People and planet

Chapter 5

Standard 5: Students will understand how Earth science interacts with society

Objective 1: Characterize Earth as a changing and complex system of interacting spheres.

The Earth is made up of 4 main spheres: the biosphere (all living/once living things on Earth) the geosphere (all the rocks on Earth) the atmosphere (all the air on the Earth) and the hydrosphere (all the water on the Earth). These spheres interact with each other as energy and matter cycle through them. These interactions give rise to the processes that shape our Earth.

Earth's systems (all the things that make the earth work) are dynamic and continually react to natural and human-caused changes. In the following sections you will see examples of this in both the natural world and humans' influence on Earth.

How do technological advances increase human knowledge?

Section 1: Satellites

One of the first uses of rockets in space was to launch satellites. A satellite is an object that orbits a larger object. An orbit is a circular or elliptical path around an object. The Moon was Earth's first satellite, but now many human-made "artificial satellites" orbit the planet. Thousands of artificial satellites have been put into orbit around Earth. We have even put satellites into orbit around the Moon, the Sun, Venus, Mars, Jupiter, and Saturn.

Satellites operate with solar panels for energy.

There are four main types of satellites:

- Imaging satellites take pictures of Earth's surface for military or scientific purposes. Imaging satellites study the Moon and other planets.
- Communications satellites receive and send signals for telephone, television, or other types of communications.
- Navigational satellites are used for navigation systems, such as the Global Positioning System (GPS).
- The International Space Station, the largest artificial satellite, is designed for humans to live in space while conducting scientific research.

Can you forecast your health?

You can use a thermometer to better understand your health just like a meteorologist uses one to better understand the weather. A thermometer will help you forecast your health just as it will help to forecast the weather. Other tools, like barometers, also help with weather forecasting.

Collecting Weather Data

To make a weather forecast, the conditions of the atmosphere must be known for that location and for the surrounding area. Temperature, air pressure, and other characteristics of the atmosphere must be measured and the data collected.

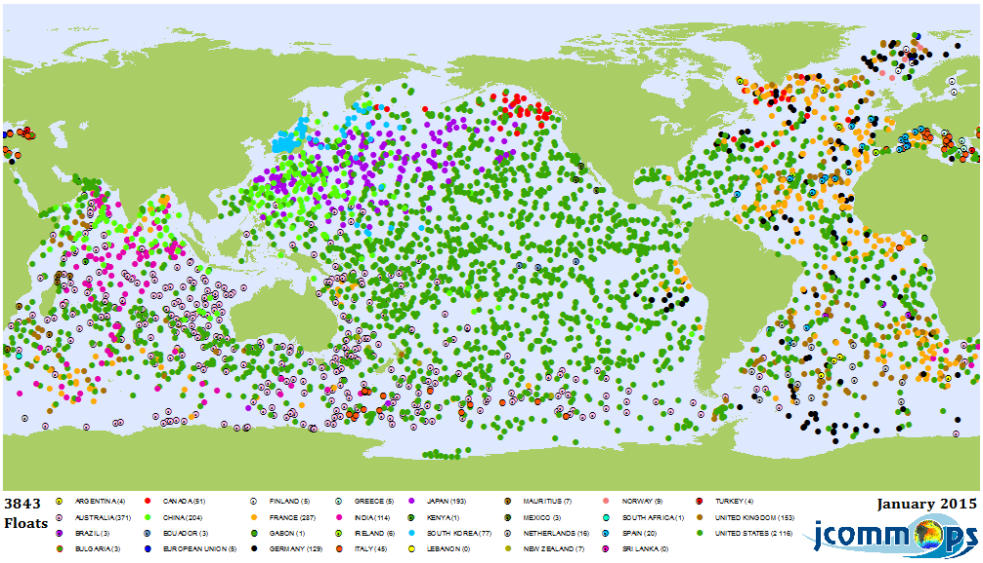
Collecting Ocean Data

Argo is a system for observing temperature, salinity, and currents in the Earth's oceans which has been operational since the early 2000s. The real-time data it provides is used in climate and oceanographic research. A special research interest is to quantify the ocean heat content (OHC).

Argo consists of a fleet of approximately 3700 drifting profiling floats deployed worldwide. Each Argo float weighs 20–30 kg. Profiling floats are commonly used in oceanography and become "Argo floats" only when they are deployed in conformity with the Argo data policy. In most cases probes drift at a depth of 1000 meters (the so-called parking depth) and, every 10 days, by changing their buoyancy, dive to a depth of 2000 meters and then move to the sea-surface, measuring conductivity and temperature profiles as well as pressure. From these, salinity and density can be calculated. Seawater density is important in determining large-scale motions in the ocean. Average current velocities at 1000 meters are directly measured by the distance and direction a float drifts while parked at that depth, which is determined by GPS or Argos system positions at the surface. The data are transmitted to shore via satellite, and are freely available to everyone, without restrictions.

The Argo program is named after the Greek mythical ship Argo to emphasize the complementary relationship of Argo with the Jason satellite altimeters. Some documents refer to Argo as an acronym, but the occasionally used "Array for Realtime Geostrophic Oceanography" arose post hoc; the name was chosen solely because of its relationship to Jason.

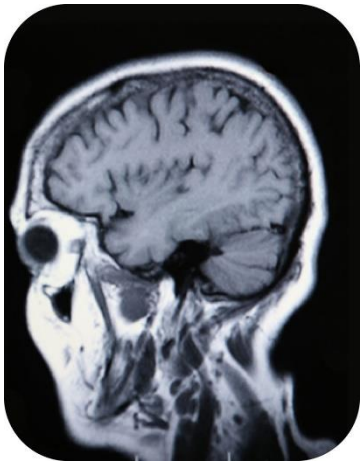
The distribution of active floats in the Argo array, color coded by country that owns the float, as of November 2014 (Image and resource link: hp://en.wikipedia.org/wiki/Argo_%28oceanography%29)



Lesson Summary

- Various instruments measure weather conditions: thermometers measure air temperature, and barometers measure air pressure.
- Satellites monitor weather and also help with understanding long-term changes in climate.
- Radar is used to monitor precipitation.

How is a seismologist like a medical doctor?



Just as a medical doctor uses an MRI, CT scan, or x-ray to see inside a patient's body, seismologists use wave energy to learn about Earth's interior. The difference is that the doctor can run the energy through the patient at any time. Scientists need to wait for an earthquake to get information about Earth's interior

With these and other technologies we are able to gain more knowledge about the Earth around us and in turn are better able to predict when physical changes will occur here on our planet. With these predictions we can save lives and keep our future safe. (*source: written by compiler of all of this information.)*

1. Design and conduct an experiment that investigates how Earth's biosphere, geosphere, atmosphere, or hydrosphere reacts to human-caused change.

Try this: think of an experiment where you can investigate how Earth's biosphere, geosphere, atmosphere, or hydrosphere reacts to human-caused change. Keep track of your data in your science journal and share what you learn with a friend. (*source: written by compiler of this information*)

2. Research and report on how scientists study **feedback loops** to inform the public about Earth's interacting systems.

Once you have seen patterns in what you observed in the above mentioned "try this" take another look at your conclusion. Does it give you any hint as to why you saw what you did? Is there any way to mitigate (take care of) what you observed? Is there something we as humans can do to make the results of the human-caused change not so severe? As you go through this process you are going through the process known as "**feedback loops."** You are able to see the results of some action and by that information you come up with another way to approach the issue you are investigating. Welcome to the process of science! Scientists use these **feedback loops** to inform the public about Earth's interacting systems.

Standard 5, Objective 2:
Describe how humans depend on Earth's resources.

Earth's resources are distributed

For information about Utah's own resources are distributed check out this website:

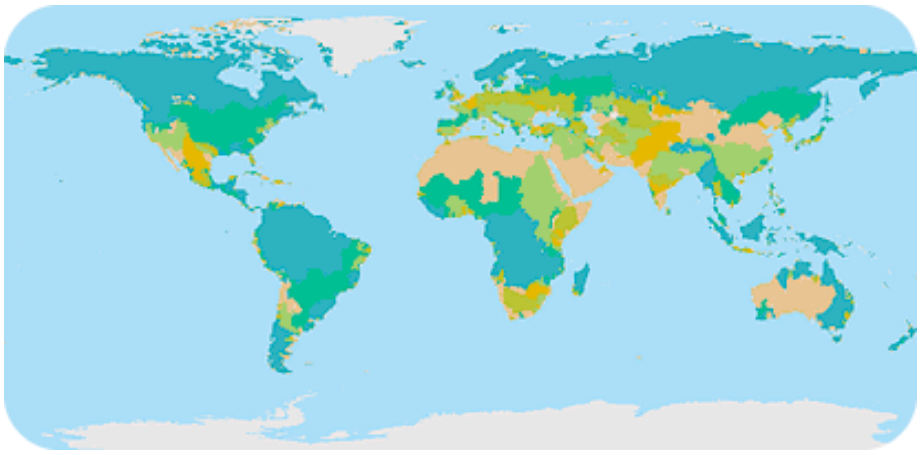
`http://naturalresources.utah.gov/about-dnr.html`

Will water cause the next war?

Wars have been fought over oil, but many people predict that the next war will be fought over water. Certainly, water is becoming scarcer.

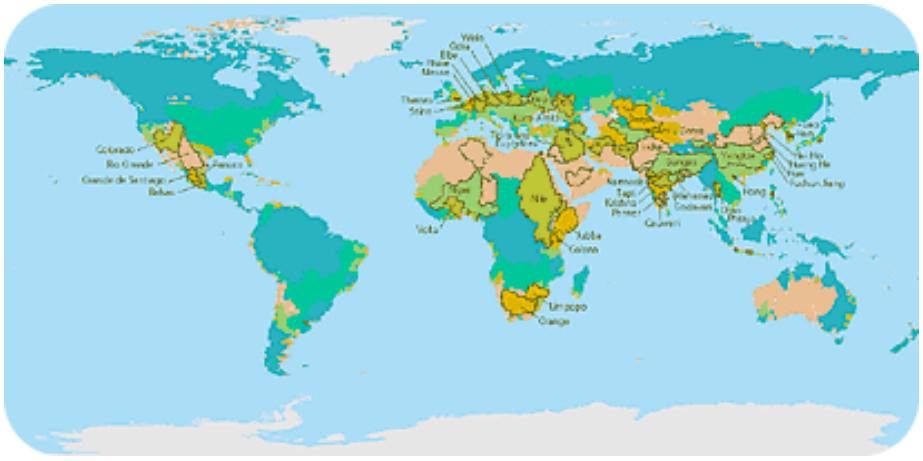
Water Distribution

Water is unevenly distributed around the world. Large portions of the world, such as much of northern Africa, receive very little water relative to their population (see the figure on the next page). The map shows the relationship between water supply and population by river basin.



Blue means there is a lot of river water for each person who lives in the river basin.
Salmon pink means there is very little river water for each person who lives in the river basin.

Over time, there will be less water per person within many river basins as the population grows and global temperatures increase so that some water sources are lost. In 2025, many nations, even developed nations, are projected to have less water per person than now (Figure below).



The same map but projected into 2025.

Water Shortages

Water scarcity is a problem now and will become an even larger problem in the future as water sources are reduced or polluted and population grows. In 1995, about 40% of the world's population faced water scarcity (Figure on the right). Scientists estimate that by the year 2025, nearly half of the world's people won't have enough water to meet their daily needs. Nearly one-quarter of the world's people will have less than 500 m3 of water to use in an entire year. That amount is less water in a year than some people in the United States use in one day.

Nearly Half the World Will Live With Water Scarcity by 2025

Figure 2: Global Renewable Water Supply per Person, 1995 and 2025 (projected)

Water Supply (m3/person /year)	1995 Population (millions)	1995 Percent of Total	2025 Population (millions)	2025 Percent of Total
<500	1,077	19.0	1,783	24.5
500-1,000	587	10.4	624	8.6
1,000-1,700	669	11.8	1,077	14.8
Subtotal	2,333	41.2	3,484	47.9
>1,700	3,091	54.6	3,494	48.0
Unallocated	241	4.2	296	4.0
Total	5,665	100.0	7,274	100.0

Source: WRI. The 2025 estimates are considered conservative because they are based on the United Nations' low-range projections for population growth, which has population peaking at 7.3 billion in 2025 (UNDP 1999:3). In addition, a slight mismatch between the water runoff and population data sets leaves 4 percent of the global population unaccounted in this analysis.

Water supply compared to population.

Droughts

Droughts occur when a region experiences unusually low precipitation for months or years (Figure right). Periods of drought may create or worsen water shortages.

Human activities can contribute to the frequency and duration of droughts. For example, deforestation keeps trees from returning water to the atmosphere by transpiration; part of the water cycle becomes broken. Because it is difficult to predict when droughts will happen, it is

difficult for countries to predict how serious water shortages will be each year.

Extended periods with lower than normal rainfall cause droughts.

Effect of Changing Climate

Global warming will change patterns of rainfall and water distribution. As the Earth warms, regions that currently receive an adequate supply of rain may shift. Regions that rely on snowmelt may find that there is less snow and the melt comes earlier and faster in the spring, causing the water to run off and not be available through the dry summers. A change in temperature and precipitation would completely change the types of plants and animals that can live successfully in that region.

Water Scarcity

Water scarcity can have dire consequences for the people, the economy, and the environment. Without adequate water, crops and livestock dwindle and people go hungry. Industry, construction, and economic development is halted, causing a nation to sink further into poverty. The risk of regional conflicts over scarce water resources rises. People die from diseases, thirst, or even in war over scarce resources.

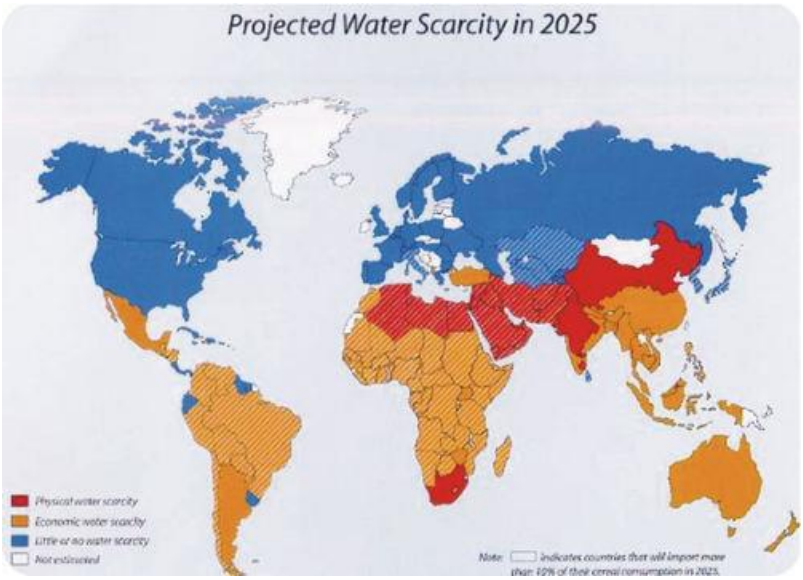
California's population is growing by hundreds of thousands of people a year, but much of the state receives as much annual rainfall as Morocco. With fish populations crashing, global warming, and the demands of the country's largest agricultural industry, the pressures on our water supply are increasing.

Find out more at:

http://science.kqed.org/quest/video/state-of-thirst-californias-water-future/

Conflicts over Water

As water supplies become scarce, conflicts will arise between the individuals or nations that have enough clean water and those that do not (Figure below). Some of today's greatest tensions are happening in places where water is scarce. Water disputes may add to tensions between countries where differing national interests and withdrawal rights have been in conflict. Just as with energy resources today, wars may erupt over water.



By 2025, many nations will face water scarcity. For the nations in red, there will simply not be enough fresh water; the nations in brown may not be able to afford to supply their citizens with fresh water.

Water disputes are happening along 260 different river systems that cross national boundaries. Some of these disputes are potentially very serious. International water laws, such as the Helsinki Rules, help interpret water rights among countries.

Lesson Summary

- A lot of the problem with water is that it is not evenly distributed across the planet.
- Many of the world's people live with water scarcity, and that percentage will increase as populations increase and climate changes.
- Some people predict that, just as wars are fought over energy now, future wars will be fought over water.

Think Like a Scientist

Practice

Use this resource to answer the questions that follow:

`http://www.youtube.com/watch?v=XGgYTcPzexE`

1. What is water scarcity?

2. Why do people take water for granted?

3. How much freshwater is there on Earth?

4. How many people do not have access to clean water?

5. What will occur by 2025?

6. What is physical water scarcity? Where does this occur?

7. What is economic water scarcity? Where does this occur?

Review

8. How will changing climate affect the availability and distribution of water?

9. How do human activities affect the occurrence of droughts?

10. How do so many people live with so little water?

Could this land be used for agriculture?

Probably not. The quality of soil is very important in determining what can grow in a particular area. Good soil is not so easy to come by. Soil should be considered another resource that we, as a population, must strive to protect.

Are Soil and Water Renewable Resources?

Theoretically, soil and water are renewable resources. However, they may be ruined by careless human actions.

Soil

Soil is a mixture of eroded rock, minerals, partly decomposed organic matter, and other materials. It is essential for plant growth, so it is the foundation of terrestrial ecosystems. Soil is important for other reasons as well. For example, it removes toxins from water and breaks down wastes.

Although renewable, soil takes a very long time to form–up to hundreds of millions of years. So, for human purposes, soil is a nonrenewable resource. It is also constantly depleted of nutrients through careless use, and eroded by wind and water. For example, misuse of soil caused a huge amount of it to simply blow away in the 1930s during the Dust Bowl (see Figure opposite). Soil must be used wisely to preserve it for the future. Conservation practices include contour plowing and terracing. Both reduce soil erosion. Soil also must be protected from toxic wastes.

The Dust Bowl occurred between 1933 and 1939 in Oklahoma and other southwestern U.S. states. Plowing had exposed prairie soil. Drought turned the soil to dust. Intense dust storms blew away vast quantities of the soil. Much of the soil blew all the way to the Atlantic Ocean.

Water

Water is essential for all life on Earth. For human use, water must be fresh. Of all the water on Earth, only 1 percent is fresh, liquid water. Most of the rest is either salt water in the ocean or ice in glaciers and ice caps.

Although water is constantly recycled through the water cycle, it is in danger. Over-use and pollution of freshwater threaten the limited supply that people depend on. Already, more than 1 billion people worldwide do not have adequate freshwater. With the rapidly growing human population, the water shortage is likely to get worse.

KQED: Are We in Danger of Running Out of Water?

California's population is growing by 600,000 people a year, but much of the state receives as much annual rainfall as Morocco. With fish

populations crashing, global warming, and the demands of the country's largest agricultural industry, the pressures on our water supply are increasing. Is the U.S.'s largest population in danger of running out of water?

For additional information see:

http://www.kqed.org/quest/television/state-of-thirst-californias-water-future

Too much of a Good Thing

Water pollution comes from many sources. One of the biggest sources is runoff. Runoff picks up chemicals such as fertilizer from agricultural fields, lawns, and golf courses. It carries the chemicals to bodies of water. The added nutrients from fertilizer often cause excessive growth of algae, creating algal blooms (see Figure right). The algae use up oxygen in the water so that other aquatic organisms cannot survive. This has occurred over large areas of the ocean, creating dead zones, where low oxygen levels have killed all ocean life. A very large dead zone exists in the Gulf of Mexico. Measures that can help prevent these problems include cutting down on fertilizer use. Preserving wetlands also helps because wetlands filter runoff water.

Algal Bloom. Nutrients from fertilizer in runoff caused this algal bloom.

Will There Be Enough Fresh Water?

http://www.concord.org/activities/will-there-be-enough-fresh-water.

Lesson Summary

- Soil and water are renewable resources but may be ruined by careless human actions. Soil can be depleted of nutrients. It can also be eroded by wind or water.
- Over-use and pollution of freshwater threaten the limited supply that people depend on.

Think Like an Environmental Scientist

Practice

Use this resources to answer the questions on Biogeochemical Cycles that follow.

`http://www.hippocampus.org/Biology → Non-Majors Biology → Search:Human`

1. What happens when fertilizer ends up in waterways?

2. Describe eutrophication.

3. What has happened at the mouth of the Mississippi River?

Review

4. What is soil?

5. Why is soil considered a nonrenewable resource?

6. Why would you expect a dead zone to start near the mouth of a river, where the river flows into a body of water?

How Will the Removal of the Elwha Dam Affect the Freshwater Ecosystem Upstream?

How resource development and use alters Earth systems

For over a hundred years in the Pacific Northwest, the Elwha freshwater ecosystem was being disturbed by the Elwha dam. Salmon that typically spawn upstream were not able to do so.

Check it out: Restoring the Elwha:

http://www.ck12.org/rwa/Destroying-the-Dam/?eid=SCI.ESC.256.2&rtitle=Hydroelectric+Power&ref=%2Fconcept%2FDestroying-the-Dam

How were the salmon being affected by the dam? By simply removing the dam, will the ecosystem improve? What will change?

Extension Investigation

1. Hydroelectric power, a renewable energy source with no pollution, is an excellent alternative to fossil fuels. Removing the dam means removing a good source of power. How was the dam threatening the survival of salmon? Pacific Salmonids: Major Threats and Impacts. Are there other threats to the survival of the salmon in the Pacific Northwest?
2. As mentioned in the video clip, scientists are paying close attention to the number of salmon present in the Upper Elwha River to assess how the ecosystem is improving. How are they measuring the population growth? If the salmon population increases in the ecosystem, how will that impact other organisms? Create a "before" food web and an "after" food web showing the other players that would be affected.
3. How will the shape of the river change as the dam is removed? How will incorporating log jams improve areas for salmon to spawn? Build a model or use a stream table to simulate the Elwha river with the dam and without the dam. Add log jams. Observe the velocity of stream flow and locations of sediment deposition.

Can we use up all of our sunlight?

No, we have a limitless supply of sunlight. That makes it a renewable resource. Products derived from fossil fuels, like the gasoline we use to drive our cars, are not renewable resources. We will eventually run out of fossil fuels.

Section 1: Renewable Resources and Alternative Energy Sources

A resource is renewable if it is remade by natural processes at the same rate that humans use it up. Sunlight and wind are renewable resources because they will not be used up (Figure below). The rising and falling of ocean tides is another example of a resource in unlimited supply. A sustainable resource is a resource that is used in a way that meets the needs of the present without keeping future generations from meeting their needs. People can sustainably harvest wood, cork, and bamboo. Farmers can also grow crops sustainably by not planting the same crop in their soil year after year. Planting the same crop each year can remove nutrients from the soil. This means that wood, cork,

bamboo, and crops can be sustainable resources.

Wind power, a renewable resource, shown here in a modern wind energy farm.

Alternative Energy Sources

A nonrenewable resource is one that cannot be replaced as easily as it is consumed. Fossil fuels are an example of nonrenewable resources. They take millions of years to form naturally, and so they cannot be replaced as fast as they are consumed. To take the place of fossil fuel use, alternative energy resources are being developed. These alternative energy sources often utilize renewable resources. The following are examples of sustainable alternative energy resources:

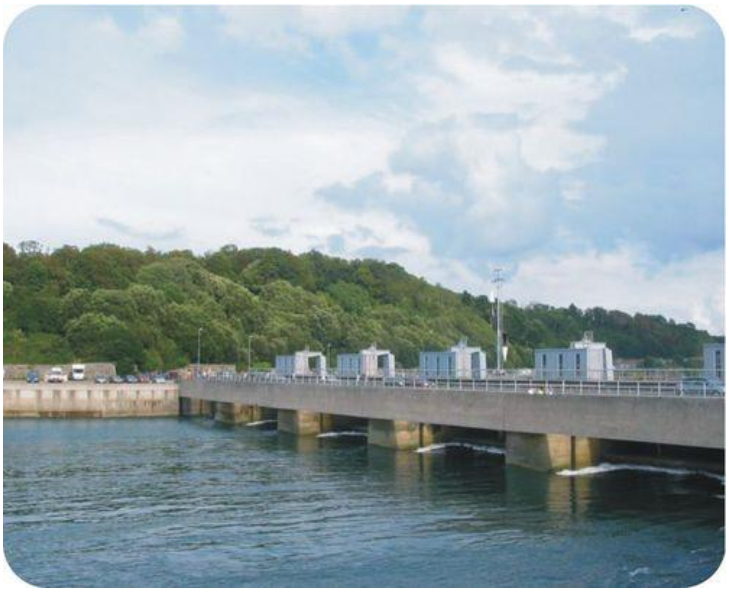
An example of solar power, using solar cells to convert sunlight into electricity.

- Solar power, which uses solar cells to turn sunlight into electricity (Figure above). The electricity can be used to power anything that uses normal coal-generated electricity.

- Wind power, which uses windmills to transform wind energy into electricity. It is used for less than 1% of the world's energy needs. But wind energy is growing fast. Every year, 30% more wind energy is used to create electricity.
- Hydropower (Figure below), which uses the energy of moving water to turn turbines (similar to windmills) or water wheels, that create electricity. This form of energy produces no waste or pollution. It is a renewable resource.

Hydropower plant.

- Geothermal power, which uses the natural flow of heat from the earth's core to produce steam. This steam is used to turn turbines which create electricity.
- Biomass is the mass of biological organisms. It is usually used to describe the amount of organic matter in a trophic level of an ecosystem. Biomass production involves using organic matter ("biomass") from plants to create electricity. Using corn to make ethanol fuel is an example of biomass generated energy. Biomass is generally renewable.
- Tides in the ocean can also turn a turbine to create electricity. This energy can then be stored until needed (Figure below).



Dam of the tidal power plant in the Rance River, Bretagne, France

Lesson Summary

- Renewable resources can be replaced by natural processes as quickly as they are used.
- Alternative energy sources include wind power, solar power, hydropower, and geothermal power.

Think Like a Scientist

Practice

Use the resource below to answer the questions that follow:

http://www.youtube.com/watch?v=1cysaOnlv_E (3:54)

1. How much of the energy needs of the European Union in 2005 was supplied from renewable resources?

2. What energy producing techniques can be used to produce electricity? What techniques can be used to produce heat?

3. Why is biomass based energy known as the "Sleeping Giant"? What energy could it replace that some of the other techniques (such as tidal power) would have difficulty replacing?

4. What is Biogas? How is it produced? What resources is it targeted to replace?

Review

5. What does sustainable mean?

6. What are some ways that renewable resources can be used to generate energy?

What data do scientists provide data that informs the discussion of Earth resource use?

What is electronic waste? We obtain resources of developing nations. We also dump waste on these nations. Many of our electronic wastes, which we think are being recycled, end up in developing countries. These are known as electronic waste or e-waste. People pick through the wastes looking for valuable materials that they can sell, but this exposes them to many toxic compounds that are hazardous to them and the environment.

Section 1: Resource Availability

Supply

From the table in the previous lesson you can see that many of the resources we depend on are nonrenewable. Nonrenewable resources vary in their availability; some are very abundant and others are rare. Materials, such as gravel or sand, are technically nonrenewable, but they are so abundant that running out is no issue. Some resources are truly limited in quantity: when they are gone, they are gone, and something must be found that will replace them. There are even resources, such as diamonds and rubies that are valuable in part because they are so rare.

Price

Besides abundance, a resource's value is determined by how easy it is to locate and extract. If a resource is difficult to use, it will not be used until the price for that resource becomes so great that it is worth paying for. For example, the oceans are filled with an abundant supply of water, but desalination is costly, so it is used only where water is really

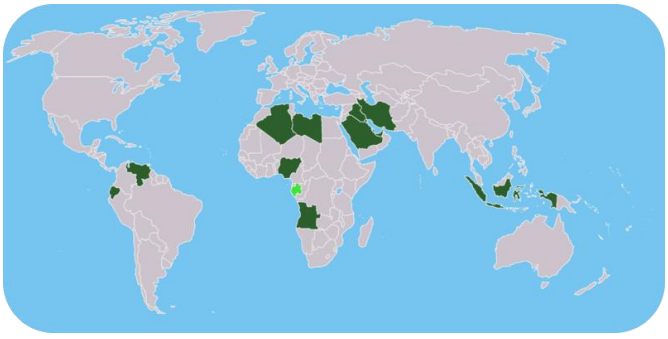
limited (Figure below). As the cost of desalination plants comes down, more will likely be built.

Tampa Bay, Florida, has one of the few desalination plants in the United States.

Politics

Politics is also part of determining resource availability and cost. Nations that have a desired resource in abundance will often export that resource to other countries, while countries that need that resource must import it from one of the countries that produces it. This situation is a potential source of economic and political trouble.

Of course the greatest example of this is oil. 11 countries have nearly 80% of all of the world's oil (Figure below). However, the biggest users of oil, the United States, China, and Japan, are all located outside this oil-rich region. This leads to a situation in which the availability and price of the oil is determined largely by one set of countries that have their own interests to look out for. The result has sometimes been war, which may have been attributed to all sorts of reasons, but at the bottom, the reason is oil.



The nations in green are the 11 biggest producers of oil; they are Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela.

Waste

The topic of overconsumption was touched on in Concept Life on Earth. Many people in developed countries, such as the United States and most of Europe, use many more natural resources than people in many other countries. We have many luxury and recreational items, and it is often cheaper for us to throw something away than to fix it or just hang on to it for a while longer. This consumerism leads to greater resource use, but it also leads to more waste. Pollution from discarded materials degrades the land, air, and water (Figure below).

Pollution from discarded materials degrades the environment and reduces the availability of natural resources.

Natural resource use is generally lower in developing countries because people cannot afford many products. Some of these nations export natural resources to the developed world since their deposits may be richer and the cost of labor lower. Environmental regulations are often more lax, further lowering the cost of resource extraction.

Lesson Summary

- The availability of a resource depends on how much of it there is and how hard it is to extract, refine, and transport to where it is needed.
- Politics plays an important role in resource availability since an unfavorable political situation can make a resource unavailable to a nation.
- Increased resource use generally means more waste; electronic waste from developed nations is a growing problem in the developing world.

Think Like an Environmental Scientist

Practice

Use this resource to answer the questions that follow.
http://www.youtube.com/watch?v=0JZey9GJQP0

1. Why are they melting computer circuit boards?

2. What toxic gases are given off?

3. What metals are they extracting from these computers?

4. What do CRTs contain?

5. What do computer batteries contain?

6. How can these chemicals harm people?

7. How much does recycling a computer cost in India?

8. What companies have committed to reducing the toxic chemicals in their products?

Review

9. Why does electronic waste that is generated in developed nations get dumped in developing nations?

10. Why is politics important in the availability of resources?

11. Why do some nations consume more goods and generate more waste than others?

Earth science literacy helps the public make informed choices

Knowledge is power. We have heard that phrase over and over as we are on this journey of gaining knowledge as we attend school. Knowledge about the Earth is key when we, as humans, choose how to use natural resources here on Earth. We are able to gain knowledge about where and when to use natural resources as we pay attention to Earth science literacy. These sources give us the knowledge we need to make informed choices about where to drill for oil, where the best wind plant locations would be, how to clean and conserve water, etc. *(source: written by compiler of information)*

Standard 5, Objective 3: Indicate how natural hazards pose risks to humans.

Can we Prevent Natural Hazards?

Natural hazards

There is a great source from UGS - a PDF that contains a lot of great info specifically for Utah.

`http://geology.utah.gov/online/pdf/pi-48.pdf`

House damaged by the April 6, 2004 debris flow in Farmington, Utah.

Landslides: Events & Information

Landslides are common natural hazards in Utah. They often strike without warning and can be destructive and costly. Common types of landslides in Utah are debris flows, slides, and rock falls. Many landslides are associated with rising ground-water levels due to rainfall, snowmelt, and landscape irrigation.

Therefore, landslides in Utah typically move during the months of March, April, and May, although debris flows associated with intense thunderstorm rainfall are common in July.

Source for the above article:
`http://geology.utah.gov/utahgeo/hazards/landslide/index.htm`

Section 1: Prevent Wildfires: What can you do?

Debris Burning

- Check with your local officials to see if it is an "open burn season."
- Inquire with your local fire chief or fire warden to see if a permit is required.
- Have a shovel and water accessible and ready to go.
- Be prepared to stay near your burn until it is out and cold.
- Notify the city or county dispatch when you are ready to ignite.

Building Safe Campfires

- Clear campfire site down to bare soil.
- Circle pit with rocks.
- Build campfires away from overhanging branches, steep slopes, dry grass, and leaves.
- Keep a bucket of water and a shovel nearby.
- Never leave a campfire unattended.
- When putting out a campfire, drown the fire, stir it, and drown it again.
- Always have adult supervision.
- Be careful with gas lanterns, barbeque grills, gas stoves, and anything that can be a source of ignition for a wildfire.

Off-Road Safety

- Never park on or drive through dry grass.
- Grease trailer wheels, check tires, and ensure safety chains are not touching the ground.
- Internal combustion engines on off-road vehicles require a spark arrestor
- Check and clean the spark arrestor.
- Carry a shovel and fire extinguisher in your vehicle or OHV/ATV
- Spark from chainsaws, welding torches, and other equipment can cause wildfires.
- Please check local restrictions before using such equipment.

Fireworks Safety

Safety tips for the use of fireworks on PRIVATE LAND when authorized:

- Always read directions.
- Always have adult supervision
- Never use fireworks near dry grass or other flammable materials.
- Have a bucket of water and a hose nearby.
- Never attempt to re-light or "fix" fireworks.
- Fireworks are not toys.
- Use only Utah State Fire Marshal approved fireworks.

Source for above info:

http://www.utahfireinfo.gov/prevention/fire_safety.html

What causes the greatest damage in an earthquake?

This photo shows the Mission District of San Francisco burning after the 1906 earthquake. The greatest damage in earthquakes is usually not from the ground shaking. The greatest damage is caused by the effects of that shaking. In this earthquake, the shaking broke the gas mains and the water pipes. When the gas caught fire, there was no way to put it out. Fire causes the greatest damage in many earthquakes.

Section 2: Earthquake!

An earthquake is sudden ground movement. This movement is caused by the sudden release of the energy stored in rocks. An earthquake happens when so much stress builds up in the rocks that the rocks break. An earthquake's energy is transmitted by seismic waves.

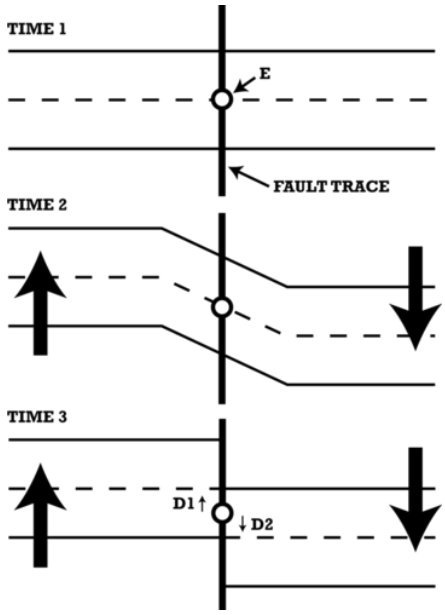
Causes of Earthquakes

Almost all earthquakes occur at plate boundaries. All types of plate boundaries have earthquakes. Convection within the Earth causes the plates to move. As the plates move, stresses build. When the stresses build too much, the rocks break. The break releases the energy that was stored in the rocks. The sudden release of energy is an earthquake. During an earthquake the rocks usually move several centimeters. Rarely, they may move as much as a few meters. Elastic

rebound theory describes how earthquakes occur (see Figure next page).

Elastic rebound theory

Stresses build on both sides of a fault. The rocks deform plastically as seen in Time 2. When the stresses become too great, the rocks return to their original shape. To do this, the rocks move, as seen in Time 3. This movement releases energy, creating an earthquake.



Elastic rebound theory in an animation:

http://earthquake.usgs.gov/learn/animations/animation.php?flash_title=Elastic+Rebound&flash_file=elasticrebound&flash_width=300&flash_height=350.

How can you prepare for an earthquake?

If you live in earthquake country the actions you take before, during, and after a quake could make the difference in your comfort for several days or even your survival.

Protecting Yourself in an Earthquake

There are many things you can do to protect yourself before, during, and after an earthquake.

Before the Earthquake

- Have an engineer evaluate the house for structural integrity. Make sure the separate pieces – floor, walls, roof, and foundation – are all well-attached to each other.
- Bracket or brace brick chimneys to the roof.
- Be sure that heavy objects are not stored in high places.
- Secure water heaters all around and at the top and bottom.
- Bolt heavy furniture onto walls with bolts, screws, or strap hinges.

- Replace halogen and incandescent light bulbs with fluorescent bulbs to lessen fire risk.
- Check to see that gas lines are made of flexible material so that they do not rupture. Any equipment that uses gas should be well secured.
- Everyone in the household should know how to shut off the gas line.
- Prepare an earthquake kit with three days supply of water and food, a radio, and batteries.
- Place flashlights all over the house and in the glove box of your car.
- Keep several fire extinguishers around the house to fight small fires.
- Be sure to have a first aid kit. Everyone should know basic first aid and CPR.
- Plan in advance how you will evacuate and where you will go. Do not plan on driving, as roadways will likely be damaged.

During the Earthquake

- If you are in a building, get beneath a sturdy table, cover your head, and hold on.
- Stay away from windows, mirrors, and large furniture.

- If the building is structurally unsound, get outside as fast as possible.
- If you are outside, run to an open area away from buildings and power lines that may fall.
- If you are in a car, stay in the car and stay away from structures that might collapse, such as overpasses, bridges, or buildings.

After the Earthquake

- Be aware that aftershocks are likely.
- Avoid dangerous areas like hillsides that may experience a landslide.
- Turn off water and power to your home.
- Use your phone only if there is an emergency. Many people will be trying to get through to emergency services.
- Be prepared to wait for help or instructions. Assist others as necessary.

Section 3: FLOODS

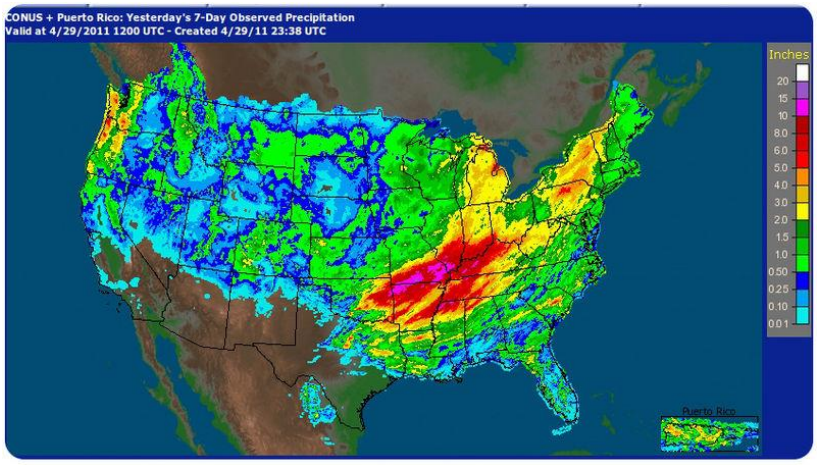
Why are there so many floods?

Floods are a natural part of the water cycle, but that doesn't make them any less terrifying. Put most simply, a flood is an overflow of water in one place. How can you prepare for a flood? What do you do if you're caught in one?

Causes of Floods

Floods usually occur when precipitation falls more quickly than water can be absorbed into the ground or carried away by rivers or streams. Waters may build up gradually over a period of weeks, when a long period of rainfall or snowmelt fills the ground with water and raises stream levels.

Extremely heavy rains across the Midwestern U.S. in April 2011 led to flooding of the rivers in the Mississippi River basin in May 2011 (Figures below).



This map shows the accumulated rainfall across the U.S. in the days from April 22 to April 29, 2011.

April 14, 2010

May 3, 2011

Record flow in the Ohio and Mississippi Rivers has to go somewhere. Normal spring river levels are shown in 2010. The flooded region in the image from May 3, 2011 is the New Madrid Floodway, where overflow

water is meant to go. 2011 is the first time since 1927 that this floodway was used.

Flash Floods

Flash floods are sudden and unexpected, taking place when very intense rains fall over a very brief period (Figure below). A flash flood may do its damage miles from where the rain actually falls if the water travels far down a dry streambed.

A 2004 flash flood in England devastated two villages when 3-1/2 inches of rain fell in 60 minutes.

Buffers to Flooding

Heavily vegetated lands are less likely to experience flooding. Plants slow down water as it runs over the land, giving it time to enter the ground. Even if the ground is too wet to absorb more water, plants still slow the water's passage and increase the time between rainfall and the water's arrival in a stream; this could keep all the water falling over a region from hitting the stream at once. Wetlands act as a buffer between land and high water levels and play a key role in minimizing the impacts of floods. Flooding is often more severe in areas that have been recently logged.

Flood Protection

People try to protect areas that might flood with dams, and dams are usually very effective. But high water levels sometimes cause a dam to break and then flooding can be catastrophic. People may also line a river bank with levees, high walls that keep the stream within its banks during floods. A levee in one location may just force the high water up or downstream and cause flooding there. The New Madrid Overflow in the image above was created with the recognition that the Mississippi

River sometimes simply cannot be contained by levees and must be allowed to flood.

Effects of Floods

Within the floodplain of the Nile, soils are fertile enough for productive agriculture. Beyond this, infertile desert soils prevent viable farming.

Not all the consequences of flooding are negative. Rivers deposit new nutrient-rich sediments when they flood, so floodplains have traditionally been good for farming. Flooding as a source of nutrients was important to Egyptians along the Nile River until the Aswan Dam was built in the 1960s. Although the dam protects crops and settlements from the annual floods, farmers must now use fertilizers to feed their cops.

Floods are also responsible for moving large amounts of sediments about within streams. These sediments provide habitats for animals, and the periodic movement of sediment is crucial to the lives of several types of organisms. Plants and fish along the Colorado River, for example, depend on seasonal flooding to rearrange sand bars.

“Floods 101” is a National Geographic video found in Environment Video, Natural Disasters, Landslides, and more:

http://video.nationalgeographic.com/video/player/environment/.

Lesson Summary

- Before an earthquake, be sure that your home is secure and that you have supplies to last a few days.
- During an earthquake, get to a safe place.
- After an earthquake, avoid dangerous situations, wait for instructions, and assist as necessary.
- When the amount of water in a drainage exceeds the capacity of the drainage, there is a flood.
- Floods are made worse when vegetation is cleared, when the land is already soaked, or when hillsides have been logged.
- People build dams and levees to protect from flooding.
- Floods are a source of nutrients on a floodplain.

Think Like a Geologist

Practice

Use this resource to answer the questions that follow.

`http://video.nationalgeographic.com/video/environment/environment-natural-disasters/landslides-and-more/floods/`

1. Where are floods more likely to occur?

2. Why have farmers relied on floods?

3. What causes floods?

4. At what depth can a flood move a car? Why is this dangerous?

5. What cause the Mississippi Flood of 1993?

6. Why did Hurricane Katrina cause so much damage to New Orleans?

7. What could cause massive flooding today?

Review

7. How does a flash flood differ from another type of flood?

8. What was the role of flooding on the Nile River and what was the consequence of damming the river?

9. Why do floods still occur, even though people build dams and levees?