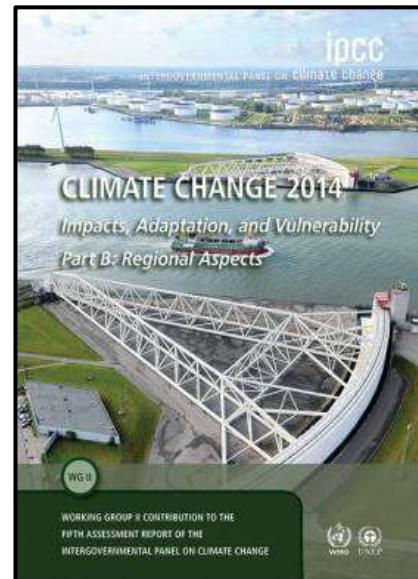




TEACHER BACKGROUND: POTENTIAL EFFECTS OF CLIMATE CHANGE

Climate change is already effecting the global environment in a variety of ways. Glaciers are melting, river and lake ice is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner. Impacts that were predicted in the past would result from global climate change are now occurring: loss of sea ice, enhanced sea level rise and longer, more severe heat waves.

Scientists have high confidence that global temperatures will continue to rise for decades to come, largely due to greenhouse gasses produced by human activities. The **Intergovernmental Panel on Climate Change (IPCC)**, which includes more than 1,300 scientists from around the world, forecasts a temperature rise of 2.5 to 10 degrees Fahrenheit over the next century. According to the IPCC, the level of climate change effects on different regions will differ over time and with the ability of different societies and environments to alleviate or adapt to change.



The IPCC predicts that increases in global mean temperature of less than 1.8 to 5.4 degrees Fahrenheit (1 to 3 degrees Celsius) above 1990 levels will produce beneficial impacts in some regions and harmful ones in others. Net annual costs will increase over time as global temperatures increase.

Consensus: 97% of climate scientists agree and multiple studies published in peer-reviewed scientific journals show that 97 percent or more of actively publishing climate scientists agree: Climate-warming trends over the past century are very likely due to human activities.

These changes are not easily predicted for any given region, but experiments and computer simulations provide evidence that an increase in the average global of only 5 degrees F would result in the following changes:

HIGHER TEMPERATURES-Heat-trapping

gases emitted by power plants, automobiles, deforestation and other sources are warming up the planet. In fact, the five hottest years on record have all occurred since 1997 and the 10 hottest since 1990, including the warmest years on record - 2005 and 2010. High temperatures are to blame for an increase in heat-related deaths and illness, rising seas, increased storm intensity, and many of the other dangerous consequences of climate change. During the 20th century, the Earth's average temperature rose one degree Fahrenheit to its highest level in the past four centuries - believed to be the fastest rise in a thousand years. Scientists project that if emissions of heat-trapping carbon emissions aren't reduced, average surface temperatures could increase by 3 to 10 degrees Fahrenheit by the end of the century. Don't be fooled by average temperatures: A one-degree increase may be found in one place, a 12-degree increase in another, while at the same time other locations may become much colder.



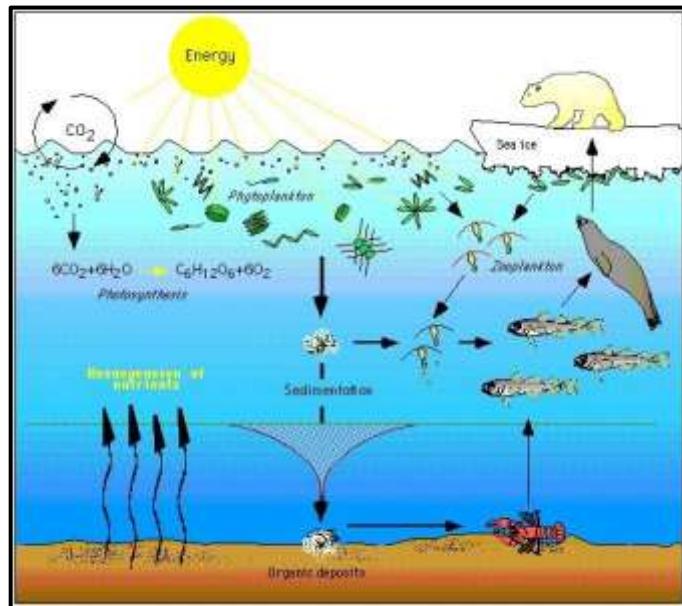
SEA LEVEL RISE-As the

Earth heats up, sea levels rise because warmer water takes up more room than colder water, a process known as **thermal expansion**. Melting glaciers compound the problem by dumping even more fresh water into the oceans. Rising seas threaten to inundate low-lying areas and islands, threaten dense coastal populations, erode shorelines, damage property and destroy ecosystems such as mangroves and wetlands that protect coasts against storms. Sea levels have risen between four and eight inches in the past 100 years. Current projections suggest that sea levels could continue to rise 4 - 36



inches over the next 100 years. A 36-inch increase in sea levels would swamp every city on the East Coast of the United States, from Miami to Boston. Worldwide, approximately 100 million people live within three feet of sea level. Sea level rise associated with climate change could displace tens of millions of people in low-lying areas - especially in developing countries. Inhabitants of some small island countries that rest barely above the existing sea level are already abandoning their islands and becoming some of the world's first climate change refugees.

ECOSYSTEM and BIODIVERSITY LOSS – Climate change and the impacts of climate change affect ecosystems in a variety of ways. For instance, warming could force species to migrate to higher latitudes or higher elevations where temperatures are more conducive to their survival. In the same way, as sea level rises, saltwater intrusion into freshwater systems, may force some key species to relocate or die, removing predators or prey that were critical in the existing food chain. The impact of climate change on a particular species can ripple through a food web and affect a wide range of other organisms. For example, the image above shows the complex nature of the food web for polar bears. Declines in the duration and extent of sea ice in the Arctic leads to declines in the abundance of ice algae, which thrive in nutrient-rich pockets in the ice. These algae are eaten by zooplankton, which are in turn eaten by Arctic cod, an important food source for many marine mammals, including seals. Seals are eaten by polar bears. Declines in ice algae can contribute to declines in polar bear populations. As habitats change, the availability of food, water and shelter will change, forcing species to either adapt or migrate. The rapid nature of climate change is likely to exceed the



ability of many species to migrate or adjust. Experts predict that one-fourth of Earth's species will be headed for extinction by 2050 if the warming trend continues at its current rate.

AGRICULTURE: The toll that climate change will take on agriculture is nearly incalculable. As a result, our food security will be at risk. All over the world, farmers are already struggling to keep up with shifting weather and increasingly unpredictable water supplies. Farmers also must contend with unexpected attacks from weeds, diseases and pests, which all affect crop yield. Overall, climate change could impact agriculture in many ways. Some of these effects are biophysical, some are ecological, and some are economic, including:

- ✓ A shift in climate and agricultural zones towards the poles;
- ✓ Changes in production patterns due to higher temperatures;
- ✓ A boost in agricultural productivity due to increased carbon dioxide in the atmosphere;
- ✓ Changing precipitation patterns;
- ✓ Increased vulnerability of the landless and the poor



WATER RESOURCES: There are four main factors worsening water scarcity according to the IPCC:

- ✓ **Population growth**- In the last century, world population has tripled. It is expected to rise from the present 6.5 billion to 8.9 billion by 2050. Water use has been growing at more than twice the rate of population increase in the last century, and, although there is no global water scarcity as such, an increasing number of regions are chronically short of water.

- ✓ **Increased urbanization** will focus on the demand for water among a more concentrated population. Asian cities alone are expected to grow by 1 billion people in the next 20 years.
- ✓ **High level of consumption-** As the world becomes more developed, the amount of domestic water used by each person is expected to rise significantly.
- ✓ **Resources of freshwater** will disappear as climate change increases.

EXTREME WEATHER EVENTS-

Scientific research indicates that climate change will cause hurricanes and tropical storms to become more intense — lasting longer, unleashing stronger winds, and causing more damage to coastal ecosystems and communities. Scientists point to higher ocean temperatures as the main culprit, since hurricanes and tropical storms get their energy from warm water. As sea surface temperatures rise, developing storms will contain more energy. At the same time, other factors such as rising sea levels, disappearing wetlands, and increased coastal development threaten to intensify the damage caused by hurricanes and tropical storms.



DROUGHTS AND FOREST FIRES-

Climate change is intensifying the circulation of water on and above the surface of the Earth — likely causing drought and floods to be more frequent, severe and widespread.



Higher temperatures increase the amount of moisture that evaporates from land and water, leading to drought in many



areas. Lands affected by drought are more vulnerable to flooding once rain return. As temperatures rise globally, droughts will become more frequent and more severe, with potentially devastating consequences for agriculture, water supply and human health. This phenomenon has already been observed in some parts of Asia and Africa, where droughts have become longer and more intense. Hot temperatures and dry conditions also increase the likelihood of forest fires. In the conifer forests of the western United States, earlier snowmelts, longer summers and an increase in spring and summer temperatures have increased fire frequency by 400 percent and have increased the amount of land burned by 650 percent since 1970.



HUMAN HEALTH: The impacts of climate change on health will depend on many factors, including the effectiveness of a community's public health and safety systems to address or prepare for the risk and the behavior, age, gender, and economic status of individuals affected. Impacts will likely vary by region, the sensitivity of populations, the extent and length of exposure to climate change impacts, and society's ability to adapt to:



- ✓ **More heat related illnesses and deaths-** Abrupt change of temperatures leading to heat waves or cold spells are becoming widespread, causing indirectly fatal illnesses, such as heat stress or hypothermia, as well as increasing death rates from heart and respiratory diseases. Statistics on mortality and hospital admissions show that death rates increase during extremely hot days, particularly among very old and very young people living in cities. Excessive heat is more likely to impact populations in northern latitudes where people are less prepared to cope with excessive temperatures. Young children, older adults, people with medical conditions, and the poor are more vulnerable. The 2003 European heat wave — involving temperatures that were 18°F (10°C) above

the 30-year average, with no relief at night — killed 21,000 to 35,000 people in five countries.

- ✓ **Increased respiratory symptoms** and aggravated asthma or other lung diseases. It is especially harmful to children, older adults, outdoor workers, and those with asthma and other chronic lung diseases. Ground-level ozone can damage lung tissue and can reduce lung function and inflame airway
- ✓ **Increased bacterial infections** are likely as a result of several factors. Higher air temperatures can increase cases of salmonella and other bacteria-related food poisoning because bacteria grow more rapidly in warm environments. These diseases can cause gastrointestinal distress and, in severe cases, death. Following heavy rainfall events, storm water runoff may contaminate water bodies used for recreation. The most common illness contracted from contamination at beaches is gastroenteritis, an inflammation of the stomach and the intestines that can cause symptoms such as vomiting, headaches, and fever. Other minor illnesses include ear, eye, nose, and throat infections.
- ✓ **Increased probability of more infectious diseases** in historically temperate regions. The Intergovernmental Panel on Climate Change (IPCC 2014) projections of increased temperature and precipitation suggest the emergence of more disease-friendly conditions in regions that did not previously host diseases or disease carriers. Climate change accelerates the spread of disease primarily because warmer global temperatures enlarge the geographic range in which disease-carrying animals, insects and microorganisms--as well as the germs and viruses they carry--can survive. In addition to changing weather patterns, climatic conditions affect diseases transmitted via vectors such as mosquitoes (vector-borne disease) or through rodents (rodent-borne disease). The geographic range of disease vectors like ticks and mosquitos are limited by temperature. As air temperatures

rise, the range of these creatures is likely to continue to expand northward. Higher temperatures are also favorable to the survival of new strains of diseases like West Nile virus, Lyme disease, Dengue fever and malaria.

- ✓ **Malnutrition and food poisoning** will result from changes in temperature and precipitation, droughts and floods that will affect agricultural yields and production. In some regions of the world, these impacts may compromise food security and threaten human health, the worst of these effects projected to occur in developing countries, among vulnerable populations. Declines in human health in other countries might affect the United States through trade, migration and immigration and have implications for national security.
- ✓ **Increased mental illnesses** such as PTSD and depression among individuals who have been displaced from their homes and communities, lost family or friends and exposed to the effects of extreme events.

 **COSTS:** Scientists and economists are beginning to grapple with the economic and environmental consequences that will appear if we fail to reduce global carbon emissions quickly and deeply. The most expensive thing we can do is nothing.

- ✓ **Damage to property and infrastructure-** Sea level rise, floods, droughts, wildfires and extreme storms require extensive repair of essential infrastructure such as homes, road, bridges, railroad tracks, airport runways, power lines, dams, levees and seawalls.
- ✓ **Lost productivity-** Disruptions to daily life as a result of climate change can mean lost work and school days and harm trade, tourism, transportation, agriculture, fisheries and energy production. Severe rainfall events and snowstorms can delay planting and harvesting, cause power outages, snarl traffic, delay air travel and otherwise make

it difficult for people to go about their normal daily activities. Climate-related health risks can also reduce productivity, such as when extreme heat curtails construction, or when more potent allergies and more air pollution lead to lost work and school days.

- ✓ **Mass migration and security threats-** Global warming is likely to increase the number of "climate refugees"- people who are forced to leave their homes because of drought, flooding or other climate-related disasters. Mass movement of people and social disruption can lead to civil unrest and might even demand military intervention and other unexpected consequences.
- ✓ **Coping Costs-** Societies will hopefully find ways to prepare for and cope with the effects of some climate impact provided that we do not allow carbon emissions to continue unabated. However, even a partial accounting of these measure suggests that coping is likely to be more costly than steps to reduce carbon emissions. For example, farmers might need to irrigate previously rain-fed areas, cool vulnerable livestock and manage new or more numerous pests. Local and state governments that take early steps to ensure that homes are more energy efficient, build early warning systems for heat waves and other disasters and add emergency responders are more apt to deal successfully with extreme events. Rebuilding after disasters strike is likely to prove even more expensive than preventative measures. In addition, these costs do not include those stemming from lives lost and other irreversible consequences.

As the **CLIMATE HOT MAP**, developed by the Union of Concerned Scientists (UCS) demonstrates, the impacts of a warming world are already being felt by people around the globe. If climate change continues unchecked, these impacts will no doubt get worse. From sea level rise to heat waves, from extreme weather to disease outbreaks, each unique challenge requires locally-suitable solutions to prepare for and respond to the impacts

of global warming. Unfortunately, those who will be hardest and first hit are likely to be the poor and vulnerable, especially in underdeveloped countries. Developed countries need to take the leadership role in providing financial and technical help to insure adaptation.

