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-

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 form 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 fun—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. <u>Optional activity</u>: 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!

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.

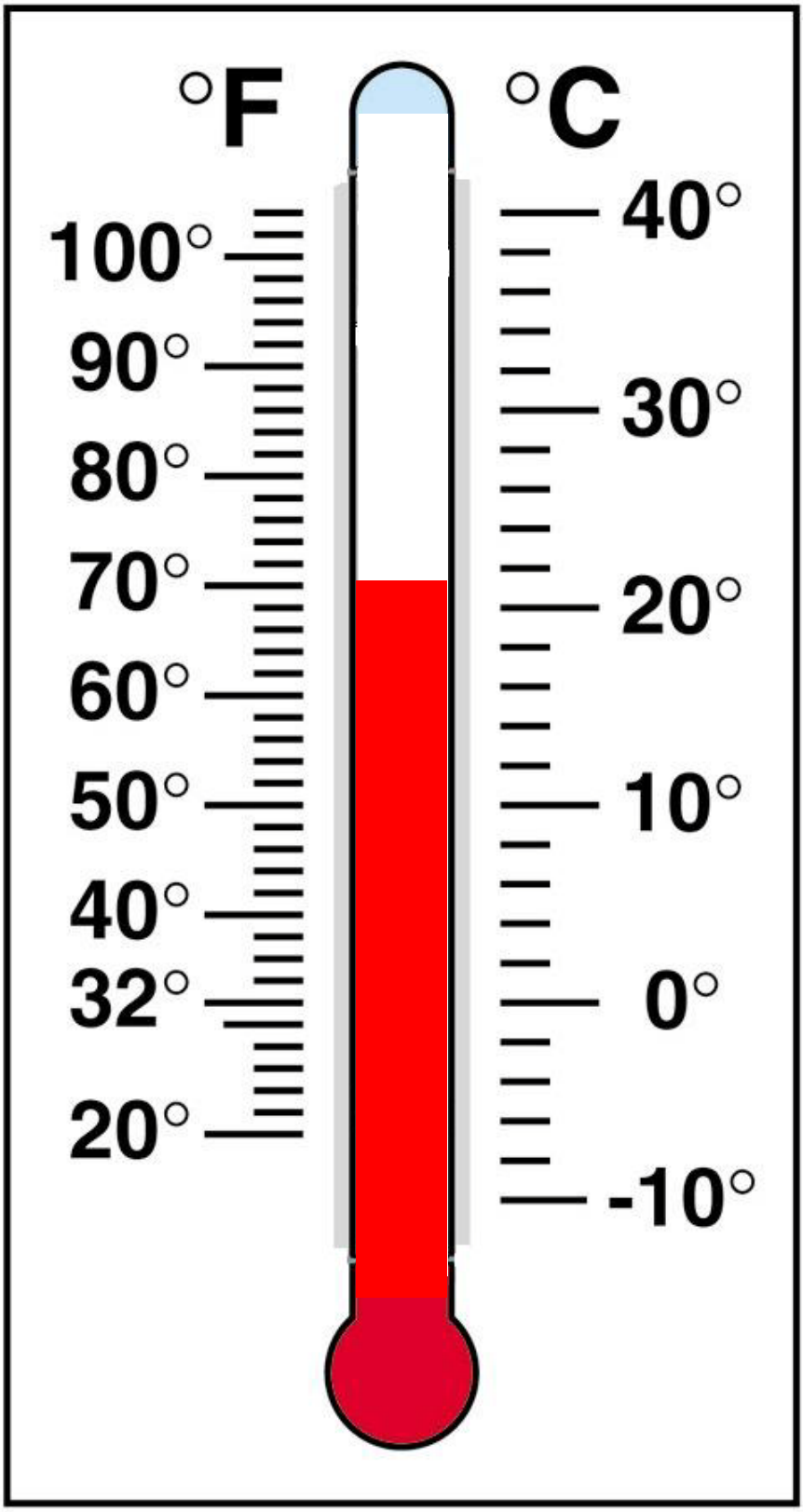
5. Remind students that some manatees have learned to migrate to artificial, or manmade, thermal refuge areas. Most of these are power plants which release large volumes of very warm water into Florida waterways. This thermal pollution warms adjacent waters enough to keep manatees warm when water temperatures 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.)

Standards: SC.3.L.17.1, SC.3.P.8.1, SS.3.G.1.1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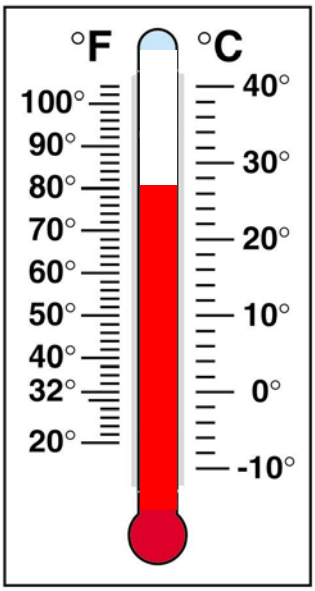
NAME _____ DATE _____

Lesson 9, Worksheet 1a: Reading thermometers

For each thermometer, write down the temperature that it shows, both in °F and in °C



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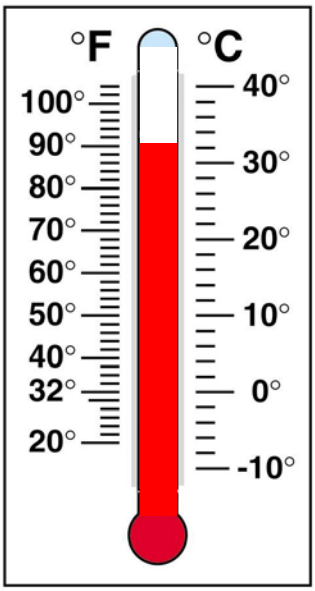

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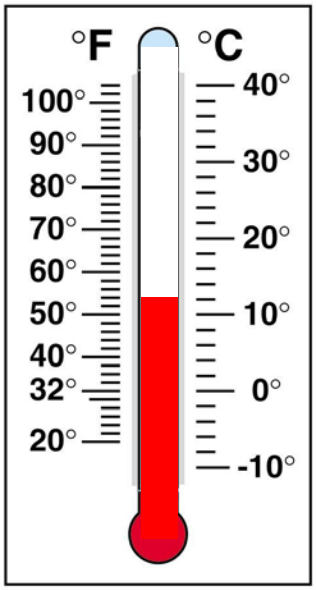

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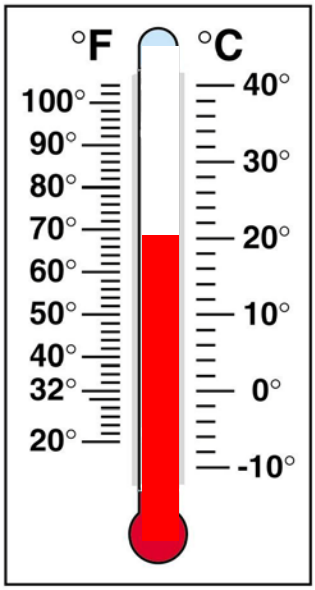


_____°F _____°C

NAME _____ DATE _____

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 <u>difference</u> in temperature between the room temperature sample and the refrigerated sample (room minus fridge)?

   _____ °F _____ °C

C. What is the <u>difference</u> in temperature between the sun-warmed sample and the refrigerated sample (sun minus fridge)?

   _____ °F _____ °C

NAME _____ DATE _____

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* (htpp://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. Color the St. John's River on your Florida map in green.

4. Go to http://www.co-ops.nos.noaa.gov/ofs/sjofs/now_temp.shtml.

a. What is the current temperature in the St. John's River?

_____ °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?

_____

_____

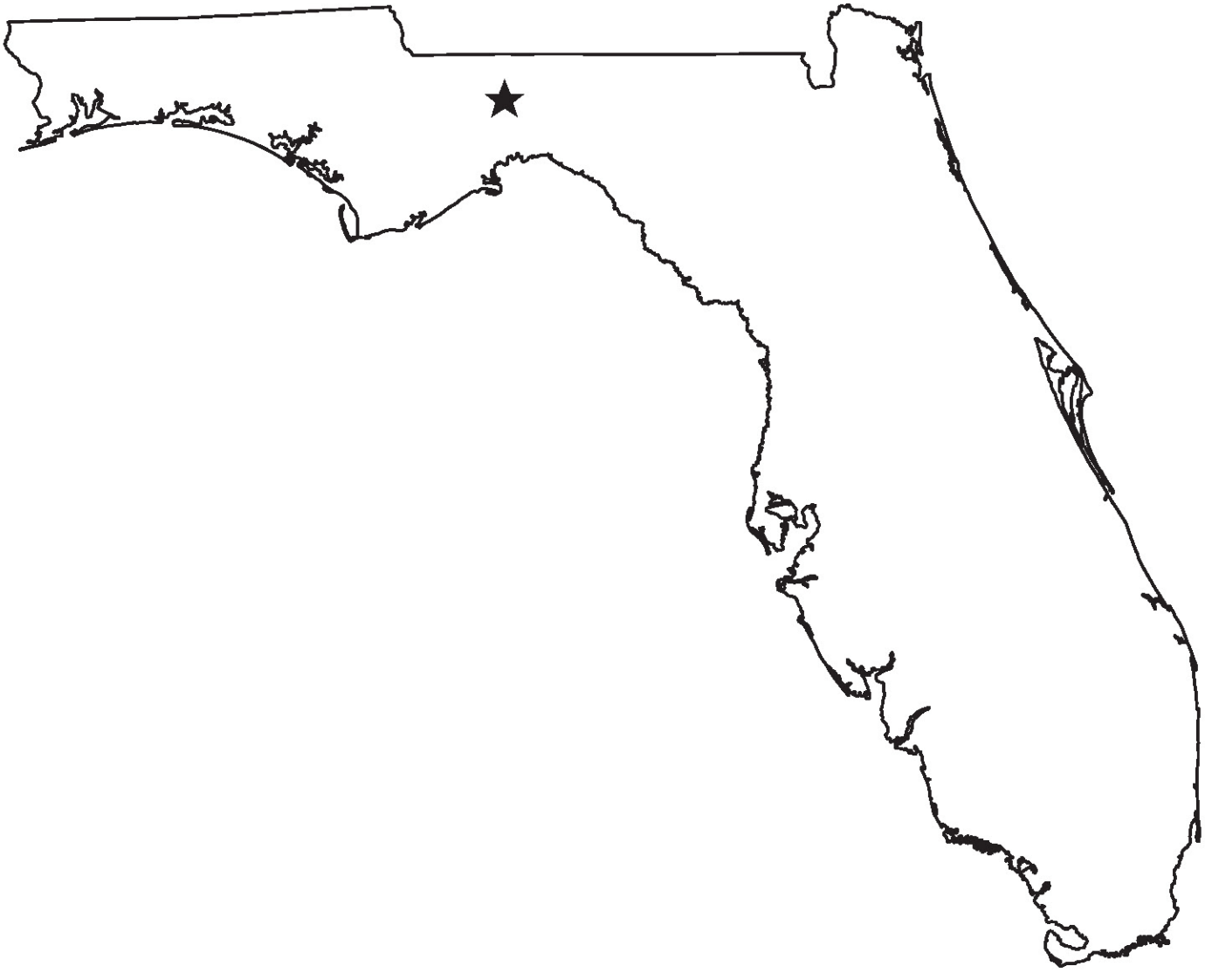
d. What is the current temperature in the Atlantic Ocean near you?(Hint: to figure this out you should use the internet to find the National Oceanographic Data Center (http://www.nodc.noaa.gov). The home page for this site looks a little scary because there is a lot of stuff there, but look down and find the link to **Coastal Water Temperatures**. 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)

Name _____ **Date** _____

Florida