants belong to? (Mammals)

5. Do elephants and manatees look similar? [The first response will probably be “No!”]. Show students pictures of close-ups of manatee and elephant skin, flipper/foot, manatee lips/elephant trunk. Have students list similarities.

This activity is available online at http://stjohns.ifas.ufl.edu/sea/manatees.html
a. Wrinkled, grey skin
b. Sparse hairs
c. Nails on end of flipper/foot
d. Eat plants
e. Use lips/trunk to get food into mouth
f. Small eyes
g. Nurse young under flipper/leg

6. Which of these are characteristics of mammals? (hairs, nursing young)

7. What differences are there between manatees and elephants?
   a. Manatees live in water, elephants live on land
   b. Manatees have a wide tail, elephants have a narrow tail
   c. Manatees have flippers, elephants have legs
   d. Manatees do not have hind (back) legs [They do have hip bones, but no leg or foot bones]
   e. Elephants have a trunk, manatees do not
   f. Elephants have large ear lobes, manatees do not
   g. Elephants can have tusks, manatees do not

8. Explain to the class that elephants are thought to have evolved from the same ancestor as manatees. Ask them why they think elephants might have developed these different characteristics. (You might break the class into small groups and give each group one characteristic and some reference materials—perhaps internet access—to have them discuss and come up with a theory that they write down, then present to the class for further discussion.)
   a. Manatees have a broad tail to help them swim (it provides power). Elephants do not need to be able to be powerful swimmers, and a wide tail would be heavy for them to carry around.
   b. Manatees use flippers to steer. Elephants must be able to hold up their heavy body and walk around on land, so they need larger, sturdier legs.
   c. Manatees do not need rear legs, elephants do. If elephants didn’t have rear legs, it would be very difficult for them to walk!
   d. Elephants have to be able to reach their food, which may be tree branches, or may be on the ground. A long trunk helps them do this more easily. Manatees eat plants that are underwater or floating and they can easily get their mouth right up to their food. A trunk would make it harder for manatees to swim.
   e. Elephants use their large ear lobes to help them cool down. Their ears contain many blood vessels which carry warm blood. Because the blood vessels are close to the surface of the skin, heat can be transferred to the air which makes the elephant cooler. Manatees live in water, which helps them cool down. Besides, large ear lobes would get in the way when a manatee is swimming.
Sunshine State Standards addressed: SC.3.L.15.1; SC.3.N.1.6
Lesson 4: Manatees are mammals (revised Jan 2013)

This activity is available online at http://stjohns.ifas.ufl.edu/sea/manatees.html
Lesson 4: Manatees are mammals (revised Jan 2013)

This activity is available online at http://stjohns.ifas.ufl.edu/sea/manatees.html

Photo credit: Tracy Colson, USFWS

Photo credit: Maia McGuire
Lesson 5: There are many species of animals similar to manatees, living in different parts of the world.

Objective: Students will learn about different species of Sirenians, and will use maps to locate where each species lives.

Vocabulary: extinct, Sirenian, blubber, species, continent

You will need:
- Copies of FWC’s Manatee activity book, “Florida’s Gentle Giants,” for each student or copies of Sirenia distribution map
- Copies of Sirenia species image (included with this activity) for small group use
- Rulers
- Map of sea surface temperatures (included with this activity)
- Copy of world map worksheet for each student

Common Core Standards: CCSS.ELA-Literacy.RI.4.7; CCSS.Math.Content.3.NF.A.1

Sunshine State Standards Addressed: SC.3.N.1.1, SS.3.G.1.3

Strategy:
1. Explain to students that the manatees that we have in Florida are one of five species that belong to a group of animals called Sirenia. This lesson will teach them a little bit about the different Sirenian species. Have students look at page 6 (“Sirenians of the world”) in the Manatees coloring and activity book (“Florida’s Gentle Giants”).
2. Explain that Florida Manatees don’t have much blubber (fat), but one of their relatives, the Steller’s Sea Cow did. It lived in the Bering Sea, off Alaska, but is now extinct. It was hunted for its blubber, which people used to burn to make light and heat (a bit like candle wax.) People discovered Steller’s Sea Cows in 1741, by 1768 they were extinct (there were no more living.)
3. Show students the drawing of the different Sirenian species (laminated handouts or projected). Ask them to write down on their worksheet which species is the largest (Steller’s Sea Cow).
4. Show students the map of sea surface temperatures. Explain to them that the water temperatures are given in degrees Celsius, and show them how to use the table to find the equivalent temperatures in Fahrenheit. Have them use the temperature map and the “Sirenians of the world” map to answer questions on the worksheet.
5. Pose a hypothesis: Animals that live in warmer water often grow faster, but don’t get as big as animals that live in colder water. Do the students’ observations about Sirenian species agree with this statement?
6. Give students a world map worksheet (e.g. http://www.enchantedlearning.com/geography/label/labelcontinents.shtml or http://www.teachervision.fen.com/tv/printables/scottforesman/24269_P_006.pdf). Have them label the continents. Which continents do not have...
any manatees or manatee relatives? (Europe, Antarctica). What fraction of the continents does have manatees or manatee relatives? (5/7)
Map showing sea surface temperatures in °C (from NOAA/National Ocean Climate Data Center)

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Lesson 5 (Sirenians) Worksheet

1. Which of the Sirenians is the largest? _________________________

2. Look at the “Sirenians of the world” map. There are different patterns on the map showing where the different types of sirenians live. Use the map to answer the following questions:
   a. What sea did the Steller’s sea cow live in? ________________
   b. The dugong can be found on the edges of three continents. Name one of those continents: _________________________

3. Look at the temperature map side by side with the Sirenians of the world map. Look for the lines on the temperature map that have the number 20 written in them. Try and draw these lines on the Sirenians of the world map. Look for the points where the 20°C lines meet the continents, and mark those points on the Sirenians of the world map, then connect them with lines that are close to the same shape as the ones on the temperature map.
   a. What types of sirenians are found between the 20°C lines? __________________________________________________
      __________________________________________________
   b. What type of sirenian is found outside the 20°C lines (i.e. in water colder than 20°C)? ______________________________
Lesson 6: What Do Animals Need to Survive?

Objective: Students will learn how changes in the environment affect survival of animals.

Vocabulary: Ecosystem, invertebrate, crustacean, salinity, independent and dependent variables, estimate, hypothesis, conclusion

Total Time Needed: 3-4 Days (consecutive)
- Day 1 – 50 minutes
- Day 2 or 3 – 20 minutes
- Day 3 or 4 – 50 minutes

Teacher Advance Preparation and Supplies Needed:
Note: optimum salinity for brine shrimp hatching is around 15-30 ppt. Most optimal hatching will occur at 15ppt, but it will depend upon where the brine shrimp eggs you purchase come from. You will need to mix up salt solutions for the students ahead of time.

You will need:
- 4-1 liter bottles
- 1 vial of brine shrimp (6 gram vial is plenty)
- Artificial sea salt from pet store (for salt water aquaria)
- Petri dishes (4 for each group of 3-4 students)
- Plastic cups (bigger than 3 oz; 4 for each group)
- Graduated droppers (1-ml)
- Toothpicks
- Hand Lens or Magnifying Glass
- Masking tape
- Pens/pencils
- Rulers
- Paper
- Microscope (optional)
- Cafeteria serving trays (optional)—1 for each group
- Balance (for the teacher’s use in making salt solutions)
- Data sheet for each student (pages 6-8 and 6-9)
- Petri dish layout sheet (optional; page 6-12)—one per group of students.

To prepare salt solutions:
Use either purchased water (drinking water is fine), or tap water that has been allowed to stand in an open container for at least an hour (to remove chlorine).
To one liter of water, add the following amounts of artificial sea salt to obtain the desired salinities (you will want 1 L of each):

- 0 ppt (parts per thousand) = 0 grams salt
- 15 ppt = 15 grams salt
- 30 ppt = 30 grams salt
- 45 ppt = 45 grams salt

If you want to check the salinity you can use a hydrometer which is available at pet stores in the aquarium section. However, you can simply trust the weights to give you accurate solutions.

Label cups with 0, 15, 30 and 45 ppt for each group.

**Strategy:**

**Day 1:** 50 minute period

1. Start the class by explaining to students that they will be conducting some experiments using animals called brine shrimp. Share background information about brine shrimp with the class.

**Background Information**

Brine shrimp live and are harvested primarily from natural salt lakes and solar salt operations around the world; popular commercial sources for brine shrimp are the Great Salt Lake in Utah and San Francisco Bay in California. Adult brine shrimp are also called 'sea monkeys.' Brine shrimp are often used as live food for aquariums.

Brine shrimp (Artemia) belong to the group of animals called crustaceans. Other crustaceans include crabs, shrimp and lobsters. Like other crustaceans, brine shrimp have an external "shell" which they grow out of several times throughout their life. When they outgrow their shell, they actually remove their body from the old shell, and then a new, larger shell will harden around their body. This process is called “molting.”

The brine shrimp life cycle includes the production of cysts which can remain dormant for many years as long as they are kept dry. This is an adaptation for living in desert lakes which can completely dry out. When the cysts are placed in salt water, they are rehydrated and resume their development. After 15 or 20 hours under ideal conditions, the cysts burst and the embryo leaves the shell. The embryo will grow and progress through 15 molts before reaching adulthood in approximately 8 days. Adult brine shrimp average about 8mm long, but can reach lengths of 20 mm.

2. Explain that all animals need certain things to grow and survive. The students will learn what brine shrimp need in order to hatch and survive.
3. Ask the students the key discussion questions:
Lesson 6: What do animals need to survive?  Page 6-3

a. What do you need to survive?
b. Do all animals need the same things to survive?
c. What is an ecosystem? How do ecosystems differ?
d. Why is an organism as small as a brine shrimp so important to an ecosystem?
e. What do brine shrimp need to survive?

4. Explain to the students that salinity (how salty the water is) is vital to the hatching and survival of brine shrimp. However, you are not certain what salinity will be the best for the brine shrimp to hatch in. Therefore, the class will conduct experiments to determine which salinity will cause the brine shrimp to hatch and survive the best. Explain to the students, that brine shrimp need salty water in order to hatch. Avoid telling them the correct salinity needed for them to hatch.

5. Before conducting the experiment, review how to design an experiment. As a class, answer the following [you may want to keep these up on the board all week; or have them on something that can be projected on the last day]:
   a. Why are we doing the experiment (what’s the PURPOSE)? To understand how an ecosystem works and to learn what factors are related to making the ecosystem work.
   b. QUESTION: How does the amount of salt in solution affect the hatch rate of brine shrimp?
   c. HYPOTHESIS: If place brine shrimp in salt solutions that contain different amounts of salt, then I think ______________(what will happen? Will all the shrimp hatch in all the solutions?) because________________
   d. What is the INDEPENDENT VARIABLE (the thing we are going to change in the experiment)? The amount of salt used.
   e. What is the DEPENDENT VARIABLE (the thing we are going to be able to measure, that should change based on the independent variable)? The hatch rate of the brine shrimp.

6. Explain that now that the students have an idea of what the purpose of the experiment is, they can begin the experiment.

7. Give each group of 4 students the following:
   a. 4 Petri dishes, 4 pieces of masking tape, 4 toothpicks, 4 droppers, 4 labeled cups (one for each salinity,) 1 ruler, pencil or pen, cafeteria serving tray, copy of page 6-12 (optional).

8. Ask students to place tape on the lids of each Petri dish and use a pen or pencil to write 0, 15, 30 and 45 on the tape (each number on a different lid)

9. Partially fill the cups with the appropriate pre-mixed salt solution (students need about 4 ounces of each)

10. Have students use the droppers to measure 20 ml of the 0 PPT solution into the appropriate Petri dish. Students should place the lid on the Petri dish once it has 20 ml of liquid in it. Repeat for each of the solutions - 15 ppt, 30 ppt and 45 ppt. ALL OF THE SOLUTIONS WILL LOOK THE SAME, so it is very important that students put the correct lid on the correct Petri dish!

11. Students should measure and mark 0.6 cm on the toothpicks.

This activity is available online at
http://stjohns.ifas.ufl.edu/sea/manatees.html
12. Students then dip the toothpick to the 0.6 cm mark in a solution and then dip it into the tube of brine shrimp. (You will bring the tube around for the students to dip into). They will then take the toothpick (with brine shrimp eggs stuck to it) and dip it into the appropriate Petri dish (the one with the same salinity that was used to wet the toothpick), making sure to remove and replace the lid on the Petri dish. One the toothpicks are marked, the dipping takes a short amount of time. Students should use a new toothpick for each salinity.

13. Have students write their names on the Petri dish layout sheet (or a blank sheet of paper.) Place each group’s Petri dishes on this paper in a safe place in the classroom (cafeteria trays work well for moving the Petri dishes around).

14. Have students complete the first section of the data sheet.

**Days 2 or 3: 20-25 minutes**

1. Students will make observations of the brine shrimp in their Petri dishes. The brine shrimp will hatch in 24-48 hours, so the teacher will make a determination when the students should make their first observations (i.e. on day 2 or 3).

2. Students should make qualitative (descriptive—what do they see?) observations on their data sheets during this time. They can work in their groups to observe the brine shrimp with microscopes (if available) and magnifying glasses. Students can remove the lids of the Petri dishes to make their observations, but warn them to make sure they put the correct lid back on the correct dish when they are done looking at it!

3. Have the groups share their observations with the class.

Brine shrimp that are about 24 hours old. Notice the gut or digestive system that has begun to form. Photo credit: Ho-Wen Chen.
Day 3 or 4: 50 minute period
1. Have the students observe the brine shrimp in their petri dishes.
2. Ask them if they can count the number of brine shrimp in any of the dishes. They should find that there are too many brine shrimp, and that they move too quickly to count!
3. Ask students if they can think of a way that they could come up with an estimate as to the number of brine shrimp in the dishes. Suggest that if they were able to take a small sample from the Petri dish, they might be able to count the number of brine shrimp, then use that small number to estimate the total number in the dish.
4. Have students open one of the Petri dishes. Ask them to place the lid upside down (so there is a rim sticking up) next to the Petri dish. Have them suck up some of the water with a dropper, then drop ONE drop of this onto the inside of the lid. Ask each student to count how many brine shrimp are in that one drop (using a magnifying glass). Students should record their observations on the data sheet. The three or four counts will be averaged. [For advanced students: One drop is about 0.1 ml, so students can estimate the number of brine shrimp in 20 ml by multiplying the average number counted in the drop by 200.]
5. Each group should provide their estimates for a master data table (this could be on the board, or projected so all can see). Discuss the data with the students—were each group’s results similar or not? What factors could make them different? [there is variability in eggs—some samples may have had more eggs that didn’t hatch; brine shrimp are attracted to light, so if samples were taken from a spot in the dish that had more light, there might have been more brine shrimp there; different people looking at the same sample came up with different numbers, drops may not have been representative of the overall dish, etc.] Explain that scientists have many of these same sources of error and this is one reason that experiments should have many trials (to be averaged).
6. Have each group of students write a CONCLUSION (What was the result of the experiment?)
7. As a class, discuss the following questions:
   a. How does the amount of salt in a solution affect the hatch rate of brine shrimp?
   b. Was your hypothesis accepted or rejected? Explain that it is normal for scientists to reject hypotheses; this does not mean that the students are “wrong.” A hypothesis is just a guess.
   c. What did you learn from conducting the experiment.
   d. If you were to do this experiment again, what would you do differently?
   e. What questions do you have that are still unanswered?

NOTE: For brine shrimp, their rapid swimming makes counting difficult. To examine which salinity worked, counting is not essential. Students should still be able to observe overall differences in the hatching Petri dishes. 0 ppt should have no brine shrimp.
hatched, 15 and 30 ppt should have the best hatch rates, 45 ppt should have a lower hatch rate.

**Disposal of Brine Shrimp:**
Several options exist for brine shrimp disposal after experiments are complete. You can give them to your students to take home and raise, as long as they understand the responsibility and requirements of taking care of the brine shrimp to adults. To help them there is an enclosed guide. You can freeze to humanly kill the brine shrimp and dispose in trash. You can feed to aquarium fish as they make a very nutritious live food for captive fish. **DO NOT** release brine shrimp into lakes, ponds, estuaries, or oceans as they are non-native organisms to many ecosystems.

**COOL THINGS TO TELL THE CLASS ABOUT BRINE SHRIMP**
1. They can survive a wide range of temperatures: 6 - 35°C (43 - 95°F)
2. They can survive high salinities: 70-240 parts per thousand (ppt)
   a. the ocean is just 35 ppt
   b. sea monkeys have efficient systems to regulate salt
3. Adults are 2-3 millimeters in length and the eggs are 200-300 micrometers in diameter (very small)
4. The very young embryos can live most of their lives inside a capsule in a dry state and without much oxygen
5. Larvae molt about 15 times after hatching
6. By living in harsh environments, brine shrimp can avoid predators (they are very nutritious and delicious to bug-eating animals).
7. And they’re not very good-looking 😃

**Sunshine State Standards:** SC.3.N.1.1; SC.3.N.1.3; SC.3.N.1.6

**Online Resources:**
[http://people.westminstercollege.edu/faculty/tharrison/gsfood/studentpages/brine.html](http://people.westminstercollege.edu/faculty/tharrison/gsfood/studentpages/brine.html)

Modified from “Let’s learn about life cycles. What do you need to survive?” created by Alexis Morris, Elisa Livengood and Carmel O’Steen; GK-12 Fellows, University of Florida.
DATA SHEET—Brine shrimp experiment.

Day 1: Fill out this first section of the data sheet

My name: _____________________________________________________________

Other students in my group: ____________________________________________

Date experiment was started: ____________________________________________

What do brine shrimp eggs look like? ________________________________

Do the different liquids in the Petri dishes look the same or different? ________

Day 2 or 3: Observations

Today’s date is: _______________________________________________________

Use the magnifying glass to look at brine shrimp in one of the Petri dishes. Draw a picture of a brine shrimp in the space below.

What do you see the brine shrimp doing? (Are they swimming? Staying still? Eating?) ____________________________________________

In which dish or dishes have the brine shrimp hatched? ____________________
Day 3 or 4: Counting brine shrimp

In this table, there is a space for your counts, and also for the counts made by other people in your team. Write your name next to the word “ME.” Write one of your team members’ names in each blank box in the “Observer” column. Put a drop of water from one of the Petri dishes into the lid from that dish. Use a magnifying glass to count the number of brine shrimp that you see in the drop of water. Write that number in the appropriate box (under the correct salinity). When you are done with all 4 salinities, work with the other members of your group to fill in the rest of the boxes (copy down the numbers from each person’s sheet in the correct row).

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<th>SALINITY</th>
<th>OBSERVER</th>
<th>example</th>
<th>0 ppt</th>
<th>15 ppt</th>
<th>30 ppt</th>
<th>45 ppt</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME</td>
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<td>48 ÷ 4 = 12</td>
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</tbody>
</table>

Calculate the AVERAGE number of brine shrimp seen for each salinity. To find the average, add all of the numbers in one column (e.g. under the 0 ppt). Divide this total by the number of observations that there were (= how many people were in your group). Write the result in the Averages row under the correct salinity.

**Discuss with your team:** Did salinity affect the number of brine shrimp that hatched? How? Write your answers below as a CONCLUSION:

Our conclusion is that ______________________________________________________
______________________________________________________________________
______________________________________________________________________
Growing Adult Brine Shrimp

By William Berg

General Info.

Brine shrimps, or artemia, are a zooplankton used mainly as fry food, but they can also be grown to about 20 mm (0.8 inch) in length and be a valuable food source for adult fishes as well. What makes brine shrimps such ideal fry food is their good nutritional value, their ability to live 5 hours in fresh water before dying, and the fact that the eggs can be stored for many years as long as they are kept away from water and oxygen. Once the dried eggs are returned into oxygenated saltwater they resume their development and hatch. This is an adaptation to living in desert lakes that dry up.

The time it takes them to hatch depends on the temperature. It takes 15 to 20 hours at 25°C (77°F). A higher temperature shortens hatching time. The optimal hatching temperature depends on the origin of the brine shrimps, however temperatures between 25-30°C (77-86°F) are recommended.

- Recommended salinity: 30-35 ppt (1.022-1.026 density)
- Recommended pH: 8.0 (pH 6.0-9.0 is acceptable)

Once they hatch they enter the umbrella stage, during which the larvae do not feed since they haven't yet developed a mouth or anus. They survive on their yolk sac during this time.

After 12 hours they enter the second stage of development and start feeding by filtering micro-algae from the water. The nauplii grow fast, and can reach adulthood in 8 days. Brine shrimp can live for up to 3 months.

Since this article is focusing on growing brine shrimp to adulthood, I shall not address the question of how to hatch brine shrimp.

Caring for your brine shrimp

There are several factors that contribute to the successful raising of brine shrimp to adult size. The two most important ones, besides giving the brine shrimp the above stated water parameters, are:

- Feeding: brine shrimp are not hard to feed. They accept most food they can filter out of the water as long as it's not too big and doesn't dissolve in water. There is brine shrimp food available in pet stores, containing micro-algae for the nauplii to eat. There are, however, quite a few cheaper alternatives that you can buy in your regular grocery store; for example yeast, wheat flour, soybean powder and egg yolk. It's hard to know how much to feed the nauplii, but the transparency of the water can be of help. During the first weeks you should be able to see about 15 cm into the water. When the nauplii grow, the food concentration should be kept a little
lower, and a water transparency of 25 cm is recommended. Food levels should be kept constant, so frequent feedings are required.

Aquarium maintenance: Brine shrimp are usually kept in small tanks, and therefore water quality may deteriorate quickly. Water changes are of utmost importance. I recommend changing at least 20% two times a week. This is to prevent low oxygen levels which will be a result of poor water quality. It's also important to clean the bottom of the tank since brine shrimp moult very often during their way to adulthood, leaving a lot of remains on the bottom of the tank which may lower the water quality. Cleaning should be done at night using a flashlight to draw the brine shrimp to the surface. Brine shrimp are drawn to light, and the light from the flashlight will attract them to the light source, keeping them safe while you clean the bottom of the tank.

Breeding brine shrimp

If well cared for and kept in a low salinity, your adult brine shrimp will (or might) spawn in your aquarium. Every adult female is capable of producing 75 nauplii a day, or 300 every 4 days. They will be able to spawn 10 times during a normal lifespan. However if well cared for they can, as I stated earlier, live for as long as 3 months and during that entire time spawn every 4 days.

About The Author

Article by William Berg writer for Aquatic Community with more then 20 years of aquarium experience. Find more of William's articles about Brine shrimp or maybe something completely different like Lungfish

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Article Source: http://EzineArticles.com/?expert=William_Berg
Lesson 7: What do Manatees Need to Survive?

Objectives: Students will learn about plant biology, herbivory and what manatees eat. Students will realize that all plants are not the same and the manatee has some that it prefers.

Vocabulary: herbivore, seed, root, stem, leaves, flower, fruit, water hyacinth, manatee grass, sediment, diameter, pollen, invasive

You will need:
- Copies of “plant parts rap” (www.jmgkids.us/media/plant_parts_rap.pdf) for students
- Optional: internet access/computers
- Color printouts of pages 7-3 through 7-6
- Copy of Venn diagram (page 7-7) for each student or group of students

Strategy:
1. Ask students if they remember what type of food manatees like to eat (plants). What do we call animals that eat only plants? (Herbivore)
2. Explain that today’s lesson is going to teach the students about parts of a plant, similarities and differences between plants, and some of manatees’ favorite things to eat.
   a. As the students sing the rap, you might show the “life-cycle” animation from http://www.mbgnet.net/bioplants-parts.html (it’s at the bottom of the page—it can be downloaded as a .gif file and opened in an image viewing program or run from the website.)
   b. The Great Plant Escape is a fun interactive/educational game from the University of Illinois Extension geared towards 4th and 5th grade students. If you have access to a computer lab, you can have students do this individually (or in teams) or can do as a class activity. http://urbanext.illinois.edu/gpe/index.cfm. Case #1 includes an activity labeling the parts of a plant, and includes questions about plant part functions.
   c. Your students can test their knowledge about edible plant parts by playing “Supermarket Botany” at http://www.mbgnet.net/bioplants/supermkt.html
4. Show students pictures of water hyacinth, manatee grass and pine tree. Do all three types of plants have roots, stems and leaves? (Yes, although pine tree leaves are called needles) Point out that manatee grass grows underwater with its roots buried in the sediment. Water hyacinth plants float on the surface of the water, with their leaves and flowers in the air, and their roots hanging down in the...
water. Pine trees grow on land, with roots in the soil. All three types of plant do produce flowers, but the flowers of pine trees and manatee grass are very small.

a. Remind students that manatees live in water. Explain that manatees eat two of the three types of plants (manatee grass and water hyacinth.) Ask the students how plants get their food (they use the sun’s energy to make it). Explain that animals like manatees have to get their energy by eating plants

b. Have students use a Venn diagram (and the plant data sheets) to compare the three different types of plants using the following characteristics:

i. Long, thin leaves
ii. Wide, rounded leaves
iii. Large, showy flowers
iv. Small flowers
v. Lives in water
vi. Lives on land
vii. Roots in soil/sediment
viii. Roots hang loose in water

Sunshine State Standards: SC.3.L.17.2; SC.3.L.14.1;
Common Core Standards: CCSS.ELA-Literacy.RI.3.7
Plant Data Sheet: **Water hyacinth**

**Where does it live?** Water hyacinth plants float in fresh water. They can be found growing in rivers, lakes and ponds in Florida. Their leaves and flowers are in the air, while their roots hang down in the water.

**What does it look like?** Water hyacinth plants have pretty purple flowers. A single plant can be from a few inches to three feet tall!

**What’s special about it?** Water hyacinth is an INVASIVE plant in Florida. It was brought here from another country because people thought it was pretty and wanted to have it growing in their ponds. Unfortunately, it ended up in places like the St Johns River where it grows and grows and grows, covering the surface of the water in some places. This means that light cannot get into the water so underwater plants cannot survive. Also, boats cannot get through the thick water hyacinth. Now people are not allowed to bring any more water hyacinth into Florida!
Plant Data Sheet: Manatee grass

Where does it live? Manatee grass lives in salty water (ocean and bays) in Florida. It lives completely underwater. Its roots are buried in the sediment, and its leaves stick up into the water. Manatee grass grows in shallow water—it cannot grow in very deep water.

What does it look like? Manatee grass leaves look like green spaghetti! They are rounded and can be rolled in your hands. Manatee grass does have tiny flowers, but they are very difficult to see.

Manatee grass. Image credit: Tracey Saxby. Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/imagelibrary/).
Plant Data Sheet: Pine Tree

Where does it live? There are many types of pine trees, but all live on land, with roots buried in the soil.

What does it look like? Pine trees have long, thin needles instead of leaves. Pine trees can be very tall. Pine trees have small flowers, which release lots of yellow pollen. Pine tree seeds grow inside pine cones.

Longleaf pine needles. Photo credit: Melinda Shelton

Longleaf pine cone. Photo credit: Daniel Oines
Lesson 7: What do Manatees Need to Survive? (revised Jan 2013)

This activity is available online at http://stjohns.ifas.ufl.edu/sea/manatees.html

Longleaf Pine trees
Photo credit: Chris M. Morris

Manatee grass
Photo credit: FWC

Water Hyacinth
Photo credit: Samuel Huckins
Comparing Manatee grass, Water hyacinth and Pine trees

Use the photographs and plant data sheets to help with this activity. Write the letter for each characteristic in the proper place in the diagram below:

a. Long, thin leaves  
b. Wide, rounded leaves  
c. Large, showy flowers  
d. Small flowers  
e. Lives in water  
f. Lives on land  
g. Roots in soil/sediment  
h. Roots hang loose in water
Lesson 8: How much do manatees need to eat?

Objective: Students use math skills to calculate manatee feeding needs

You will need:
- scissors for each student
- A copy of “Manatee feeding time” activity page (page 8-4) and worksheet (page 8-5) for each student
- Tape or glue

Strategy:

1. Remind students that manatees have to eat a lot of food every day. Generally, manatees will eat one tenth (1/10) of their body weight every day in plants. So, a manatee that weighs 1000 pounds will have to eat 100 pounds of food a day.
2. Have students complete “Manatee Feeding Time” activity (Sea World*). Explain to students that they are going to pretend to be manatee biologists at Sea World. It will be their job to make sure that each manatee gets its share of food. They will be feeding the manatees romaine lettuce, cabbage, carrots and grapes.
   a. Students are to cut out all of the boxes on the sheet (manatees and food items)
   b. Students should count how many of each item they have and enter those numbers on their worksheet.
   c. Students need to give an equal amount of each food item to each manatee.
   d. Students should then create equations to show how they distributed the food and write these on the worksheet.

Standard addressed: CCSS. Math.Content.3.OA.A.1.2

*Manatee Feeding Time activity also available online at http://www.seaworld.org/just-for-teachers/classroom-activities/k-3/pdf/Manatee%20Feeding%20Time.pdf
Manatee Feeding Time

OBJECTIVE

The student will explore how numbers are put together and taken apart. He or she will experiment with division, connecting what they know to symbolic representations.

ACTION

1. Discuss manatees and what they eat. In this exercise, students will pretend they are animal care specialists at SeaWorld who are responsible for caring for and feeding the manatees.

2. Distribute Manatee Feeding Time cut-out on page 7. Explain to pre-readers that their job is to distribute the food to the manatees. They must decide how much of each kind of food each manatee gets for this feeding. Each manatee eats the same amount of food: romaine lettuce, cabbage, carrots, and grapes.

3. Students use scissors to cut apart food items and tape or glue them to the bottom of the manatee drawings.

4. When finished, discuss the exercise with students. Ask them to explain how they decided how many of each food item to give each manatee.

5. (For grades 2-3) Students write number sentences that describe how they divided the food.

ANSWERS

Students should suggest the following number sentences:

- $45 \div 5 = 9$ (romaine lettuce)
- $15 \div 5 = 3$ (cabbage)
- $10 \div 5 = 2$ (grapes)
- $5 \div 5 = 1$ (carrots)
BACKGROUND INFORMATION

Manatees are large, herbivorous marine mammals that live in fresh water, sea water, and brackish water. In the wild, they eat a wide variety of aquatic and shoreline plants.

The manatees at SeaWorld eat romaine, greenleaf, and iceberg lettuce; spinach; and cabbage. The immense mammals devour nearly 227 kg of greens every day. For special treats, they nibble grapes, carrots, apples, and sweet potatoes.

MATERIALS

For each student:
- copies of Manatee Feeding Time cut-out, page 7 (if needed, you can enlarge copies)
- scissors
- tape or glue
- pencils and paper

In the wild, manatees eat a variety of aquatic and shoreline plants. At SeaWorld (above), manatees eat lots of romaine lettuce and other healthy vegetables.
### Cut out page

<table>
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</table>
Worksheet for “Manatee Feeding Time” Activity.

Before you start distributing the food to the manatees, you should take “inventory.” This means you need to count how much of each type of food you have.

1. How many romaine lettuce pieces did you start with? _____________
2. How many cabbage pieces did you start with? _____________
3. How many grapes did you start with? __________
4. How many carrots did you start with? ____________
5. How many manatees do you have to feed? ____________

Once you have “fed” the manatees, write an equation for each food type to show how the food was distributed. For example, if you had had 20 water hyacinths to give to 4 manatees, each manatee would get 5 hyacinths. An equation for this could be

\[ 20 \div 4 = 5 \]

Write an equation for each food type:

Romaine

Cabbage

Grapes

Carrots
Lesson 9: Manatees Need Warm Water to Survive

Objectives: Students will understand thermal refuges and manatee winter migrations. They will be able to use a map of Florida to identify natural (i.e. warm springs) and man-made (i.e. power plants) thermal refuges used by Florida manatees in cold weather. They will be introduced to the role of water temperature in manatee migrations and begin to understand why biologists conduct manatee population counts only when it has been very cold for at least three days.

Vocabulary: endangered, extinct, thermal pollution, thermal refuge, blubber, population, migration, thermal regulation

You will need:
- The ability to show a powerpoint presentation (LCD projector or smartboard)
- “Manatees need warm water to survive” (Lesson 9) PowerPoint presentation.
- Copies of worksheets 1a, 1b and 2 for each student (pages 9-8 to 9-11)
- Copies of Florida map for each student (page 9-12)
- One color copy of thermometer on page 9-7 to show with Elmo projector, or on an overhead transparency
- Computer/internet access for students
- Thermometers
- Plastic cups
- Masking tape or labels
- Optional: gallon plastic bags, duct tape, shortening, ice, 5-gallon bucket (for “blubber glove”)

Strategy:
1. Use the provided powerpoint presentation to teach students different strategies used by marine mammals to stay warm. For example, manatees do not have a thick blubber layer which most marine mammals (ie. dolphins, whales and seals) use to keep warm in cold water. The other marine mammal which does not have blubber is the sea otter which is found in California and Alaska.

Script for PowerPoint

Slide 1: This short PowerPoint presentation will teach you about the ways that different groups of marine mammals stay warm in cold water.

Slide 2: The word “thermal” means to do with temperature. The word “regulation” means “control,” so thermal regulation means the same thing as “controlling temperature”. Mammals have many different things that they can do to keep themselves warm when the weather is cold and cool when it is hot. What might YOU do to stay warm on a cold day? [put on a jacket, stand in the sun, go inside etc.] How might you cool off? [Wear shorts and t-shirts instead of winter-
Lesson 9: Manatees need warm water to survive (revised Jan 2013)

This activity is available online at
http://stjohns.ifas.ufl.edu/sea/manatees.html

type clothes, get in the water if at the beach, move into the shade, go into air conditioning.] These are all things that we humans can do for thermal regulation.

**Slide 3:** There are just a few groups of mammals that live in the ocean. Whales and dolphins; seals, sea lions and walrus; manatees; sea otters (found only in California and Alaska) and polar bears. Each of these different groups of animals has different ways to keep warm.

**Slide 4:** Whales have very thick blubber layers. Blubber is a special type of fat, and functions like a jacket. It is very efficient at holding in body heat. If a whale or a dolphin is out of the water for some reason, people need to be careful that it does not overheat. While people can take off a jacket if they get too hot, whales cannot take off their blubber!

Whales have some other ways of staying warm. They can change the way their blood flows to keep the warm blood more in the middle of their bodies, instead of near the skin, where the water would cool it down. This lets whales keep their hearts, lungs and other organs working even in cold water. When whales eat food that has a lot of fat, the calories in that food help make their bodies warm. Energy is transferred from the food to the whale.

**Slide 5:** Not all marine mammals have blubber. Whales, dolphins, seals, sea lions, and even polar bears have blubber layers, but sea otters and manatees do not. In a few slides we will talk a little more about sea otters. They have special hair that is extremely thick and it holds air next to the body. The air keeps the otter warm. Divers who dive in very cold water use a “dry suit” which also traps air next to the body to keep the person warm. Manatees do not have blubber or the special hair of a sea otter to help keep them warm.

**Slide 6:** Walrus live in arctic environments which are very cold all year long. Walrus have massive amounts of blubber. Approximately one-third of their body weight is blubber! Walrus are an important food source for Native Americans who require a lot of fat calories in their diet to survive in the cold climate of the arctic. Like whales, walrus can make their blood flow towards the center of their bodies and away from icy water. Walrus are highly social and will “cuddle” together to conserve body heat.

**Slide 7:** In addition to blubber and other adaptations, seals and sea lions use behavior to help them keep warm or cool off. In this example, the sea lions are crowding together on some rocks. The rocks are warmed by the sun, as are the sea lions. There is also close contact which lets the animals share body heat. The light brown colored animals have already dried out.

**Slide 8:** These sea lions are showing a natural behavior which helps them to cool off. By lifting a flipper out of the water, the blood (which is right under the skin) can be cooled down which will help cool the animal’s body temperature.
Slide 9: Here are some pictures of sea otters. The main point here is that these are the only marine mammal, other than the manatee, which does not have a blubber layer to help keep it warm. Sea otters have very special, and very thick hair (more than a million hairs per square inch) that traps a layer of air between the animal’s skin and the ocean. This keeps the otter warm, and also provides floatation (see photo upper right). Anything that disturbs the hair, such as an oil spill, is devastating to the sea otter. A sea otter with damaged fur will quickly die of hypothermia in cold water.

Slide 10: Now that we have talked about different methods that other marine mammals use to stay warm, we can talk about manatees.

Slide 11: Manatees are relatively tropical animals and they cannot live year round further north than Florida, because they cannot survive in cold water. When water temperatures fall below 68°F manatees become cold-stressed. Many young manatees die when Florida has severe cold weather. In early 2010, more than 400 manatees died, a record number, and most of died because of the cold water temperatures. Water temperatures near Flagler County were in the 40’s in January 2010. This is far too cold for manatees.

So what do manatees do to stay warm? They have to swim to somewhere where the water temperatures are warmer! Springs have naturally warm water in the winter, and some power plants pump warm water into the coastal areas, which creates warm places where manatees can spend the winter months.

Slide 12: There are underground lakes called aquifers. Most people in Florida get their drinking water from aquifers. Sometimes the water in an aquifer comes up to the surface, creating a spring. The water in a spring is 72°F all year long. This water feels really cold in the summer, but feels warm in the winter! The top photo shows Blue Spring, which is just south of Flagler County. Manatees often come to Blue Spring in the winter months.

Slide 13: Power plants have become a source for artificially warmed water for manatees. Since manatees learn to migrate to warm water from their mothers, some young animals do not know where the natural water sites are—they only know to go to the power plants. The problem with this is that if the power plant is turned off for any reason, the manatees still go there. If there is no warm water they will stay by the power plant and often die.

Slide 14: These pictures show manatees crowding into power plant basins in the winter. If you look carefully, you can see the warm water being pumped into the bay (it looks white and frothy). The manatees only crowd like this when water temperatures around the plant are cold. This is the reason the state biologists (Florida Fish and Wildlife Conservation Commission) count manatees in cold weather. If it is very cold for three days in a row, the biologists will fly in small
airplanes over areas where manatees are gathered and will count how many manatees they see. In December, 2009, when it stayed so cold for so long, more than 5000 manatees were counted. Can you count the manatees in these pictures? It is not easy!

**Slide 15:** Why do manatees need to stay warm? Manatees need to stay warm because they are tropical, or near-tropical animals. They do not have blubber layers or other means of staying warm that other marine mammal species have.

**Slide 16:** Manatees migrate into Florida springs each winter, including Blue Spring State Park, to stay warm when temperatures in surrounding waters fall below 68°F. In general, water from these springs is a constant 72°F and will help keep the manatee warm. If the cold weather lasts for too long, as it did in late 2009 and early 2010, it can make it hard for the manatees to feed as they must leave the spring and travel in cold water to find food.

**Slide 17:** The problem with power plants is that they are a man-made source of warm water. If they are turned off for some reason, or break down, or are shut down, the manatees go there and there is no warm water. The manatees, especially the young ones, may not know where to go. If they cannot find another source of warm water they may die.

**Slide 18:** Let’s review what we just learned. Who can tell me ONE way that marine mammals stay warm in cold weather? [blubber, their food, thick fur, move to warmer water]. How are sea otters different from most other marine mammals? [they use thick fur to trap air to stay warm; they have no blubber]. How are manatees different from most other marine mammals? [They have no blubber or thick fur—they must go to warm water areas in the winter]. Where are the best places to find manatees in the winter? [springs, power plants]

Good job! You’ve learned a lot about marine mammals today!

a. **Optional activity:** Make “Blubber Gloves”. Take two 1-gallon plastic bags. Fill one bag about half-way full with shortening, trying to keep the shortening all in the bottom of the bag. Take the second gallon bag, and put it inside the first bag, so the shortening is sandwiched between the two bags. Be careful not to push shortening out of the top of the bags! Use Duct tape to seal the openings of the two bags together. DO NOT seal the two sides of the inside bag together! Use a bucket or large bowl and fill about half full with ice water. Hold the blubber glove at the surface of the ice water and have one student put their hand in the bag and push the bag down into the water. The shortening will insulate the student’s hand so it doesn’t feel the cold. Have the student place their other hand in the ice water without using the blubber glove!
Lesson 9: Manatees need warm water to survive (revised Jan 2013)

Allow all students to do this. In between students, you may need to redistribute the shortening so there is an even layer between the bags.

2. Measuring water temperature. This lesson will be used to teach students how to collect data on water temperature. Show students the diagram of a thermometer (use an ELMO or overhead projector, if possible). Explain to students how to read the thermometer, which has both Fahrenheit and Celsius scales. This thermometer shows a reading of 70°F—help the students figure out what temperature that would be in °C. Have students complete worksheet 1a: Reading a Thermometer.

3. Have three students make labels using masking tape or adhesive labels. One label should say “room,” one should say “fridge” and one should say “sun.” Ask students to stick one label on each of three small plastic containers. Have students carefully add one cup of water to each of the containers, and use a thermometer to measure the temperature of the water in each container. They will record these temperatures on worksheet 1b. They will then place each container in one of three different locations. One will be kept at room temperature, one will be in the refrigerator, and one will be in direct sunlight. Students will wait at least 30 min before using a thermometer to test water temperatures in the three samples. They will record the data on their data sheets using both °F and °C measurements. They will be asked to do some simple calculations with these data.

4. Give students copies of Worksheet 2. Remind them that manatees in Florida must migrate to warm water areas when water temperatures fall below 68°F. Students will use on-line resources to help them locate natural refuge areas (warm water springs), including Blue Spring State Park, and will mark these locations on a blank Florida map.

5. Remind students that some manatees have learned to migrate to artificial, or manmade, thermal refuge areas. Most of these are power plants which release large volumes of very warm water into Florida waterways. This thermal pollution warms adjacent waters enough to keep manatees warm when water temperatures fall below 68°F. The problem with man-made thermal refuges is that these power plants may not be running at the times the manatees need the warm water areas. In addition, some of Florida’s power plants are quite old and will be shut down in coming years. Once manatees have learned to use these areas for thermal refuge it is difficult for them to find naturally warm waters (i.e. springs) when it gets cold. We believe that manatees learn their migration routes from their mothers so if a power plant has been used for a long time by manatees they may not know where they can
find warm water when the power plant is not available. Students will use online 
resources to identify several major areas with power plant thermal refuges.

6. Explain to students that they will use on-line resources to find real-time water 
temperature data for the St. Johns River and the Atlantic Ocean (St. Augustine). 
They will be asked to use this data in some simple calculations.

7. Explain to students that in order to estimate how many manatees live in Florida, 
biologists fly all over the state in small airplanes, and count every manatee that they 
see. They do this during the winter, and they only conduct population counts on 
manatees when it has been very cold for at least three days. Ask the students why 
they think that is. Leading questions could be, “What will manatees do when the 
weather gets cold?” (Ans: head south or to the springs). “Do you think it would be 
easier to count thousands of manatees if they were swimming actively all around the 
state, or if they were mostly in a few locations?” (Ans: A few locations.)

Clip art thermometer from FCIT
(http://etc.usf.edu/clipart/)
Lesson 9, Worksheet 1a: Reading thermometers
For each thermometer, write down the temperature that it shows, both in °F (“FAHR.”) and in °C (“CENT.”)

a) Temperature
   _____°F _____°C

b) Temperature
   _____°F _____°C

c) Temperature
   _____°F _____°C

d) Temperature
   _____°F _____°C
Lesson 9, Worksheet 1b: Water Temperature

Each class will have three plastic containers to put water in. Place the tip of the thermometer (the colored part) into the water in one container. Watch the colored line move up (or down) the thermometer until it stops moving. There will be two sets of numbers, one along each side of the colored line. One of these is the temperature in Fahrenheit (°F) and the other is in Celsius (°C). Read the numbers (Fahrenheit and Celsius) closest to the top of the colored line. You may have to estimate the actual temperature, if the line falls between two numbers. Write those numbers in the spaces provided below. Repeat this for each of the water samples.

The starting temperature in the container labeled “Room” is _______°F (_______°C)
The starting temperature in the container labeled “Fridge” is _______°F (_______°C)
The starting temperature in the container labeled “Sun” is _______°F (_______°C)

Place one container on a counter in the classroom. Ask your teacher to place one in the refrigerator. The third can be placed in a sunny window or outside in direct sun. Wait at least 30 minutes before continuing with this assignment.

A. After 30 minutes, what is the temperature in each of the three water samples?
   a. Room temperature _______ °F _______ °C
   b. Refrigerator temperature _______ °F _______ °C
   c. Sun-warmed sample _______ °F _______ °C

B. What is the difference in temperature between the room temperature sample and the refrigerated sample (room minus fridge)?
   _______ °F _______ °C

C. What is the difference in temperature between the sun-warmed sample and the refrigerated sample (sun minus fridge)?
   _______ °F _______ °C
Lesson 9, Worksheet 2: Manatees Need Warm Water to Survive

1. Using the blank map of Florida, and your computer, you will map out the natural and man-made areas that manatees use for thermal refuge (safe, warm areas) in winter. You should be able to find each location below using Google Maps (http://maps.google.com). Draw a blue star on your map at locations that are natural warm water refuges, and draw a red star for man-made warm water refuges.

A. Natural warm water springs:
   a. Blue Spring State Park (Orange City, Florida)
   b. Crystal River National Wildlife Refuge (Crystal River, Florida)
   c. Manatee Springs State Park (Chiefland, Florida)
   d. DeLeon Springs State Park (DeLeon Springs, Florida)
   e. Fanning Springs State Park (Newberry, Florida)

B. Man-Made (power plant) warm water refuge:
   a. Moore’s Creek – Ft. Pierce Utilities Authority (Ft. Pierce, Florida)
   b. Orange River and FPL Discharge Canal (Ft. Meyers, Florida)
   c. Tampa Bay – Tampa Electric Company (Apollo Beach, Florida)
   d. Florida Power and Light Company (Riviera Beach, Florida)

2. Migrating manatees.
   Find this information at: http://savethemanatee.org/info_manatee_migration.html
   a. Manatees usually try and find warm water when water temperatures fall to
      __________ °F (_________ °C)
   b. In what season of the year do manatees migrate (spring, summer, fall or winter ?
      ____________________________.
   c. Why do they migrate?
      _________________________________.

3. Draw a line to show the St. John’s River on your Florida map in green.
   a. What is the current temperature in the St. John’s River at Palatka?  
      
      _______ °F (________ °C)
   
   b. Is this warm enough for manatees? ________________.
   
   c. Do you think manatees are grazing in the river today or keeping warm at Blue Spring State Park and other warm refuge areas?  
      
      ____________________________________________________________
      ____________________________________________________________
   
   d. What is the current temperature in the Atlantic Ocean near you?(Hint: to figure this out you should use the internet to find the National Oceanographic Data Center ([http://www.nodc.noaa.gov](http://www.nodc.noaa.gov)). The home page for this site looks a little scary because there is a lot of stuff there, but scroll down and find the link to Coastal Water Temperatures (in the Project Data Sets box). Click on this link and you will find a map of the United States. You will find your area of eastern Florida highlighted in yellow. Click on this link, and using the Google map provided, find the sea temperature closest to Flagler Beach (This will likely be St. Augustine, Florida).
      
      What is the recorded temperature shown? _______ °F (________ °C)
   
   e. Could a manatee migrate along the beach when coastal water temperatures are in this range? _______________________
   
   f. What is the difference in temperature between the ocean and the St. Johns River (ocean temperature minus river temperature)?  
      
      _______ °F (________ °C)
Map of Florida
(from http://fcit.usf.edu/florida/maps)
Lesson 10: Students will learn how they impact their environment.

Objective: Students will learn that different activities create different amounts of pollution.

Vocabulary: Pollution, solar, wind energy, sewage, stormwater, environment

You will need:
• The ability to project (LCD projector or smartboard)
• Pollution PowerPoint presentation (Lesson 10)

Strategy:

1. Using the Pollution PowerPoint presentation, explain to students that people sometimes do things that are not healthy for the natural environment. Often we release chemicals or other harmful items into the air or into the water. We call these items “pollution.” Sometimes we can see pollution, but sometimes we cannot.

Teacher Script:

Slide 1: Sometimes people do things that harm the natural environment and make it difficult for wild animals and plants to live healthy lives. We call this pollution. Today we will learn about different types of pollution—some are easy to see, and some are very difficult to see.

Slide 2: We don’t like to see trash on the ground, especially at the beach. Unfortunately, trash is often dropped on the ground, or sometimes it blows out of trash cans. Storms can wash trash from the ground into the water. This picture was taken after a hurricane came past Flagler Beach.

Slide 3: Cars, buses, airplanes, trains and other vehicles use gasoline or coal to make them go. When gas or coal are burned, the result is a smoke that contains harmful chemicals.

Slide 4: Can you see the brown stuff in the air over the buildings? This is called smog, a mixture of the words “smoke” and “fog.” The exhaust from cars, smoke from fires and many other things can cause smog. We mostly see smog around cities.

Slide 5: Have you ever looked at the parking lot after it has rained and noticed a rainbow on the ground? This rainbow is caused by small amounts of oil that have leaked from cars and trucks onto the parking lot surface. When it rains, the oil gets spread out and light shining on it looks like a rainbow. Sometimes ships have accidents and oil gets spilled in the ocean. This oil can cover birds and animals and can kill them. Even the small amounts of oil from the parking lot can be harmful to wildlife.
Slide 6: Many animals and plants need it to be dark at night for 10 or more hours or their bodies become confused. Some plants will not start to make flowers unless the night length is correct. Some animals will not reproduce unless they have enough darkness. When we leave lights on all night, we can mess up the day-night cycle that animals and plants are used to. This picture shows North America from space at night. Can you find Florida? Where do you think the big cities are located? [Where the brightest lights are]

Slide 7: Loud noises can scare animals and can even damage their ability to hear (just like in humans!). Sound travels long distances underwater, and scientists are worried about the effect of loud underwater noises on animals like whales.

Slide 8: When we flush the toilet, the stuff that is flushed is called “sewage.” In some places, that sewage is piped out into the ocean. This sewage has had some of the harmful stuff removed from it, but is not safe to drink.

Slide 9: When people put fertilizer on their yards to make the grass green, or spray outside the house to kill bugs, those chemicals can wash into creeks or ponds when it rains. We cannot see the chemicals in the water, but sometimes the chemicals can harm the creek or pond.

Slide 10: Power plants, like this one in St. Lucie County, FL, use water to cool down the big engines that create electricity. The water that is in the front of the picture was originally taken from the lagoon. As it was piped past the engines, the heat from the engines made the water hot, letting the engines cool down. It was then pumped into the ponds. It is allowed to cool down in these ponds before it is pumped back into the lagoon. If it was not allowed to cool down first, it would make the water in the lagoon too hot for some creatures to live in.

Slide 11: Which one of these pictures shows a polluted lake? The bottom picture is obviously polluted—we can see lots of plastic and even a tire floating in the water. That cannot be healthy for wildlife. The picture at the top looks healthy, doesn’t it? But without testing the water, we cannot say for sure that it is healthy. In reality, both pictures were taken at the same lake, just around the corner from each other.

Slide 12: We have mentioned that rainwater can wash chemicals and even trash into the water. We call this stormwater pollution. All of the ditches that you can see next to the roads drain into a canal, lake or other waterbody, so whatever is in the ditches will eventually get into the water somewhere.

Slide 13: There are lots of things that we can all do to help keep our water and air healthy. Here are some examples. How does each of these help prevent pollution?
Lesson 11: Biodegradable or Not?

Objectives: Students will learn what types of items are biodegradable and what types are not.

Vocabulary: biodegradable, physical characteristics, recycling, decay, bacteria

You will need:

- Piece of wood (eg. popsicle stick)
- Slice of apple
- Piece of styrofoam cup
- Small piece of plant or a leaf
- Piece of plastic bag
- Penny
- Piece of napkin
- (optional) Piece of a soda can
- (optional) Biodegradable packing peanuts
- Masking tape
- Markers that will write on masking tape
- Eight 2-Liter soda bottles or gallon milk containers cut down to about 6” in height. Cover the cut edge with masking tape or duct tape so it is not sharp.
- Potting soil
- Plastic wrap
- Rubber bands
- Copies of “Is it Biodegradable?” worksheet (page 11-3) for students

Strategy:  (NOTE: this activity will be conducted on two days, at least a week apart)

Day 1

1. Ask students what they know about recycling. Ask them to give you examples of things that they can recycle (newspaper, soda cans, tin cans, plastic bottles etc.) Ask them to think about why some items can be recycled and why some cannot. Ask if anyone knows what happens to our trash—when we throw items away? Explain that most trash is taken to a big place called a landfill, and that it just piles up there. As more and more trash goes to the landfill, the pile of trash gets bigger and bigger. Some of the things in the landfill will decay—this means that they will eventually disappear, as they are eaten by bacteria and other things. However, there are some things that take a VERY long time to decay, so it is a good idea to recycle most of those things. Let the students know they are going to do an experiment with different types of items to see which items decay fairly quickly (are biodegradable) and which ones do not (non-biodegradable). Many natural things are biodegradable, while many man-made things are not.
2. Have students get into seven or eight groups of 2-3 students per group. Give each group a soda bottle and have them label the soda bottle with the name of the item that will be buried inside. Show students all of the items to be buried, and have them record their observations on their data sheets.

3. Have the students place soil in their bottles until it is about 3 inches deep.

4. Have each student place their item on top of the soil in their bottle.

5. Have students add another 2" of soil on top of their item.

6. Give the students a measuring cup and have each of them pour one cup of water on top of the soil in their bottle.

7. Cut pieces of plastic wrap that are big enough to cover the top of the soda bottles, and have students use rubber bands to attach the plastic wrap so it covers the opening of the bottle.

8. Have students place all of the bottles on a table or counter where they will be safe for a week.

9. Have students make a hypothesis as to which items will be the most biodegradable. Their hypothesis will be a guess as to which items they think will be biodegradable and which ones will not be. Have them list why they think this is so.

Day 2 (about a week later)
1. After a week passes by you will have the students take the buried items out of the soda bottles. What do they notice? Do any of the items look different from the time they were first buried? Have the students write what has happened on their worksheets.

Standards addressed: SC.3.N.1.1; SC.3.N.1.6

This activity is modified from:

Lesson 11 Worksheet: Is it Biodegradable?

**My Hypothesis:** I think that __________________________ will be the most biodegradable because __________________________

<table>
<thead>
<tr>
<th>ITEM</th>
<th>What did it look like before you put it in the soil? (color, size, shape etc.)</th>
<th>After one week, did it change? Yes or No</th>
<th>Describe the changes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apple</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Styrofoam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penny</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Napkin</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lesson 12: Pollution and Other Threats to Manatees

Objective: Students will learn about threats to manatee survival

Key words: monofilament fishing line, watercraft, entangled,

You will need:
- source of music that can be turned on and off
- chairs
- tape
- printed manatee threat cards (page 12-2 through 12-8) — make enough copies to have cards equal to your number of students, minus 1

Strategy:
1. Explain to students that many things can affect a manatee’s ability to survive. They are going to play Manatee Musical Chairs (activity modified from Sea World) to learn about these threats to manatees.
2. Set up chairs in a circle (facing outwards). You need one fewer chair than the number of students.
3. Tape one of the cards to the back of each chair (with the writing towards the back of the chair, so it cannot be seen.) Use as many duplicate cards as you need to—each chair should have a card.
4. Explain to the students that they are all manatees, trying to survive in the wild. Review the rules for musical chairs (Everyone gathers in a circle around the chairs. When the music starts, students must walk in single file in one direction—they must keep moving smoothly and slowly. When the music stops, students must sit in the chair that is closest to them. Only one child can sit in each chair. One child will not be able to find a seat.)
5. Start the music. Stop the music after a few seconds to a minute. Tell the child who does not have a seat that they can pick a card from any of the chairs. Have them read the information on the card. This will tell what happened to that “manatee”, which is now gone from the herd. That child sits down (this is a good time to have them work on manatee workbooks or coloring sheets), the chair from which the card was taken is removed, the circle of chairs is re-formed, and the game continues until only a single “manatee” remains.
6. Review with the students the threats that came about during the game. Write them up on the board under two headings: Human and Natural.
7. Ask the students to brainstorm about ways that they might be able to decrease some of the human threats. (e.g. Slow speed zones for boats in manatee areas—show sign; throwing away or recycling fishing line; not throwing trash in the water; not attracting manatees to docks with food or water; flood gates now have manatee detectors which prevent the gates from closing if a manatee is in the way.)

Sunshine State Standard: SS.3.C.2.1
BOAT ACCIDENTS

When manatees are hit by boats, they can get broken bones or other injuries. Sometimes a broken rib will puncture a lung, which makes it difficult for a manatee to float.

![Boat Accident Image]

FLOOD GATES

Flood gates are used to control the amount of water that can flow through an area. When these gates close, they can trap and crush manatees.

![Flood Gates Image]

Photo credit: FWC
POACHING

Manatees can not legally be hunted, however sometimes people will kill them illegally for their meat. This is called poaching.

FISHING LINE

Fishing line can last up to 600 years in the water. When manatees swim into pieces of fishing line, it can get wrapped around their flippers. Sometimes it cuts into their skin and the cut can get infected. Manatees sometimes eat fishing line because they do not see it tangled up in the seagrass where they are feeding.
CRAB TRAPS

Crab traps are tied to one end of a rope. A float is on the other end of the rope. Manatees sometimes get tangled up in the rope when they swim around crab traps. The rope can cut into their flippers. It is hard for a manatee to swim when it is dragging a crab trap behind it.

Photo credit: Tim Donovan, FWC

RED TIDE

Red tide is caused by tiny plants that live in the ocean. These plants release chemicals into the air and water. When there are a lot of red tide plants around, the chemicals can make manatees sick.
COLD WEATHER

Manatees need water temperatures warmer than 68°F in order to be healthy. When temperatures fall below this, manatees can get sick and even die from cold stress.

DISEASES

Like people, manatees can get sick. Sometimes they are not able to recover from illness.
FISHING HOOKS

Fishing hooks can get caught in manatees’ skin. The wound might become infected.

HABITAT DESTRUCTION

Manatees need clean, shallow water. They need plants to eat. Sometimes people make the water polluted, or build seawalls where plants used to grow. These actions can destroy the things that manatees need to be healthy.
TRASH

When people throw trash in the water, manatees can get tangled up in it. Manatees might eat trash by mistake. Some types of trash might injure manatees.

PROPELLERS

Manatees often get cuts on their backs, tails or flippers when they are hit by a boat propeller. The spinning blades leave a series of cuts on the manatee. If the cuts are deep, the manatee might die.
CANAL LOCKS

Canals are man-made water channels. When canals must carry water uphill or downhill, they are often controlled using gates called locks. These locks can crush manatees that get trapped when they are closing.

Photo credit: John Burke
Lesson 13: Manatee Migration Activity
(Modified from Sea World’s “Marvelous Manatees”)

Objective: Students will learn about factors that can affect manatees in their migration to find warm water in the fall and winter months. Students will work together to complete a successful manatee migration.

Vocabulary (definitions from Merriam-Webster student dictionary):

<table>
<thead>
<tr>
<th>Word</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid</td>
<td>a compound that usually dissolves in water, has a sour taste, reacts with a base to form a salt, and turns litmus paper red</td>
</tr>
<tr>
<td>Acidic</td>
<td>acid-forming</td>
</tr>
<tr>
<td>By-products</td>
<td>products or results produced in addition to the main product or result</td>
</tr>
<tr>
<td>Digestion</td>
<td>the process of digesting something; especially food</td>
</tr>
<tr>
<td>Discard</td>
<td>to get rid of as useless or unwanted (throw away)</td>
</tr>
<tr>
<td>Disease (=illness)</td>
<td>an abnormal bodily condition of a living plant or animal that interferes with functioning and can usually be recognized by signs and symptoms</td>
</tr>
<tr>
<td>Entangled</td>
<td>Tangled up; wrapped up in something that prevents normal movement</td>
</tr>
<tr>
<td>Floodgate</td>
<td>a gate (as in a canal) for controlling a body of water</td>
</tr>
<tr>
<td>Harass</td>
<td>to annoy persistently</td>
</tr>
<tr>
<td>Hide (= skin)</td>
<td>the skin of an animal</td>
</tr>
<tr>
<td>Hypothermia</td>
<td>reduction of the body temperature to an abnormally low level</td>
</tr>
<tr>
<td>Impact</td>
<td>to hit or cause to hit with force</td>
</tr>
<tr>
<td>Migration</td>
<td>passing from one region or climate to another usually on a regular schedule for feeding or breeding</td>
</tr>
<tr>
<td>Parasite</td>
<td>A living thing that obtains benefits from another living thing (the host) which is usually harmed in some way</td>
</tr>
<tr>
<td>Pectoral flipper</td>
<td>either of a pair of flippers that correspond to the front limbs of a four-footed animal</td>
</tr>
<tr>
<td>Pesticide</td>
<td>a substance used to destroy pests</td>
</tr>
<tr>
<td>Propeller</td>
<td>a device consisting of a hub fitted with blades that is made to turn rapidly by an engine and is used especially for propelling airplanes and ships</td>
</tr>
<tr>
<td>Propeller guard</td>
<td>A device that fits over a propeller to prevent the sharp edges of the blades from being able to cut anything</td>
</tr>
<tr>
<td>Refuge</td>
<td>a place that provides shelter or protection</td>
</tr>
<tr>
<td>Rehabilitate</td>
<td>to restore to a condition of health</td>
</tr>
<tr>
<td>Sanctuary</td>
<td>a place that provides shelter or protection</td>
</tr>
<tr>
<td>Toxin</td>
<td>a substance (produced by a living organism) that is very poisonous to other organisms</td>
</tr>
<tr>
<td>Vegetation</td>
<td>plant life</td>
</tr>
</tbody>
</table>
You will need:

- Area of floor approximately 10 feet wide and 20 feet long
- 2' x 2' foam mat pieces, or masking tape (optional)
- Manatee migration cards—printed on card stock, with the number written on the back of the card stock (pages 13-4 to 13-21)

Strategy:

1. Clear a large floor area
2. Connect 35 foam mat pieces to make a grid that is five squares wide by seven squares tall (see picture below; note that numbers in **bold** are those which will allow students to take another turn). Alternately, use masking tape to mark off a grid on the floor, or simply use floor tiles to set up the grid—in these cases, each square in the grid should be 2' x 2'.

3. Place the appropriately-numbered Manatee Migration Card on each square so the number is facing upwards. (If you need to print out these cards, print them on card stock, if available, and cut the sheets in half. On the blank side, write the number that corresponds to the statement on the other side of the card.)

4. Break the students into two equal-sized groups. Each group represents a manatee.

5. Tell the students that manatees face many obstacles in their environment. Students in each group will take turns trying to find the appropriate migration pathway through the maze. Teams can choose to start at box # 1, 2, 3, 4, or 5.

6. The first student from the first team will select the card # 1, 2, 3, 4 or 5. They will stand on that square, turn the card over, and read it aloud. The student should return the card, number upwards, to the mat. If the card directs the student to take another turn, they can move one square in any direction (including diagonally). They will repeat the process until they “miss a turn.” At that point,
the student must replace the card, leave the mat, and the other team will take a turn. Teammates can help each other by suggesting which direction the player should move.

7. Teams will take turns until one of the teams manages to end up at the card that says “CONGRATULATIONS!”

Sunshine State Standard: SC.3.L.17.1
1. Brrr. The water temperature has dropped quickly and you are experiencing hypothermia. Between 2000 and 2009, an average of 31 manatees per year died due to cold weather. In January 2010, 77 manatees died from the cold! Lose your turn!

2. Slow-speed signs are in the area you are going to move through. Boaters are following the speed limit. Take another turn! Move one space in any direction.
3. As you begin your migration, you encounter a closed floodgate. The floodgate won’t let you migrate any further. The water is getting colder and you experience hypothermia. Lose your turn!

4. Disease and parasites have plagued you all summer long. You’re too weak to make the long journey back to your winter habitat. Lose your turn!
5. The water temperature is getting colder so you start your migration to warmer waters. You prefer water temperatures above 70°F. Take another turn! Move one space in any direction.

6. Industry by-products have been dumped into the river, making the water too acidic for plant life. Since there are no plants to eat, you starve. Lose your turn!
7. You begin your migration too late and fall victim to hypothermia. Lose your turn!

8. As you attempt to swim through a drainage pipe, you get stuck! You will starve unless someone rescues you. Lose your turn!
9. A school group is cleaning the edge of the river. By cleaning up the fishing line and plastics, there is less chance that you will become entangled. Take another turn! Move one space in any direction.

10. People are observing you from a distance. They don’t disturb you. Take another turn! Move one space in any direction.
11. As you travel through a flood gate, it closes and crushes you. Most flood gates are remote-controlled and can crush a manatee passing through them. Lose your turn!

12. Poachers hunting for manatee hides and meat spot you. Unfortunately you are no match for their powerful guns. Lose your turn!
13. You reach an area in the river where most boaters use propeller guards to protect manatees from being injured by the propeller. Take another turn! Move one space in any direction.

14. Someone has dumped pesticides into the water. The pesticides are absorbed into the plants that you eat, making you very sick. Lose your turn!
15. You have reached an area with boat speed limits. Boaters will now be able to see you more easily, which reduces your chance of being hit. Take another turn! Move one space in any direction.

16. A speeding boat passes overhead as you come up to breathe. The propeller blades accidentally hit you and you are severely injured. There were no “slow speed” signs to warn boaters. Lose your turn!
17. You accidentally eat fishing line discarded in the river. The fishing line does not break down in your stomach and causes digestion problems. Lose your turn!

18. A small creek drains into the coastal waterway. You enjoy the drink of fresh water. Take another turn! Move one space in any direction.
19. You have become entangled in a crab trap. The nylon cord has wrapped around your pectoral (side) flippers, making it impossible to reach the surface to breathe. Lose your turn!

20. Someone has discarded used motor oil in the river. You accidentally eat some plants with oil on them and become very sick. Lose your turn!
21. Toxic chemicals used as pesticides have been sprayed on vegetation you have eaten. Your body cannot get rid of the toxins and you become very ill. Lose your turn!

22. You have been released after successful rehabilitation from an injury. A rescue team from Sea World took care of you as you regained your health. Take another turn! Move one space in any direction
23. Development along the river has altered the environment. Vegetation you need for food no longer exists. You cannot continue your migration until you find food. Lose your turn!

24. You have found a large growth of water hyacinth, one of your favorite plants! You eat 100 lbs of this tasty vegetation and continue your migration. Take another turn! Move one space in any direction.
25. The river has been dammed and you can no longer pass upstream. You will not be able to reach your refuge. Lose a turn!

26. You swim into a manatee sanctuary. Sanctuaries are areas free from human-related threats to your survival (such as boats.) Take another turn! Move one space in any direction.
27. Swimmers in the river harass and scare you. As you try to escape, you become confused and do not follow your normal migration route. Lose your turn!

28. You observe a boater driving slowly and wearing sunglasses to help spot manatees. The boater’s thoughtful driving has prevented your injury. Take another turn! Move one space in any direction.
29. The power plant that supplies the warm water for your winter refuge has closed down. Soon the water will be too cold and you will have no place to live. Lose your turn!

30. You have become entangled in fishing line. The fishing line is wrapped around your pectoral (side) flippers and is cutting into your skin. A serious infection is soon to follow. Lose your turn!
31. CONGRATULATIONS! You have successfully completed the migration to your winter refuge. Over 200 manatees may gather at one refuge.

32. While you are eating in a shallow area, a speeding boat accidentally hits you. Unless you receive medical attention, you will not survive the injury. Lose your turn!
33. A speeding boat accidentally hits you when you surface to breathe. Although the propeller does not cut you, the impact breaks your ribs and punctures your lung, which makes you sink. Lose your turn!

34. Your refuge has been destroyed by human development. You have no place to spend the cold winter months. Lose your turn!
35. A scuba diver harasses you. In an attempt to flee, you become confused and lose your normal migratory route to the refuge. Lose your turn!
Lesson 14: Reviewing what we know about manatees

Objective: Students will take online quizzes to see how much they have learned about manatees.

You will need:
- Computers with internet access
- KWL chart from Lesson 1

Strategy:

1. Have students go to the Save the Manatee Club website and take the manatee quizzes. There are four quizzes for elementary students—they are listed as “Manatee Calves 1” through “Manatee Calves 4.” Explain that after they answer each question, the correct answer will be shown in a blue box at the top of the next screen. Have the students record their scores to each quiz. Each quiz should take less than 10 minutes (there are 10 questions in each).
   http://www.savethemanatee.org/quiz.htm

2. Collect the students’ scores (they don’t have to put their names on them.) How many students are Newbie Newborns (0-40% correct), how many are So-So Seacows (50-70% correct) and how many are Sirenian Smarties (80-100% correct)!

3. Bring out the KWL chart from the beginning of the curriculum. Have the students give you information to fill in the “L” portion of the chart. Review the “W”s and make sure that all of the information that students said they wanted to learn has been covered. If not, see if you can find out answers from an expert.
Lesson 15: Collecting Data about Manatees

Objectives: Students will learn how scientists identify and track individual manatees.

Vocabulary: endangered, extinct, population, migration, scar patterns

You will need:
1. Rulers (optional)
2. Print outs or pictures of manatees for each group of students (pages 15-6 through 15-11)
3. Copies of manatee scar sheet and key to manatee ID sheet for each group of students (page 15-3 and 15-5)
4. Copies of manatee sketch sheet for each student (page 15-4). Each student will need at least one copy of the sketch sheet, and possibly more.

Strategy:
1. Explain to students that they will learn how scientists identify individual manatees. Ask if anyone can think of some way that people can tell one manatee from another. Ideas might include color (but manatees are all pretty similar in color), size (but manatees can grow). The answer you are looking for is “by using scars.”

2. Ask students where they think each of the scars on the manatees come from. Explain to students that manatees are very slow moving animals and cannot get out of the way of boats.

3. Divide students into groups of 2-4; give each group copies of photos of different individual Florida manatees (included with this lesson). Explain that they will use the scar patterns on the manatees to identify them. These are all manatees that are commonly seen at Blue Spring State Park.

4. Give each group a copy of the “Key to Manatee Identification Drawings” and copies of the sketch worksheet. Explain that students will try to identify the manatees in their photographs by sketching what they see. Show the class a copy of Ranger Wayne’s Scar Chart (perhaps project it so all can see) and briefly show how scars and damaged flippers are shown on the chart. Explain that students will create their own sketches from the photographs, and then will identify the manatees by comparing both the sketches and the photos to Scar Charts. This is similar to the method that scientists use to visually identify manatees.

5. The Manatee photographs are labeled A-F. Tell students to select one photograph and study it carefully. They should look for distinguishing scars or other features that make this manatee unique. Questions that they should consider:
   - Which side of the Manatee is the scar on?
   - What is the shape of the scar?
   - What color is the scar?
   - Are there other distinctive markings on the skin?

This activity is available online at http://stjohns.ifas.ufl.edu/sea/manatees.html
• Do you see anything missing from the Manatee?

6. Working in their groups, have students label each of their sketch worksheets with the same letter as the photograph they are about to sketch (A, B, C, D, E, and/or F).

7. Tell students that they can now begin their sketches. They should draw the unique scars and features that they see in the photographs. Remind them that they are drawing the manatee’s back (dorsal view) so they need to think about which side of the manatee is the left and right side (they need to pay attention to the direction the manatee is facing in the photograph).

8. Ideally, each student in the group should complete one sketch. Have the students in the group review each other’s sketches and make sure that they match the photographs. Once the group has completed their sketches, distribute copies of Ranger Wayne’s Scar Sheet to the group. Have the students use the Scar Sheet to find Manatees with the same scars or other features that are shown (or missing) in the photos and sketches? Ask the students if they can make a positive ID. Suggest that they might want to turn the Scar Sheet or sketches sideways or upside down to correspond to the layout of the photograph.

9. Point out to students that the sketches on the scar sheet and the photographs may have been made at different times, so one may have more markings that the other. Tell the students that even if they do not have an exact match, if there are some of the same markings in the same positions on their sketch and the scar sheet they may have a match!

Sunshine State Standards: SC.3.N.1.1, SC.3.N.1.3; SC.3.N.1.6

References:
Adapted from “You make the call (roll call that is)"
http://www.learner.org/jnorth/tm/manatee/RollCall.html
Lesson 15: How to Identify Manatees

**KEY TO MANATEE IDENTIFICATION DRAWINGS**

Flipper drawn to show damage or to show relation of a scar to the flipper

### SCARS

- **White**
- Visible but healed grey (sometimes deep)
- **Cut**
- **Section missing from tail**

**PHOEBE**

Credit: Wayne Hartley/Blue Spring State Park.
Lesson 15: sketch worksheet

Name: ________________________________  Manatee photo letter: ________

Consider these questions, then draw the appropriate scars/marks on the manatee outline:

• Which side of the Manatee is the scar on?
• What is the shape?
• What color is the scar?
• Are there other distinctive markings on the skin?
• Do you see anything missing from the Manatee?
Lesson 15: Manatee Identification
Ranger Wayne’s Scar Sheet from Blue Springs State Park

Credit: Wayne Hartley/Blue Spring State Park.

SCAR SHEET

AFRICA  CALISTA  DONNA  FLASH  FLOYD

GEORGIA  JIM  LILLITH  LOLA  PHYLLIS
Lesson 15: Manatee Photo Identification

Manatee A

Photo credit: USGS, Southeast Ecological Science Center, Sirenia Project.
Manatee B

Photo credit: USGS, Southeast Ecological Science Center, Sirenia Project.
Manatee C

Photo credit: USGS, Southeast Ecological Science Center, Sirenia Project.
Manatee D

Photo credits: USGS, Southeast Ecological Science Center, Sirenia Project.
Manatee E

Photo credit: USGS, Southeast Ecological Science Center, Sirenia Project.
Manatee F

Photo credit: USGS, Southeast Ecological Science Center, Sirenia Project.
Lesson 16: Sharing what we know about manatees!

Objective: Students create podcasts/PSA’s/posters to teach others about ways to protect manatees

You will need:
- Computers with internet access
- Digital video camera
- Poster board or large sheets of paper
- Markers
- Props (stuffed manatee toy, boat toy, fishing line etc.)—optional

Strategy:
Ideally, students should have access to the internet (for research), and access to digital video cameras and/or computers with microphones to complete this activity. If electronic access is not available, students can create traditional posters.

1. You may wish to have students work individually or in small groups. Explain that the students’ goal is to use the information they have learned about manatees to create podcasts/PSA’s/posters to teach others about ways to protect manatees. Podcasts/PSA’s can be audio only, or can be video with audio.

2. Students who are planning to create podcasts or PSA’s should write scripts and think about what they might need as props (for video podcasts). Students should think about what message they want to get across with their product.

3. Allow students at least two class periods to complete their projects. Allow students to share their recordings/posters with the rest of the class.

Standards addressed: CCSS.ELA-Literacy.3.SL.4; CCSS.ELA-Literacy.3.SL.5; CCSS.ELA-Literacy.3.SL.6
Lesson 17: Exploring the manatees’ habitat!

This was designed as a field study at Blue Spring State Park. The activity could be modified for other sites where manatees can be seen. The trip should be conducted during the winter in order to maximize the chances of seeing manatees.

For those unable to visit a location where manatees are present, you could do a virtual field trip (in winter months) using the live manatee cams available online at http://www.savethemanatee.org/savethemanateeecam.html. This will probably not show the fish (although some may be seen if the underwater camera is active), but may allow for viewing of manatee behaviors, scars etc.

Our schedule for Blue Spring is below. Each bus had 2-3 classes of students. Over 4 days, we brought 18 classes of 3rd grade students from two schools to the park. We coordinated with the park to have one of their volunteers available to show students a video and talk to them about manatees. We also arranged for free admission to the park (each of the vehicles needed to have a copy of a letter on letterhead explaining about the education program that they would be doing in the park). We had our own volunteers assigned as leaders for each class. The leaders had a clipboard with data sheets on it, and they worked with the students to complete the data sheets as they explored the park. We made some laminated fliers with images of the different fish species on them, and attached these to railings at some of the observation points.

Timeline for Blue Spring State Park field trip—BUS # 1

11:15—buses arrive. Lead students to programs room. Students use bathrooms next to that building.
11:30—Students watch video, learn from park staff
12:10—Divide students by classes (teacher). One volunteer takes each class. One class goes to spring run, two down to dock. After a couple of minutes, a second class heads to the spring boil, then a couple of minutes later, the third class. After the spring boil, lead the classes (staggered) back towards the picnic area, making observations of manatees and fish along the way. (Fill out the data sheet). Stop briefly at each of the observation decks. Be back at the picnic area by about 12:45-12:50.
12:50-1:15—Students eat lunch, under supervision of their teachers.
1:15-1:30—Students use bathrooms and load up on buses.

Timeline for Blue Spring State Park field trip—BUS #2

11:15—buses arrive. Students can use bathrooms next to playground.
11:30—Divide students by classes (teacher). One volunteer takes each class. Stagger classes by a couple of minutes and lead them along the walkway, stopping briefly at each observation deck and making observations of manatees and fish along the way. (Fill out the data sheet). If time permits, go all the way to the spring boil. Line up classes outside the programs room.
12:10—Students watch video, learn from park staff. At conclusion of
program, lead students back to picnic area.
12:50-1:15—Students eat lunch, under supervision of their teachers.
1:15-1:30—Students use bathrooms and load up on buses.

**Standards addressed:** SC.3.N.1.1; SC.3.N.1.3; SC.3.N.1.6; CCSS.ELA-Literacy.3.RI.5
Teacher’s name ______________________________________

BLUE SPRING STATE PARK
Observations data sheet

Date: ______________________

1. The water depth by the observation dock is _______________________________

2. The water that comes out of the spring is __________ °F

3. We saw (how many?) ______________________ manatees today.

<table>
<thead>
<tr>
<th>HOW MANY MANATEES WERE DOING EACH BEHAVIOR?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resting</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

4. We saw (how many?) ______________________ manatees that had scars on their bodies.

5. We saw many different types of animals at the park today (in addition to fish and manatees). These animals included:

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
### 6. Fish Observations

<table>
<thead>
<tr>
<th>Type of fish*</th>
<th>Did you see this fish?</th>
<th>How many did you see?</th>
<th>What were the fish doing?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluegill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Largemouth Bass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sailfin catfish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tarpon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tilapia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (specify)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Fish images from www.myfwc.com
Lesson 18: Let’s have a manatee science night!

**Objective:** To coordinate a family science night at the school, around the theme of manatees. Students will share their podcasts, etc. with other students and families.

**Strategy:**

**Early in the school year:**
1. Set a date for the science night and reserve the cafeteria or auditorium. Ideally, you will want to set the date several months in advance. Some schools like to do this on a PTA meeting night, to attract parents to that meeting.
2. Check with your PTA to find out if they might be able to provide food for the event (schools may be able to use Title 1 money to provide food, or the PTA may wish to sell slices of pizza, hotdogs, etc.)
3. Decide on a format for the event. The format that seems to work well is to start at either 5:30 or 6:00 pm and have several "booths" that the families can roam around. Each booth should ideally have interactive activities that people can participate in. You might be able to use some of the activities from this curriculum (e.g. create a matching game with sketches and photographs of manatees from Lesson 15, or have the manatee migration game set up from Lesson 14). You might show podcasts that students created (possibly do this in an adjacent classroom where it will be quieter). After about 90 minutes, try to arrange for a "grand finale" to draw everyone together—this might be a musical performance, or a live animal presentation. Wrap up the evening at about 7:30 or 8:00 pm.
4. Start rounding up partners for the event. Your local extension office, local aquarium or zoo, water management district are all good places to start. Once you find someone who is interested, they probably have contacts with others who will help out. These folks will help by providing booths*, and will sometimes come into the classrooms on the days preceding the event to teach the kids and get them excited about bringing their families to the event. Partners might also be able to provide door prize items!

* water cycle bracelets, pollution/trash activities, touch tanks, fish printing, exhibits with manatee or dolphin artifacts, safe boating displays, water safety, sun safety are all great topics for booths.
5. Assign responsibilities for the event. Someone from the school will need to coordinate the logistics (reserve the room, work with PTA, distribute fliers to classes etc.) Someone will need to take overall charge of the event (this might be someone from the school, or might be one of the partners). This person will coordinate with exhibitors, arrange the grand finale, design the layout of the event, create fliers and signs etc.

**About two weeks before the event:**
1. School and overall coordinator should touch base to make sure all of the logistics are in place.
2. Teachers should work with students to select videos, posters, activities etc. to showcase at the event.
A few days before the event:
1. Fliers should be sent home with all students to promote the event. If fish printing is going to be an activity, fliers might ask parents to bring along blank shirts to print on.
2. In-class visits may be made by some of the presenters.

Night of the event:
1. Exhibitors will probably begin setting up about 2 hours ahead of time.
2. Once the families arrive, it is great if there is some way for them to sign in (perhaps they get a free tote bag to carry all their goodies in when they sign in, perhaps they get free food tickets when they sign in…) This will allow for a head count of participants.
3. Once the event is underway, someone should give a “heads-up” about 10 minutes before the grand finale (over the PA system) to encourage folks to wrap up whatever they are doing and make their way to the stage area (or wherever).
4. Before the grand finale, make announcements and do door prize drawings as appropriate.