



**Title: Raising Awareness about Rising Sea Level**

Liz Duff 2005

**Grade Level:** Middle School and High School or above

**Time:** At least 1 hour

**Learning Goals:**

1. Climate change is altering our coastal landscape, and changes will occur in our lifetimes.

**Conservation Goals:**

2. Participants will consider the impact of their own actions and make informed decisions to try to reduce their negative impact on the coast.

**Objectives:**

1. Participants will learn that sea level may rise up to one meter in the next 100 years.
2. Participants will learn how to use a spotting level to show where one meter higher will be on a favorite beach or salt marsh.
3. Participants will raise others awareness about sea level rise by flagging the spot they predict, for others to see.
4. Participants will learn the difference between the high tide wrack line and the storm surge line.

**Engaging Experience:** Participants will enjoy a field trip to a coastal habitat such as a beach or salt marsh and learn about how it is predicted to change in the next century due to sea level rise.

**Materials:**

- 1 meter stick
- Pocket Sighting level (about \$20)
- 5"x8" Flags on 3' wires

Note: You can get sighting levels and flags from Forestry Suppliers Inc.

To get the flags and level that are pictured, call 1-800-647-5368.

"Sea Level Rise in 2100"

Pink: Legend #12191

"Storm Surge Line in 2100"

Yellow: Legend #12190

(About \$117 per 1000)

Optional: Tide Chart



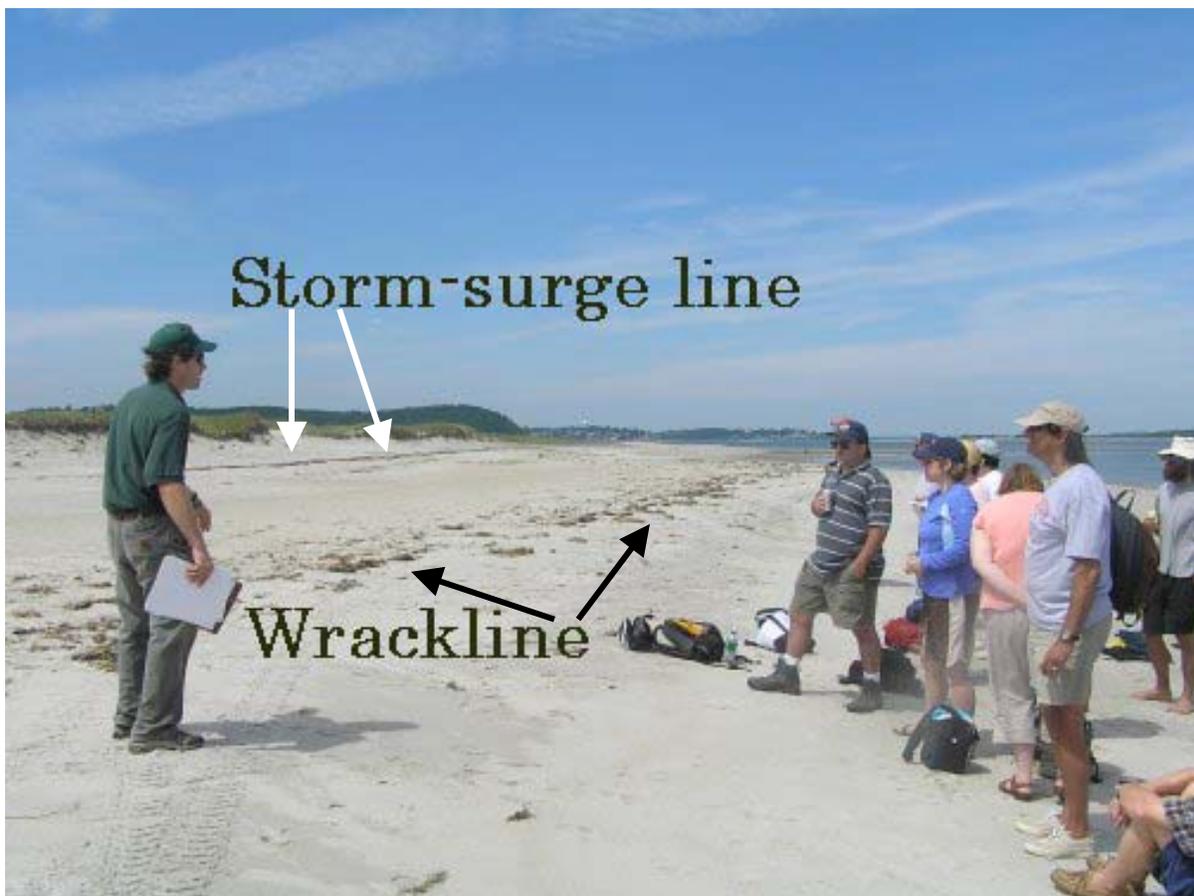
## Facilitation Guidelines:

Preparation: If possible, take your students some coastal environment that is special to you and really bond with its beauty in advance of all this. (Or take them somewhere you know is already special to them.)

**Please note:** If you want to leave the flags in place as a way of raising public awareness, please contact landowners in advance to get their permission. Some dune areas are off limits to visitors, in order to minimize erosion. Do not go in areas that are off-limits unless you are given specific permission to do so.

1. Introduce your students to the topic of Climate Change and Global Warming. Explain that studies show that in Massachusetts, the sea level has risen 20 cm in the since 1900. Explain that scientists are expecting sea level to continue to rise and that there is a range of predictions. (See background information.) "A recent EPA study estimated that global sea level has a 50 percent chance of rising 45 cm (1-1/2 ft) by the year 2100, but a 1-in-100 chance of a rise of about 110 cm (over 3-1/2 ft)."
2. Read and discuss "SEA LEVEL" background information with students.
3. Discuss coastal places that are important to them. Optional: Look on Massachusetts Coastal Zone Management (CZM) web-site to see how beaches have changed since the mid 1800's. Discuss a local beach or local salt marsh and ask students to imagine what 1 meter sea level rise might look like.
4. Introduce the idea that occasional storm surges would also impact shorelines dramatically.
5. Choose a site to visit as a class. Follow normal field trip procedures. (Permission slips, first aid kits, cell phones, appropriate apparel, insect repellent, etc.)
6. Check a tide chart and see if you can plan a trip to be at the beach when the tide is high. Note whether it is a spring tide, which is the highest tide of the month when the force of the sun and the moon's gravitational power is working together and result in our highest tides.
7. If it is not high tide when you are there, look for the wrack line along the beach, in an area that may still have wet sand. This is where the highest point of the tide has left behind sea-weed and debris. This is your starting elevation: this year's high tide line. You may notice further up the beach another line of wrack. This is typically high and dry sand. It is usually where our biggest winter storms left the wrack. That is the starting point for the storm surge line.

8. Demonstrate how to use the spotting level.\*
  - a. Remind participants that scientists predict sea level may rise as high as one meter in the next 100 years.
  - b. Stand on the wrackline, with your back to the ocean, facing perpendicular to the shore.
  - c. Place the spotting level on the top of a meter stick, and place one end of the meter stick on the wrackline.
  - d. Look through the spotting level (the end with a small hole) and line up the bubble of the level in the center.
  - e. Look through the clear glass area of the level to see where the black cross line intersects on the beach.
  - f. Ask a participant to take a flag and go to that point to mark it.
  - g. Communicate with each other until that person is in the correct spot, and has flagged it.
  - h. Use the same protocol with the storm surge line, starting at the storm surge elevation.



\*Depending on how many spotting levels you have, you may do this as a whole group, or divide into multiple groups after demonstrating the procedure.

Optional: Predictions for sea-level rise vary. We may be able to slow sea level rise down if we change our behavior. You can see where 20 cm, 50 cm and 100 cm are. You can write messages on the backs of the flags in permanent marker to encourage behaviors that support less sea level rise.

From a salt marsh: Find the upper edge of the marsh, and spot for one meter up from there. You can do this with different zones: Low marsh, High marsh, *Phragmites* (if present).



With your back to the ocean, spot from the top of the meter stick, looking perpendicular to the shore.

### **Follow-up Discussion:**

How do people feel about the prediction? Share your own feelings, and listen to group members.

Have participants imagine they are one thing that lives or visits the beach (grass, beach-goers, crabs, fish etc.) speak from that things point of view about how life will change with rising sea level.

Discuss what are things that people can do to slow down the rate of sea level rise? (See some suggestions in the background information.)

The web-site listed on our flags is one web-site that has suggestions for what people can do. There are lots of others. Have participants do a web-search to find more.



Mark the 1 meter rise spot on the beach with a "Sea Level Rise in 2100?" flag. (Not actual size!)



Place the "Storm Surge Line in 2100" flag one meter up from the storm surge line. Make sure you have permission if you are going in fragile areas. (Not to actual size.)

**Follow-up activities:**

Have participants investigate their own ecological footprint and discuss actions that they may choose to take to slow down the rate of sea-level rise. Visit [www.myfootprint.org](http://www.myfootprint.org), or [www.redefiningprogress.org](http://www.redefiningprogress.org).

Have participants research the best ways of slowing down sea-level rise, and plan a public outreach day where you share this information, and also show the sea-level predictions.

Make posters to go in public viewing areas such as your local library or city hall.

The high tide leaves behind seaweed and debris. The wrackline shows the elevation of the last high tide. The storm-surge line is higher on the beach and is evidence of the height of winter storm surges.

Assessment: Participants accurately measure 1 meter up and flag the spot.

**Connections to Concepts/Frameworks:**

	Key Academic Concept	Frameworks Grades 9-10
1	Climate change is associated with physical changes to the atmosphere and ocean.	Earth & Space 1.5, 1.7, 1.9
2	The concentration of Carbon Dioxide in the atmosphere has a major impact on climate.	Earth & Space 1.6, 1.9, 3.5
3	Some amount of climate change is natural and has happened throughout the history of the earth.	Biology 6.4
4	Human actions have increased the rate of climate change.	Earth & Space 2.5
5	Climate change affects the distribution of plants and animals in ecosystems.	Biology 6.1, 6.2, 6.3, 6.4
7	Coastal ecosystems change over time in response to climate change.	Earth & Space 1.11, 1.12, 1.13, 3.2, 3.6, 3.7
8	Human actions such as conservation, use of renewable energy, pollution control and increased energy efficiency, may reduce the rate of climate change.	Earth & Space 2.1, 2.2, 2.3, 2.4, 2.5, 2.6
9	Scientists are able to measure climate change through long-term ecological monitoring.	Biology 6.1, 6.3, 6.4
10	We can't predict all the impacts of climate change.	Earth and Space 1.14

## Background Information

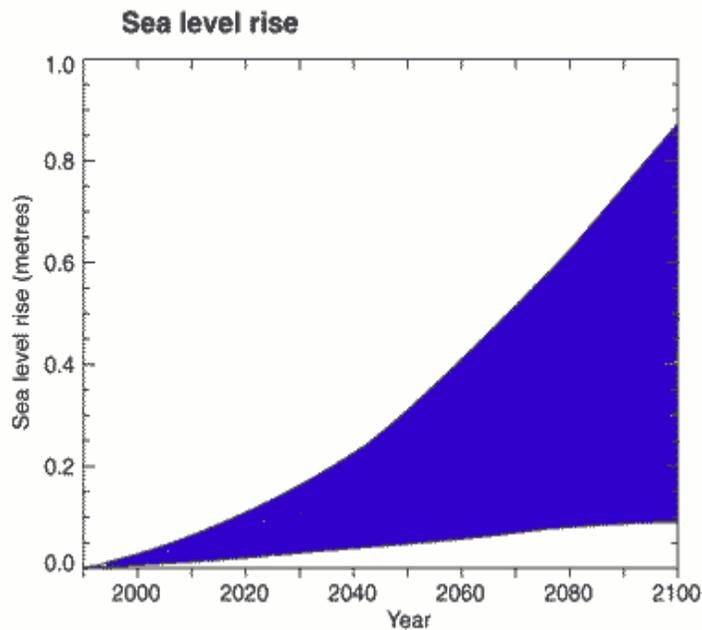
### Sea Level

From:

United States Environmental Protection Agency

<http://yosemite.epa.gov/OAR/globalwarming.nsf/content/ClimateFutureClimateSeaLevel.html>

Warmer temperatures are expected to raise sea level by expanding ocean water, melting mountain glaciers, and melting parts of the Greenland Ice Sheet. Warmer temperatures also increase precipitation, as described below. Snowfall over Greenland and Antarctica is expected to increase by about 5 percent for every 1°F warming in temperatures. Increased snowfall tends to cause sea level to drop if the snow does not melt during the following summer, because the only other place for the water to be is the ocean. (The amount of water in the atmosphere is less than the water it takes to raise the oceans one millimeter). Considering all of these factors, the Intergovernmental Panel on Climate Change's (IPCC) estimates that sea level will rise 9 to 88 cm by the year 2100. A recent [EPA study](#) estimated that global sea level has a 50 percent chance of rising 45 cm (1-1/2 ft) by the year 2100, but a 1-in-100 chance of a rise of about 110 cm (over 3-1/2 ft).



Source: IPCC Third Assessment Report (2001)

Over the longer run, more substantial changes in sea level are possible. Some scientists believe that the West Antarctic Ice Sheet could slide into the oceans after a sustained warming, or if other factors raised sea level. The vulnerability of this ice sheet is poorly understood. It contains enough ice to raise sea level 6 meters (20 feet), and coastal scientists generally agree that sea level was 20 feet higher than today during the last interglacial period, which was only slightly warmer than today. While some scientists have suggested that there is fossil evidence on the polar ocean floor that this ice sheet collapsed during the last interglacial period, there is no scientific consensus on this question.

An [EPA study](#) solicited the opinions of 8 US glaciologists on the vulnerability of this ice sheet. All but one concluded that Antarctica is most likely to have a negligible contribution to sea level over the next century. Nevertheless, they all agreed that there is some risk that a catastrophic collapse of the ice sheet could occur over a couple of centuries if polar water temperatures

warm by a few degrees. Most of the scientists estimated that such a risk had a probability of between 1 and 5 percent. Because of this risk, as well as the possibility of a larger than expected melting of the Greenland Ice Sheet, the [EPA study](#) estimated that there is a 1 percent chance that global sea level could rise by more than 4 meters (almost 14 feet) in the next two centuries.

Sea level rise along the US coast is likely to be somewhat greater than the global average. The [EPA study](#) includes a set of projections that coastal residents can use to calculate how much sea level will rise in specific communities. Along the coast of New York, which typifies the US Coast, sea level is likely to rise 26 cm (10 inches) by 2050 and 55 cm (almost 2 feet) by 2100. There is also a 1 percent chance of a 55 cm rise by 2050, a 120 cm rise (4 ft) by 2100, and a 450 cm rise (15 feet) by the year 2200.

## Suggested Web-sites:

<http://www.cleanair-coolplanet.org>

<http://yosemite.epa.gov/OAR/globalwarming.nsf/content/ClimateFutureClimateSeaLevel.html>

<http://www.whoi.edu/institutes/occi/index.htm>

<http://www.mass.gov/czm/shorelinechangeproject.htm>

<http://www.abcbirds.org/climatechange/>

<http://www.usepa.gov> <http://www.worldwildlife.org/climate/index.cfm>

# Get Informed

(From <http://www.cleanair-coolplanet.org>)

## What Is Global Warming?

Global warming is a shorthand way of describing a set of complex chemical and ecological processes and the growing social and environmental problems resulting from human influence on these processes.

### What Causes Global Warming?



The driver of global warming is a thick blanket of polluted air thrown around the globe by power plant pollution, vehicle exhaust, the burning of fossil fuels to heat and cool our homes and workplaces, industrial waste, and deforestation. Normally, the Earth's climate allows life to flourish by the natural presence of some heat-trapping gases. But as increasing pollution puts more of these “greenhouse gases” in the atmosphere, increased heat is trapped there and the climate is disrupted. The most prevalent greenhouse gas is **carbon dioxide**, a natural byproduct of burning oil, coal, and other organic materials. According to the National Academy of Sciences, the temperature of the Earth's surface has risen most remarkably since the advent of the Industrial Revolution in America, and atmospheric levels of carbon dioxide have increased by 30 percent since that time.

Sea Level Rise is one result of Global warming. It is already occurring. In Massachusetts Sea Level has risen 2 centimeters since 1900. Scientific models predict that sea level will rise between 13 cm and 94 cm in the next one hundred years.

# 10 Cool Climate-Saving Actions



## 1. Save Energy

Save money and help the climate. Switch to ENERGY STAR qualifying compact fluorescent light bulbs, draft-proof your windows and doors, turn in your top loading washing machine for a new, efficient front-loader, and air dry your laundry (check out [www.laundrylist.org](http://www.laundrylist.org)). For home improvement resources which go beyond draft-proofing windows, visit the ENERGY STAR web site: [www.energystar.gov/homeimprovement](http://www.energystar.gov/homeimprovement). Also, consider ceiling fans that push warm air to the floor in the winter and help circulate cool air in the summer. Appliances such as refrigerators, dishwashers and water heaters can be energy hogs. If you are in the market for a new appliance, look for the ENERGY STAR label-these appliances use 20-40 percent less energy than standard products. There are over 35 product categories that bear the ENERGY STAR, including light bulbs, ceiling fans, and appliances.

Procurement resources are available for businesses, municipalities, and colleges to help them buy ENERGY STAR products.

The Northeast Sustainable Energy Association ([NESEA](http://www.nesea.org)) has more on improving saving energy at home.



## 2. Think before You Drive

On average, every gallon of gasoline burned emits about 22 pounds of carbon dioxide.



First, don't idle; turn off your car even while doing quick errands (it's better for your car, anyway!) Likewise, skip the

drive-through; park and go inside instead. Try walking, taking public transportation or riding a bike. Make a personal pledge to cut down on unnecessary car trips and have your vehicle serviced regularly to keep the emission control systems operating at peak efficiency.



When it comes to your vehicle, opt for non-petroleum

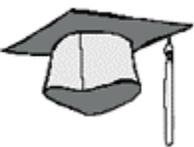
## 4. Buy Recycled Products



In many cases, products made from recycled materials require less energy to produce as compared to those made from virgin materials. For example it takes 75% less energy to make steel items from recycled steel. Another thing to look for is the recycled content of office paper-look for a minimum of 30 percent POST CONSUMER WASTE, not just recycled. And finally purchase the goods with less packaging-this means less energy to produce the package, less waste that goes to the landfill, and fewer trips to the curb to dispose of your trash.

## 5. Choose Green Electricity

Most electricity comes from the burning of fossil fuels like coal, oil and gas. In states with electricity deregulation, you can choose the company that supplies power to your home or business. Many utilities are beginning to offer consumers the choice to purchase green electricity, which is generated by wind and solar power. Call your utility and see if this option is available to you. Ask to be notified when it is. If you can't



buy green electricity through your utility, support renewable energy development by offsetting the pollution caused by your electricity use.

Learn more about how **you** can get the benefits of renewable electricity at the websites for [Green-E](#) and [NativeEnergy](#).

## 6. Use your Consumer Power

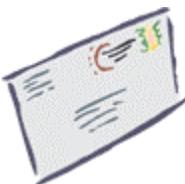
You can make a big difference just by making informed choices about the products and services you buy. Use businesses that make an effort to protect the climate and which stock climate- friendly products. Be sure to let them and their competitors know why you make the choices you do. Buy local produce whenever possible. When food does not have to travel great distances by road or air fewer greenhouse gas emissions are emitted during transport to market. Think before you Buy.

Want more information on what companies or products are the most environmentally and socially responsible? Check out these great resources: [The Green Guide](#) and [Ideals Work](#).

## 7. Educate Yourself about Climate Change

Don't believe everything you read in the newspapers or see on the television. Some Washington lobbyists spend a lot of time and

considerable amounts of money trying to confuse the issue. Use Clean Air - Cool Planet's website our [Science and Policy](#), [Additional Resources](#), and [Program](#) pages to get started and in find ing out what scientists, business people and economists are really saying.



## 8. Let Your Elected Representatives Know You Care

Write to your representatives in Congress and in the state legislature and tell them that clearing the air and slowing global warming are important to



you. Urge them to support actions to reduce carbon pollution, save energy and expand the use of renewable energy.

Don't know who your officials are or how to contact them? Get all of the info you need from [Capitol Advantage](#).

## 9. Create a Climate Friendly Environment

Initiate a Green Group on the job or in the neighborhood to investigate issues such as recycling and energy efficiency. Look into the assistance available through The EPA's Green Lights or Climate Wise programs. Make sure office equipment like photocopiers and computers are Energy Star compliant. Ask your employer to consider employee benefits for commuting by bicycle or mass transit.

## 10. Get Involved

Give a talk, or invite a guest speaker to your local school, place of worship or library. Start a local initiative aimed at reducing the community's impact on climate or get the issue on the agenda for a town meeting discussion. Support environmental non-profit groups working to slow global warming. You can become a member, take part in events like Earth Day or participate in letter-writing campaigns. Of course you can also support Clean Air-Cool Planet by making a tax-deductible [donation](#).



Photos by Elizabeth B. Duff

This activity is dedicated to one of my favorite places. As you can see, the high tide leaves very little beach. Rising sea level will dramatically change this place I love. It's one of the places that got me thinking about the big picture, and caring about my actions, and the actions of other people. I hope you have special places that you love deeply enough to influence the choices you make, and that you have the awareness that our individual and collective choices make a difference.

Liz Duff 2005