

## The Tremendous Travels of Trash

**Essential Question:** After water is used by people, what pollutants and trash can it contain, what animals can it impact, and what are some ideas for reuse and treatment of wastewater?

### Directions:

1. **Discuss** how the ocean is the end point of all water that flows off land and how the ocean can take pollutants and trash far out to sea.
2. **Show DVD "Dirty Secrets," Act 3.**
3. **Take students outside** to the school playground or parking lot to observe what happens when containers of water are slowly poured on the pavement near a drain. Add food coloring to water for a color contrast to pavement or surface. *(This activity can be simulated indoors by utilizing an elevated and channeled waterproof tarp. Utilize containers to catch the water and simulate a drain.)*
4. **Ask students "Where is the water going?"** *(Most students will answer something such as "it goes away" or "down the drain.")* Discuss the fact that there is ultimately no "away." Emphasize the point that water, and what's contained in it, flows into creeks, rivers, and ultimately to larger bodies of water such as estuaries, seas, and oceans.
5. **As representatives of pollutants** like plastics, add grass clippings, leaves, or small, light fruit peelings (such as apple) to the water, and pour this mixture toward the drain. Ask what will happen to the water and the items. Ask students to think of some measures that could be taken to prevent the items from going into the drain.

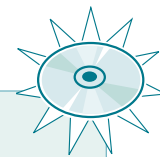
6. **Illustrate a cleanup** measure by pouring water with the grass clipping mixture through a mesh screen or white cloth to show that the solids were retained and did not go down the drain. Point out that water treatment facilities can also remove additional pollutants and help cleanse the water.

7. **Have students investigate** an example of a real water treatment and reuse issue: "[Water recycling technology from ITT is making it possible for a drought-stricken town in New Mexico to recycle all its water.](http://www.ittadvancedwatertreatment.com/specialfeature.htm) Very soon, Cloudcroft, New Mexico, will become one of the first towns in the U.S. to recycle all of its water. Every drop that goes down the pipes will be cleaned by technologies from the ITT Corporation and returned to the community for dishwashing, irrigation, clothes washing, street cleaning and—gulp—even drinking." *(Whole story can be found at [www.ittadvancedwatertreatment.com/specialfeature.htm](http://www.ittadvancedwatertreatment.com/specialfeature.htm))*

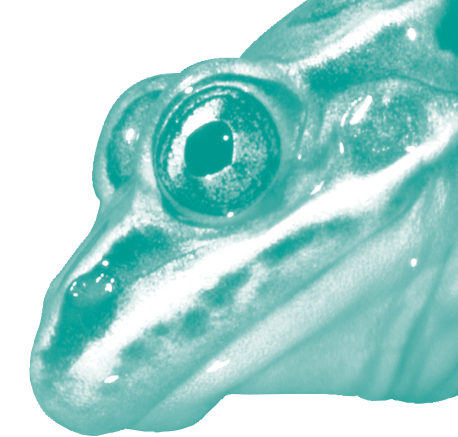
8. **Ask students** if their perception of water going "away" and the impacts of trash like plastics on wildlife and ourselves have changed as a result of the activity.

### Materials needed:

Strange Days DVD "Dirty Secrets," Act 3; water, containers, food coloring, fine mesh or white cloth, grass clippings, leaves or apple peelings



# NATIONAL GEOGRAPHIC'S STRANGEDAYS ON PLANET EARTH



## Dear Educator,

The instructional resources in this Activity Guide support the educational use of the National Geographic Television series "Strange Days on Planet Earth," produced by Sea Studios Foundation. The Guide is a component of a kit, developed by National Geographic Education & Children's Programs and underwritten by ITT Corporation, that includes student handouts, a classroom poster, and a DVD with select shows from Season One ("Troubled Waters") and from Season Two ("Dirty Secrets"), on which the educator activities are based.

These resources, and additional information on the series, are available at [www.pbs.org/strangedays/educators](http://www.pbs.org/strangedays/educators).

### Enjoy this exploration of our Earth!

National Geographic Education & Children's Programs

## What's in Your Watershed?

**Essential Question:** How do people impact a community's watershed and its freshwater supplies?

### Materials needed:

Copies of Student Handout #1, plastic or metal trays, blue enamel paint, miniatures modeling clay, tempera paint, toothpicks, construction paper, water

### Directions:

1. **Introduce the concept of "watershed."** Ask students to define the term (the land area from which surface runoff drains into a stream, channel, lake, reservoir or other body of water) and explain that people are either directly or indirectly connected to bodies of water, which connect to land. For example, people use water for agriculture, industry, manufacturing, power, transportation and recreation.
2. **Distribute Student Handout #1.** Have students label the watershed components using the words along the bottom of the diagram. *(See answer key at left.)*
3. **Explain the terms "point source" and "non-point source pollution"** and ask students to identify examples of each. *(Point sources include facilities such as sewage treatment plants and factory discharges. Non-point source pollution includes excess fertilizers from lawns and farms, oil from roads, overflows from city sewers, and animal wastes.)*
4. **Make a 3-D watershed model.** Groups of students will create a model watershed either in a plastic or metal tray. *(See above for materials.)* Students begin by molding clay to represent mountains. Next, form the watershed by gradually leveling the clay so that it leads to the mouth of your river. Form river channels and coat with blue enamel paint; color the land with tempera paint. Place miniature objects or fashioned construction paper figures on the model to simulate users of a river system, using the diagram in Handout #1 as a guide. Let the model dry overnight. The next day, pour a slow, steady stream of water from the top of the mountain area. Watch how the "river" runs from its source to its mouth.
5. **Use the model to discuss your community's watershed.** Where are its boundaries? What are the main sources of pollution in your watershed? Who is impacted? How can you ensure the watershed is a clean resource for the community?

**Answer key:** 1. River Source, 2. Upstream, 3. Downstream, 4. Main River, 5. Tributaries, 6. Floodplain, 7. Watershed Boundary, 8. Meanders, 9. Wetlands, 10. River Mouth.

### SPECIAL ANNOUNCEMENT FOR HIGH SCHOOL STUDENTS

The Stockholm Junior Water Prize (SJWP) is the most prestigious international award for a water-related science project at the high school level. The annual competition is open to projects aimed at enhancing the quality of life through improvement of water quality, water resource management, or water and wastewater treatment. U.S. winners receive cash prizes for themselves and their school, and an all-expense-paid trip to Sweden to compete in the international SJWP competition. Learn more at [www.wef.org/LearnAboutWater/ForStudents/SJWP/](http://www.wef.org/LearnAboutWater/ForStudents/SJWP/)



### ACKNOWLEDGEMENTS:

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**Image Credits:** Frog image courtesy of Sea Studios Foundation, Strange Days on Planet Earth. Background image by Emmy Scammahorn.

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**Take Action!** Involve your students in World Water Monitoring Day, an annual program that engages communities in monitoring the condition of their own water resources. To participate, go to [www.worldwatermonitoringday.org](http://www.worldwatermonitoringday.org)

## Sugar Not Sweet for the Great Barrier Reef

*Essential Question:* How might the production of sugar cane in Queensland, Australia, impact the Great Barrier Reef?

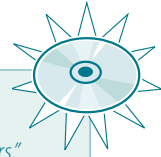
### Directions:

1. **Distribute Student Handout #2** and have students use the latitude and longitude information provided to locate the Great Barrier Reef on their map of Australia. Look for the northeastern state of Queensland.
2. **Write the words “sugar cane” and “Great Barrier Reef” on the board.** Brainstorm with students about how the production of sugar cane might be connected to the Great Barrier Reef.
3. **Distribute the 10 Statement Mix-Up statements from Student Handout #2**—printed onto individual pieces of paper or poster board—in random order. As individual students stand up and read their statements, the rest of the class identifies cause-and-effect relationships and places each student/statement in order between the words “sugar cane” and “Great Barrier Reef.”
4. **Discuss:** Inform students that the connection between sugar cane production and the increase of the Crown of Thorns seastar is a theory and still subject to ongoing research. Large numbers of these seastars consume coral faster than it can grow, reducing the coral cover and disrupting the entire coral reef system. Reveal the correct arrangement of statements (*see answer key below*) and emphasize the human connection. (*Another option is to ask students to study the statements in Handout #2 and order them sequentially after they watch the DVD.*)
5. **Show the DVD “Troubled Waters,” Act 5.** Discuss whether the Australian government should implement measures regulating the production of sugar cane by individual farmers.

**Answer key to Statement Mix-Up activity:** 1. Sugar cane is planted; 2. Fertilizers containing nitrates and manure are used to promote sugar cane growth; 3. Tropical storms and heavy rains occur; 4. Water runs off the land into creeks, rivers, and into the Great Barrier Reef; 5. Algae growth is stimulated by nitrogen derived from fertilizer and manure; 6. Algae are consumed by Crown of Thorns larvae; 7. Crown of Thorns larvae grow rapidly and settle; 8. Crown of Thorns feed on living coral tissue; 9. Coral cover is dramatically reduced; 10. Decreased coral cover disrupts the entire Great Barrier Reef coral system.

### Materials needed:

*Strange Days DVD “Troubled Waters,” Act 5; copies of Student Handout #2, 10 pieces of paper or poster board, markers*



## Yellow Corn and Green Frogs

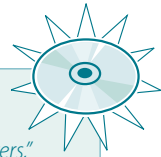
*Essential Question:* What might be the link between reproductive abnormalities found in Northern Leopard Frogs and the growing of corn?

### Directions:

1. **Distribute Student Handout #3** and have students locate and color in the habitat of the Northern Leopard Frog.
2. **Discuss:** Recent findings link atrazine, an herbicide used to kill crop weeds, with reproductive abnormalities in some populations of Northern Leopard Frogs. (*Wind, rain, and running water can transport atrazine from cornfields into the marsh habitats of the Northern Leopard Frog.*)
3. **Challenge students to think** about ways to determine if there is a link between the use of atrazine and deformities found in the Northern Leopard Frog. (*Students might say they would travel to the frog habitat and observe frogs for abnormalities. If atrazine is suspected, to determine its impact an experiment could be conducted in which some frogs are exposed to atrazine and others are not.*)
4. **Show the DVD “Troubled Waters,” Act 1** and debate this question: “Under what circumstances (if any) should government intervene to address the reproductive abnormalities found in the Northern Leopard Frog?” You may want to assign students the following roles: a scientist such as Tyrone Hayes; a farmer who produces corn; a homeowner living in the Northern Leopard Frog habitat; a representative from the U.S. Environmental Protection Agency; an environmental engineer; an owner of a farm implement business; a groundwater specialist; a representative of a chemical company that produces atrazine.

### Materials needed:

*Strange Days DVD “Troubled Waters,” Act 1; copies of Student Handout #3*



## Striped Bass are Turning Ugly

*Essential Question:* Why is the water quality of the Chesapeake Bay declining, and how is this affecting the striped bass living in the Bay?

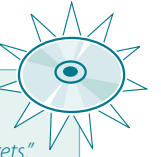
### Directions:

1. **Ask students to speculate** on why some striped bass, the Chesapeake Bay’s most popular sport fish, are severely diseased and disfigured with external lesions.
2. **Distribute Student Handout #4.** Have students study the graph and the two maps showing population growth over time in the Chesapeake Bay Watershed region. Ask students how increased population growth might impact the water quality of the Chesapeake Bay.
3. **Discuss** the growing problem of “dead zones”—large areas of declining oxygen—occurring in the Chesapeake Bay. What might have caused these dead zones to triple in size over recent decades? (*The Bay has experienced an increase in nutrient pollution, principally nitrogen, stemming from sources such as sewage treatment plant effluent, and agricultural and livestock runoff. The expanding amount of nutrients may contribute to the sudden blooming of small marine organisms, known as phytoplankton or algae. Dead zones seem to be the result of the death of this marine life and settlement to the bottom of the Bay.*)
4. **Show the DVD “Dirty Secrets,” Act 2** and ask students to consider how increasing human population of the Bay area contributes to the diseased striped bass.
5. **Following the show.** Ask students to respond to the following question: “What contributes to the declining water quality of the Chesapeake Bay?” (*Discuss how population pressures have taken out vital resources from the Bay, including oysters, sponges, clams and menhaden. These organisms used to be able to filter all the water in the Bay every three to four days. Without an intact natural filtration system, all runoff can now inflict even greater damage.*)



### Materials needed:

*Strange Days DVD “Dirty Secrets,” Act 2; copies of Student Handout #4*



## The Riviera Maya has a Secret

*Essential Question:* How does expanding human population influence a community’s watershed and the quality of its fresh water?

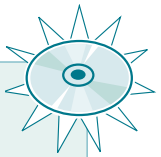
### Directions:

1. **Distribute Student Handout #3** and have the students locate Mexico and the Yucatán Peninsula on their map of North America. Point out the “Riviera Maya.” Located in Mexico’s easternmost state, Quintana Roo, the “Riviera Maya” (or Mayan Riviera) is the 75-mile stretch of Caribbean coastline from the northeastern point of the Yucatán Peninsula southward to the Mayan ruins.
2. **Inform students** that many people vacation in this region for the warm climate, sandy beaches, and the world’s second largest coral reef. Point out to students that eight percent of Mexico’s gross domestic product is generated from tourism.
3. **Write the word “cenote” on the board.** Inform students that this word is derived from a Mayan term, *dz’onot*, and means a subterranean cavity that contains permanent water. Point out to students that 99 percent of the fresh water in the Yucatán is contained in these underground cenotes (say-NOH-tays), which are part of the second largest underground river system in the world.
4. **Use a sponge and water** to help students understand the concept of groundwater held in underground rivers and aquifers. Carefully pour water over the sponge until it is saturated but not dripping. Point out to students that the sponge is holding water, even though you might not be able to see it. Squeeze the sponge into a white bowl and show that the water in the bowl is as clear as when poured over the sponge. Repeat the process with water containing red food coloring. Speculate what the red water might represent.
5. **Show the DVD “Dirty Secrets,” Act 1** and discuss how increased pollution, due to expanding human activity, affects the groundwater of the Yucatán Peninsula.
6. **Ask students** to think about where the water from their own taps actually comes from (*springs, rivers, reservoirs, wells*). Do they live on or near an aquifer? Where is their local water treatment plant? (*Search your municipality’s Department of Public Works for answers.*)



### Materials needed:

*Strange Days DVD “Dirty Secrets,” Act 1; copies of Student Handout #3, sponge, white or clear bowl, red food coloring, water*



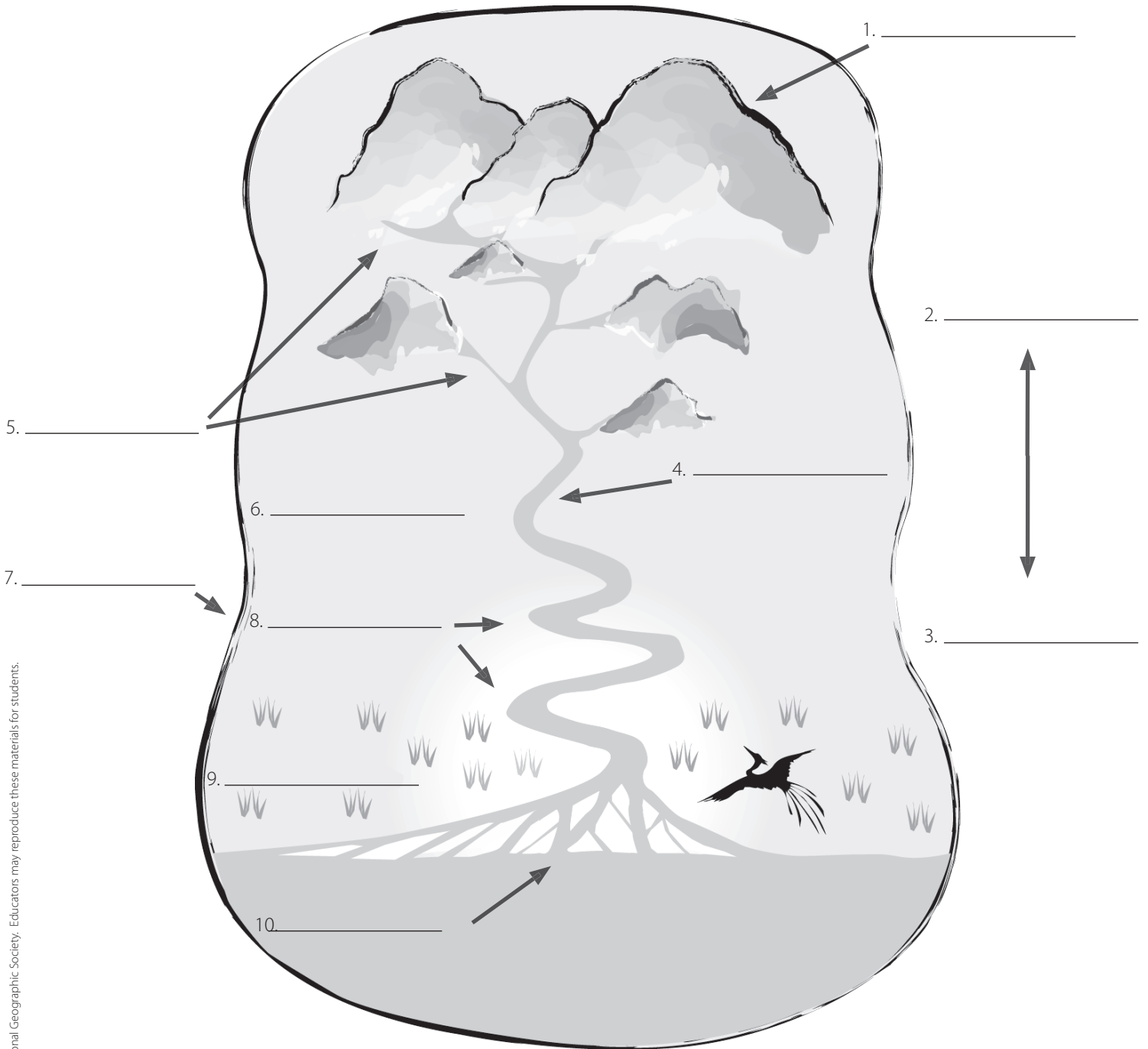
# NATIONAL GEOGRAPHIC'S STRANGEDAYS ON PLANET EARTH

## Student Handout # 1

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Directions:** Use the list below to label the watershed diagram. Each label should appear only once on the diagram, in one of the spaces numbered 1-10.



- |                |                    |              |             |            |          |
|----------------|--------------------|--------------|-------------|------------|----------|
| <b>LABELS:</b> | Tributaries        | River Source | River Mouth | Upstream   | Wetlands |
|                | Watershed Boundary | Main River   | Floodplain  | Downstream | Meanders |

# NATIONAL GEOGRAPHIC'S STRANGEDAYS ON PLANET EARTH

## Student Handout # 2

Name: \_\_\_\_\_

Date: \_\_\_\_\_

### STATEMENT MIX-UP

#### START: Sugar cane production

- \_\_\_\_ Crown of Thorns feed on living coral tissue.
- \_\_\_\_ Fertilizers containing nitrates and manure are used to promote sugar cane growth.
- \_\_\_\_ Coral cover is dramatically reduced.
- \_\_\_\_ Water runs off the land into creeks, rivers, and into the Great Barrier Reef.
- \_\_\_\_ Algae are consumed by Crown of Thorns larvae.
- \_\_\_\_ Tropical storms and heavy rains occur.
- \_\_\_\_ Algae growth is stimulated by nitrogen derived from fertilizer and manure.
- \_\_\_\_ Sugar cane is planted.
- \_\_\_\_ Decreased coral cover disrupts the entire Great Barrier Reef coral system.
- \_\_\_\_ Crown of Thorns larvae grow rapidly and settle.

#### END: Great Barrier Reef

**Directions:** After watching the Strange Days DVD "Troubled Waters," Act 5, number the above statements from 1-10 in the order in which you think they occur. What does this tell you about the human connection between sugar cane production and the Great Barrier Reef?

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#### Directions:

Using the parallels of latitude and meridians of longitude on the map frame, make a point at each of the following locations:

- Latitude 11° south, longitude 144° east
- Latitude 22° south, longitude 152° east

Draw a line between the two points. This shows you the approximate location and extent of the Great Barrier Reef. (It covers some 115,830 square miles [300,000 square kilometers] and is visible from space.)

Find Queensland, identified on the map, in the northeastern part of Australia. This is the region where sugar cane is grown.



NATIONAL GEOGRAPHIC'S  
**STRANGEDAYS**  
ON PLANET EARTH

**Student Handout # 3**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Yellow Corn and Green Frogs**

**Directions:** Read the description below, then locate and color in the Northern Leopard Frog habitat.

"Frogs are found throughout much of North America, from as far north as the Hudson Bay, along the eastern seaboard to northern Virginia and west to British Columbia, eastern Washington, and Oregon. The western part of the range extends as far south as New Mexico, Arizona, Colorado, Utah, and portions of California and Nevada. Populations in the west are fragmented and some are declining." (Dewey, T. 1999. "Rana pipiens" [On-line], Animal Diversity Web)



**The Riviera Maya has a Secret**

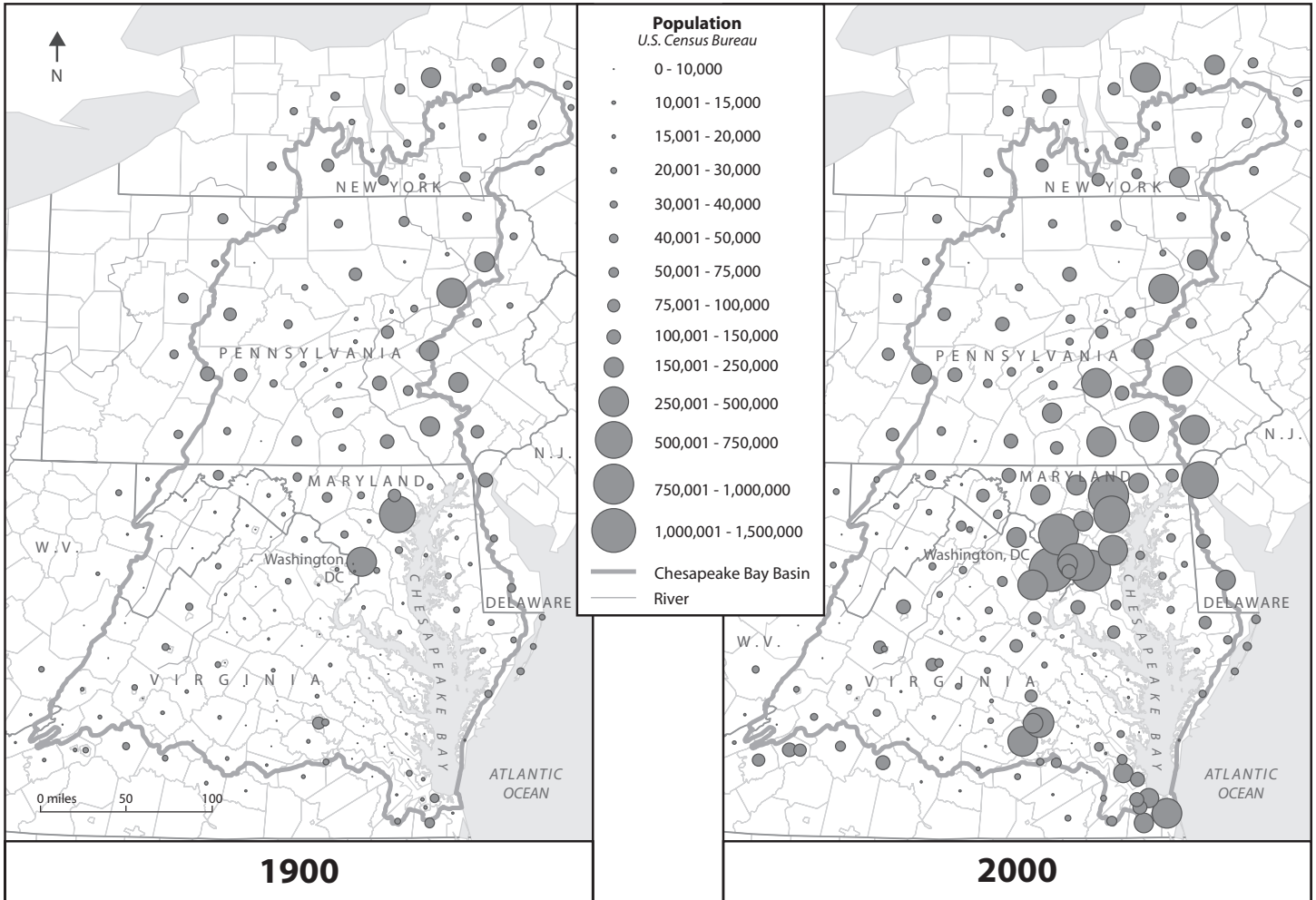
**Directions:** Use an atlas or online map resource to help you identify the Yucatán Peninsula on the map of North America. Read the description below to identify the location of the "Riviera Maya" and mark it on your map with a thick line, or arrow with a label.

"Located in Mexico's easternmost state, Quintana Roo, the "Riviera Maya" (or Mayan Riviera) is the 75-mile stretch of Caribbean coastline from the northeastern point of the Yucatán Peninsula southward to the Mayan ruins."

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Changes in Population in the Chesapeake Bay Region 1900-2000



**Directions:**

Use the two maps above, and the graph to the right, to help answer the following questions:

1. Where has most of the human population growth in the Chesapeake Bay Watershed occurred between 1900 and 2000?
2. By how many people has the population increased over this time period?
3. How might this increase in human population have an impact on the Chesapeake Bay Watershed?
4. Should any measures be implemented to limit future population growth in the Chesapeake Bay Watershed?

Chesapeake Bay Watershed population 1900-2000

