

## **STAAR Science Tutorial 55**

### **TEK 8.11D: Human Dependence on Ocean Systems**

***TEK 8.11D: Recognize human dependence on ocean systems and explain how human activities such as runoff, artificial reefs, or use of resources have modified these systems.***

#### **Human Dependence on Ocean Systems**

- Humans have relied on the Earth's oceans as a primary food source for thousands of years. In many human communities, fish and shellfish are the primary source of food.
- The Earth's oceans contain salt water, which cannot be used directly by humans for drinking and watering crops. But the Earth's oceans do indirectly provide all terrestrial (land) life with fresh water, through the **water cycle**. Most of the evaporation in the water cycle occurs from the Earth's oceans, which cover over 70% of the Earth's surface. This water vapor, now free from salt, condenses into clouds. The wind blows some of those clouds over land, where the water falls back to land as precipitation. Some of that precipitation sinks into the ground to recharge underground **aquifers**—porous rock holding **groundwater**. That underground water can return to the surface naturally as springs, or can be pumped to the surface by humans in wells. The precipitation that does not sink into the ground eventually returns to the ocean as **runoff** in streams, lakes and rivers. River runoff can be used by humans for crop irrigation and drinking water. All non-ocean life relies on freshwater runoff for their survival.
- Ships crossing the Earth's oceans provide an efficient means of transportation of trade goods between the continents. A stable sea level is essential to maintaining ocean ports.
- Many of the Earth's largest cities are built on ocean coasts, very close to the present sea level.
- The Earth's oceans are used for recreation such as boating, diving, surfing and sport fishing.
- Oceans store a large amount of heat, helping to stabilize the Earth's climate. Ocean currents such as the Gulf Stream move heat from the tropics to arctic areas, changing regional climates by moderating temperature extremes and increasing rainfall.
- Oceans absorb a large part of the carbon dioxide created by humans when they burn fossil fuels. This helps slow human-induced global warming (climate change).
- Phytoplankton (microscopic floating plants) in the Earth's oceans create a large part of the oxygen that sustains animal life on Earth.

## **Overfishing**

- Only certain parts of the ocean, usually where cold water is rising from deep currents, have a large population of fish suitable for human harvesting. Such an area is called a **fishery**.
- **Sustainable use** of a living resource, such as fish, shrimp, crabs or clams, occurs when the resource species can reproduce fast enough to maintain a stable population, by replacing those caught for food.
- During the last 100 years, the Earth's human population has increased from less than 2 billion to over 7 billion. To fill human's food needs, seafood catches have increased beyond sustainable use. Populations of many fish and shellfish species are dropping quickly because of **overfishing**—removing fish faster than they can reproduce.
- In many countries, laws have been passed to limit fish catches to a sustainable **quota** (maximum amount), to allow fish populations to grow back to healthy levels. The United States has many such quotas that govern overfishing within our territorial waters—within 200 miles of our coast. For example, red snapper is a species living in the Gulf of Mexico that has strict quotas. Even with these quotas, it will be many years before U.S. fish populations return to healthy levels.
- Most of the Earth's oceans are in international waters not governed by any one country's laws. Even when international treaties limiting overfishing have been passed, many countries or individuals have refused to obey these limits. Enforcement of these laws and treaties is difficult. As a result, the population of many of the Earth's fish species is still dropping.
- As the Earth's supply of fish shrinks and demand for food increases with human population, the market cost of the remaining fish increases, making it more likely that humans will continue to overfish until fish populations are wiped out.

## **Runoff and Pollution**

- Toxic chemicals from factories and cities wash into rivers, and collect in the Earth's oceans.
- Various toxins in runoff water collect in fish, either killing them directly or making them poisonous for humans.
- The burning of coal in factories and electric power plants releases mercury into the air. Precipitation cleans the mercury from the air and deposits it into the oceans.
- Mercury collects in fish and is carried up the food chain into large predator fish such as tuna. Mercury is highly poisonous to all animals, and can cause genetic and developmental defects in humans. The present high mercury level in fish now requires limits on use by children and pregnant women.

- Farmers often use fertilizers (artificial plant nutrients), pesticides (insect-killing chemicals) and herbicides (plant-killing chemicals) to increase crops yields. Rain washes some of those chemicals into rivers, where they are carried to the ocean.
- High levels of fertilizer in rivers can cause algae blooms. When the fertilizer is used up, the algae dies and begins to decay. The decomposing bacteria then use up all the oxygen in the water, causing a **fish kill**. Each year, a large area of the Gulf of Mexico becomes a **dead zone** because of fertilizer runoff in the Mississippi River from American farms.

### **Habitat Destruction and Creation**

- Wetlands, estuaries and protected bays along ocean coasts are important breeding grounds for fish and shellfish. Many of these essential habitats have been destroyed by human development and pollution. This habitat destruction will make it even harder for fish populations to recover.
- Humans have begun to help fish populations recover by creating **artificial reefs**. A natural coral reef supports large fish populations by giving a habitat for the producers upon which a food web is built. When humans sink old ships, oil rigs, train cars or other poison-free structures in shallow water, new food webs much like a natural coral reef can develop. Artificial reefs also can act as breakwaters (a barrier for large waves).

### **Ocean Currents and Floating Garbage**

- Most of the Earth's oceans have circular currents that create a whirlpool-like point at their center where floating garbage collects. Both the Pacific and Atlantic Oceans have vast areas filled with floating garbage, including foam and plastics that will take many centuries to break down. This garbage is sometimes eaten by fish, turtles and seabirds, causing their premature death.
- Floating garbage may wash up on beaches, requiring expensive clean-up and disposal.
- Because most of these floating garbage dumps are in international waters, no one country is responsible for cleaning it up. It is likely that these floating garbage dumps will continue to fill in the future.

### **Climate Change and Rising Sea Levels**

- Scientists believe that the Earth's climate is warming, due in part to human burning of fossil fuels and the resulting collection of carbon dioxide in the air. Carbon dioxide is a greenhouse gas that helps trap heat in the Earth's atmosphere.
- The warming planet is causing an increase in glacial melting, adding additional water to the Earth's Oceans. Floating ice is also melting, causing the darker open arctic ocean to absorb more heat from sunlight. The warming water is also expanding, since warm water is less dense and takes up more volume than cold

water. Scientists predict that the Earth's sea levels will continue to rise over the coming centuries. Future sea level rise could create a massive displacement of human populations from coastal cities and low-lying areas, and result in the complete destruction of island countries. Rising sea levels could also destroy wetlands that serve as the nurseries for fish populations.

- Warmer oceans may fuel stronger or more frequent hurricanes causing additional damage to coastal cities.
- As more carbon dioxide becomes dissolved in ocean water, the acidity of the water increases, making it harder for shell-creating organisms to survive. The producer base of the ocean food chain depends on shell-creating organisms. The entire ocean food web could be seriously damaged or even collapse if oceans become too acidic.
- Coral reefs depend on a narrow range of temperatures to survive. As ocean temperatures rise, coral reefs may die, further reducing the fish populations that coral reefs support.

### **Practice Questions**

1. What are the five steps of the water cycle? (1) \_\_\_\_\_;  
(2) \_\_\_\_\_; (3) \_\_\_\_\_;  
(4) \_\_\_\_\_; (5) \_\_\_\_\_.
2. Precipitation that falls on land and flows back to the ocean is called \_\_\_\_\_.
3. Water that is stored or flows underground is called a(n)  
\_\_\_\_\_.
4. How do oceans help stabilize the Earth's climate? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. How does the ocean help slow the effects of global warming? \_\_\_\_\_  
\_\_\_\_\_
6. What class of organisms in the ocean creates a large part of the oxygen in the atmosphere? \_\_\_\_\_
7. An area of the ocean where high fish populations support human fish harvesting is called a \_\_\_\_\_.
8. When fish harvests are limited to amounts that allow fish populations to remain stable, it is called \_\_\_\_\_ use.
9. \_\_\_\_\_ occurs when fish harvests are not limited, resulting in falling fish populations.

10. In the future, fish populations are likely to \_\_\_\_\_ because of \_\_\_\_\_ and \_\_\_\_\_ destruction.
11. A \_\_\_\_\_ is an area of the ocean with very low oxygen levels, caused by runoff of \_\_\_\_\_.
12. What dangerous poison tends to collect in larger fish, making it unsafe for humans to eat in more than small amounts? \_\_\_\_\_  
How did this poison end up in the ocean? \_\_\_\_\_  
\_\_\_\_\_
13. What negative effect is likely to occur if humans continue to destroy wetland and estuary habitat? Why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
14. An \_\_\_\_\_ is a human-created habitat in shallow ocean water that can serve to increase fish populations.
15. Why does floating garbage tend to collect at the center of Earth's major oceans?  
\_\_\_\_\_  
\_\_\_\_\_
16. Why do scientists believe that the Earth's average temperature will continue to increase in the future? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
17. Sea levels of the Earth's oceans are likely to \_\_\_\_\_ in the future. Why?  
\_\_\_\_\_  
\_\_\_\_\_
18. When additional carbon dioxide dissolves in ocean water, the water becomes more \_\_\_\_\_, making it harder for shell-creating organisms to survive.
19. Coral reefs are very sensitive to increases in \_\_\_\_\_, which could cause the coral to bleach and die.