Included in this curriculum packet:

ENGAGE: Climate Change True/False Activity
This brief true/false activity is aimed at activating students’ prior knowledge and allowing you to gauge their previous knowledge and misconceptions.

EXPLORE: Sea Level Rise Mapper Webquest
The PowerPoint and guided notes (both provided) help explain how climate change is affecting the Hudson Valley as well as the general concept of sea level rise and why it’s occurring. With Scenic Hudson’s computer-based Sea Level Rise Mapper, students will look at the effects of rising sea levels on specific communities and neighborhoods.

EXPLAIN: What Can We Do?
Start with a carousel activity—let students share what they think can be done to mitigate and adapt to climate change. Then a PowerPoint presentation and guided notes (both provided) will explain the actions students and communities can take and what currently is being done.

ELABORATE: Letter Writing to an Elected Official
Students will write a letter to an elected official outlining their knowledge, ideas and concerns.

EVALUATE: Rubrics and Teacher Keys
Teachers can evaluate student understanding and learning using the provided rubrics and teacher keys.

Investigating Sea Level Rise in the Hudson Valley
This curriculum makes global climate change more relevant to students in the Hudson Valley by allowing them to explore its local consequences. Through Scenic Hudson’s online Sea Level Rise Mapper, they will investigate the potential impacts of sea level rise on their communities. Then after exploring options for mitigating climate change and adapting to sea level rise, students will write a letter to an elected official outlining their concerns and recommendations for adapting to our changing climate.
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*To obtain additional materials contact Kate Phipps at kphipps@scenichudson.org or 845 473 4440, Ext. 233
ENGAGE: Climate Change True/False Activity

Objectives:
• To activate students’ prior knowledge of climate change
• For teachers to assess students’ prior knowledge and identify existing misconceptions

Grades: 7-12

Time frame: (15 minutes) Climate Change True/False Activity

Introduction:
Adapted from the WWF “Your Climate, Your Future” curriculum, this activity begins by looking at climate science and climate change on a global scale and then becomes locally focused. It is meant to be conducted at the beginning of your climate change unit and can serve as an excellent pre-assessment. The goal is to activate students’ prior knowledge of climate change and help teachers gauge where students are in terms of this knowledge. This true/false quiz hits on many common misconceptions about climate change and is a great way to understand what topics might need extra attention.

Background Information:
What is the difference between climate and weather?
Weather defines atmospheric conditions over a short period of time, such as day-to-day or week-to-week. Climate refers to the average weather conditions over a long period of time, decades or longer.

What is the greenhouse effect?
The greenhouse effect is a natural process responsible for warming the Earth. Greenhouse gases include water vapor (H₂O), carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). These gases are present in Earth’s lower atmosphere and allow the sun’s rays to pass through and warm our planet, but prevent the warmth from escaping back into space. Without these heat-trapping gases, Earth would be too cold for human life to exist. However, human activities emitting greenhouse gases have increased their concentration in Earth’s atmosphere past natural levels. Elevated levels of greenhouse gases strengthen the greenhouse effect and consequently warm the Earth, resulting in various changes to climates globally.

What is climate change?
Climate change refers to any significant change in average weather patterns that persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature as well as fluctuations in precipitation, altering risk of certain types of severe weather events, and changes to other features of the climate system. These changes may occur regionally or globally.
What are the facts about climate change?

There is an abundance of evidence showing that Earth’s greenhouse gases (especially carbon dioxide) and the planet’s surface temperatures have been rapidly increasing. These drastic increases have been seen since 1910. Changes in climate are happening globally and in the Hudson Valley, where bouts of extreme weather and warming are supported by local climate data. New York State’s annual average temperature has increased about 0.25° F per decade since 1900 and this rate is accelerating. The annual average temperature in New York State has risen 2.4° F since 1970.

Vocabulary:

• **Greenhouse effect**: The process by which gases in the Earth’s atmosphere trap heat and stop it from radiating back into space, resulting in increased temperatures.

• **Greenhouse gases**: Gases that work to trap heat in the Earth’s atmosphere (e.g., H₂O, CO₂, CH₄). Higher levels of greenhouse gases increase the greenhouse effect.

• **Climate change**: A long-term significant shift in regional climate patterns.

Materials Required:

• Copies of “Climate Change True/False” worksheet for every student

• Climate Change True/False teacher key

Procedure:

1. Hand each student a “Climate Change True/False” worksheet (half sheet included)

2. Have students silently answer true/false questions using a black pen.

3. Once students are finished, go over the answers as a class. Have students use a colored pen/pencil to fill in the correct answers.
Extensions:

To delve deeper into students’ understanding, ask them what other “rumors” they’ve heard about climate change. When a student brings something up, ask the class to raise their hand if they think it is true/false. This is a good way to gauge what information is getting to students about climate change and to catch any other misconceptions.

Sources:


Climate Change True/False

Directions: Use what you know about climate change to decide if each statement is true or false.

1. True or False: Without the greenhouse effect, life on Earth wouldn’t be possible.

2. True or False: Greenhouse gases act like a blanket—they trap heat in the atmosphere and warm the planet.

3. True or False: The majority of human-caused greenhouse gas emissions come from burning fossil fuels.

4. True or False: Unlike the oceans, the Hudson River won’t rise due to climate change.

5. True or False: Sea Level is rising slower in New York State than the rest of the world.

6. True or False: Along with burning fossil fuels, humans release greenhouse gases through changing land use, such as deforestation and clearing land.

7. True or False: The only impact communities in the Hudson Valley will experience from climate change is increased temperatures.

8. True or False: Because the world is already locked into a certain level of global temperature increases, it is no longer important to decrease our use of fossil fuels and energy consumption, we should only work on adaptations to climate change.

9. True or False: Climate change refers only to the increase in Earth’s temperatures.

10. True or False: Since 1970, average yearly temperatures in New York State have risen nearly 2.4° F.
TEACHER KEY: Climate Change True/False

Directions: Use what you know about climate change to decide whether each statement below is true or false.

1. True or False: Without the greenhouse effect, life on Earth wouldn’t be possible.
   **TRUE:** The greenhouse effect is a natural process that warms the Earth, and without it our planet would be too cold for humans to survive. The temperature on the moon fluctuates from about 230° F in the sun to negative 290° F when it’s dark.

2. True or False: Greenhouse gases act like a blanket—they trap heat in the atmosphere and warm the planet.
   **TRUE:** Greenhouse gases trap heat from the sun in the Earth’s atmosphere and prevent it from radiating back into space.

3. True or False: The majority of human-caused greenhouse gas emissions come from burning fossil fuels.
   **TRUE:** Carbon dioxide from the burning of fossil fuels, for energy and transportation, is the largest single source of greenhouse gas emissions from human activities.

4. True or False: Unlike the oceans, the Hudson River won’t rise due to climate change.
   **FALSE:** The Hudson River is a tidal estuary and will be affected by sea level rise.

5. True or False: Sea Level is rising slower in New York State than the rest of the world
   **FALSE:** New York’s rate of sea level rise has been 1.2 inches per decade compared to the in the global rate of sea level rise which is 0.7 inches per decade over the same time period. The New York State coast has risen over a foot since 1900.

6. True or False: Along with burning fossil fuels, humans release greenhouse gases through changing land use, such as deforestation and clearing land.
   **TRUE:** Deforestation is the second-largest source of atmospheric carbon dioxide, a greenhouse gas. When forests are cleared, most of the carbon in the burned or decomposing trees escapes to the atmosphere.

7. True or False: The only impact communities in the Hudson Valley will experience from climate change is increased temperatures.
   **FALSE:** In addition to rising temperatures, valley communities could experience many additional climate-related impacts, including sea level rise, shoreline erosion, destruction of shoreline infrastructure, higher potential for extreme storms, increased threats of flooding and storm surges, summer droughts and dangerous heat waves, decreased winter snow, growth and expansion of invasive species, increased hazard of disease carried by insects, diminished air quality, potential threats to local agricultural production and amplified risk from illness and allergies.
   [http://www.nrcc.cornell.edu/climate_change/climate_ny.pdf](http://www.nrcc.cornell.edu/climate_change/climate_ny.pdf)

8. True or False: Because the world is already locked into a certain level of global temperature increases, it is no longer important to decrease our use of fossil fuels and energy consumption, we should only work on adaptations to climate change.
   **FALSE:** Although we are locked into a certain level of temperature increase, it is incredibly important that we decrease our carbon pollution now to lessen the impacts of sea level rise and other climate change problems on communities around the world. The less carbon we put into the atmosphere now, the less likely we are to tip the scale towards the highest sea level rise scenarios.

9. True or False: Climate change refers only to the increase in Earth’s temperatures.
   **FALSE:** Climate change refers to the increasing concentration of greenhouse gases on Earth and the effects these increases will have—including increased temperatures on Earth, sea level rise, reduced ice and snow cover, changes in amounts of precipitation and increased acidity of oceans.

10. True or False: Since 1970, average yearly temperatures in New York State have risen nearly 2.4° F
    **TRUE:** Winter average temperatures have warmed even faster—almost 5° F since 1970.
    [https://www.dec.ny.gov/energy/94702.html](https://www.dec.ny.gov/energy/94702.html)
EXPLORE: Sea Level Rise in the Hudson Valley

Objectives:
• Students will understand how climate change will affect waterfronts in the Hudson Valley
• Students will be able to explain the predicted effects of sea level rise on a Hudson Valley community

Grades: 7-12

Time frame:
• (20 minutes) Sea Level Rise in the Hudson Valley PowerPoint Presentation with guided notes
• (60 minutes) Sea Level Rise Mapper Activity

Introduction:
In this activity, students will use Scenic Hudson’s online Sea Level Rise Mapper to investigate the impacts of sea level rise on a Hudson Valley community. The PowerPoint presentation (provided) will give a good introduction to sea level rise causes, effects in the Hudson Valley and how to use the SLR Mapper.

Teacher notes:
Good sites to send students to look for more noticeable potential changes:
1. Your local waterfront!
2. Poughkeepsie waterfront: Waryas Park (Dutchess County)
3. Beacon waterfront: Riverfront Park, Long Dock Park and Denning’s Point (Dutchess County)
4. Catskill/Catskill Creek (Greene County)
5. Newburgh waterfront (Orange County)
6. Cold Spring (Putnam County)
7. Stony Point to Haverstraw (Rockland County)
8. Sleepy Hollow to Tarrytown (Westchester County)
9. Yonkers (Westchester County)

Background Information for Teachers:
Sea level is rising at an accelerating rate. How much it continues to rise depends on many factors, including how much greenhouse gas pollution humans put into the atmosphere and how quickly the Greenland and Ant-arctic ice sheets melt.

The original projections of sea level rise that Scenic Hudson used to create the Sea Level Rise Mapper (SLR Mapper) came from predictions by the NYS Sea Level Rise Task Force and NYS2100 Commission. The NYS Sea Level Rise Task Force was formed in 2007 to help communities prepare for and adapt to sea level rise. The NYS2100 Commission formed after the onslaught of severe storms that wreaked havoc on New York State in 2011 and 2012. Scenic Hudson’s SLR Mapper was updated in 2018 based on projections from the 2017 NOAA report: Global and Regional Sea Level Rise Scenarios for the United States. The projections are as follows (at right):
It is still uncertain just how much sea level will rise and how quickly it will happen. The central range represents the low end of predictions; this would be a scenario where measures are taken to cut greenhouse gases, Earth’s temperature doesn’t rise as quickly and ice sheets don’t melt as rapidly. The second scenario is at the high end of predictions; it could occur if the temperature rises quickly, not much action is taken to cut greenhouse gas emissions and the ice caps melt rapidly.

Vocabulary:

- **Estuary**: Area where freshwater from a river meets saltwater from the ocean. Because of it’s connection to the ocean, an estuary has a mixing of fresh and salt water and is also affected by tides. The Hudson River is an estuary with the salt front reaching up into the lower Hudson Valley and is affected by tides all the way up to Troy, NY.

- **100-year floodplain**: An area that has a 1% chance of being flooded in a given year.

- **Inundation**: Areas that will be covered in water at high tides.

- **Brownfields**: An area once used for industrial or commercial use that may be contaminated by hazardous waste or pollution.

- **Hazmat sites**: An area where hazardous materials are stored or disposed of.

- **Hazardous materials**: Any substance or material that could adversely affect the health and safety of people or the environment (e.g., gasoline, paint, pool chemicals, batteries).

- **GIS**: Geographical Information Systems allow you to store, analyze and present spatial and geographical information. GIS puts together different layers of data to create a map that represents the information as a whole.

- **Municipal assets**: Buildings and structures provided for public use by local governments (e.g., roads, libraries, schools, sewage treatment facilities).

- **Hard shoreline**: Areas where structural methods have been employed to stabilize the shoreline (e.g., rip rap, jetties, retaining walls).

- **Natural shoreline**: Areas of shoreline that have been left natural or where natural methods have been used exclusively to stabilize it (e.g., trees, plants, rocky shoreline).

- **Resilience**: The ability of a system to withstand shocks and stresses while maintaining its essential functions.

Materials Required:

- Sea Level Rise in the Hudson Valley PowerPoint Presentation
- Copies of guided notes for every student
- Class set of computers or tablets with internet connection
- Copies of the student worksheet for every student

Procedure:

1. Go through the “Sea Level Rise in the Hudson Valley” PowerPoint presentation to prepare students
2. Give each student a copy of the “Sea Level Rise Mapper” activity worksheet
3. Using a classroom set of computers, have students conduct the activity online
4. Teacher should stand by to assist students with any questions and help troubleshoot
Extensions:

Visit a local waterfront before the Sea Level Rise Mapper activity. Choose a nearby place that will be impacted by sea level rise. At the site, study the Hudson River estuary, investigate the shoreline and make note of noticeable features. Back in the classroom use the location your class visited as a second location for your students to investigate using the SLR Mapper.

Visit a local waterfront area and bring tablets enabled with wireless internet capabilities to use the Sea Level Rise Mapper on site and investigate further how the shoreline will change. Have students make note of interesting features that might be inundated and those that will be changed. Have the students create an art piece representing the changes they will see at the park.

Visit a local waterfront area and conduct a lab exercise measuring how much the shoreline will change. I recommend Lesson 9 New York Explores Sea Level Rise - A Field Based Activity from the New York State Sea Grant’s “Hudson River Estuary Climate Change Lesson Project” available at http://www.seagrant.sunysb.edu/hriver/pdfs/climatechange/HRCC_Lesson9.pdf.

Sources:


Notes: Sea Level Rise on the Hudson River Estuary

1. The Hudson River is an estuary. An estuary is a body of water connected to the ocean that:
   1. ______________________________________________________
   2. ______________________________________________________

2. Climate change in the Hudson Valley will mean
   1. Increased temperatures
   2. __________________________
   3. __________________________

3. Because of __________________________ we will see:
   1. Inundation
   2. Increased Flooding

4. ___________ ___________ events are additive with sea level rise.

5. Hudson River is over _______ higher than a century ago and the rate of sea level rise is _________________

6. Factors that make the sea level rise include:
   1. ___________ and ___________ of ocean water
   2. Melting of _______ ____________
   3. Human altering of the water cycle (taking water out of ground storage, building reservoirs)
   4. Changes in ocean circulation
   5. _________________ of land (land sinking down lower)

7. Sea levels are projected to rise up to _______ inches by 2100
Notes: Sea Level Rise on the Hudson River Estuary

1. The Hudson River is an estuary. An estuary is a body of water connected to the ocean that:
   1. HAS BOTH FRESH AND SALT WATER
   2. IS AFFECTED BY TIDES

2. Climate change in the Hudson Valley will mean
   1. Increased temperatures
   2. MORE SEVERE EVENTS
   3. CHANGING ECOSYSTEMS

3. Because of SEA LEVEL RISE we will see:
   1. Inundation
   2. Increased Flooding

4. STORM SURGE events are additive with sea level rise.

5. Hudson River is over 12 inches higher than a century ago and the rate of sea level rise is ACCELERATING

6. Factors that make the sea level rise include:
   1. HEATING and EXPANSION of ocean water
   2. Melting of ICE SHEETS
   3. Human altering of the water cycle (taking water out of ground storage, building reservoirs)
   4. Changes in ocean circulation
   5. SUBSIDENCE of land (land sinking down lower)

7. Sea levels are projected to rise up to 75 inches by 2100
Sea Level Rise in the Hudson Valley Webquest

In this webquest you will use Scenic Hudson’s Sea Level Rise Mapper and other online resources to investigate the effects of climate change on areas along the Hudson River. Follow the instructions and answer the questions. If you can’t figure out an answer based on the page you are on, you might need to use the internet to research.

PART 1

1) Go to www.scenichudson.org/slrmapper and click “Launch the Mapper”

2) Use the information in the left side panel of the page to answer the following questions:

a) What is the total range of projected sea level rise for the 2080’s?

b) A 100-yr flood occurs during a large storm with a 1% chance of happening in a given year. What color is the 100-yr flood zone designated by on the mapper?

c) Explain how you think the concept and delineation of a 100-yr flood zone will change, or not change, with climate change?

d) On the map, if you select a sea level rise of 54” and an area is now inundated by 6” of water, how will you know? How will you know if it is now inundated by 48” of water?

e) Some shorelines are “hard shorelines” (for example: have a cement wall built along them) while others are “natural shorelines” (for example: are gently sloped with natural plants along them). Explain how you think these shorelines will be affected differently by sea level rise.

f) Scroll further down the left panel. Why will shorelines have different inundation water levels by the same level of sea level rise?

g) If sea level rise is 12”, will the new shoreline be 12” from the current high tide line? Use examples to explain why or why not.
3) Focus in on the City of Kingston so your map looks like the picture at the left. Click and drag the map to get the Kingston waterfront in the middle of your shot. Double click or use the - + buttons in the top left corner to zoom in and out.

4) Now, using the sea level rise bar in the left side panel, click through the different levels of Sea Level Rise from “Current 100-year Flood Zone” to “+72 in”. At what level of sea level rise will Kingston’s waterfront start to see significant impacts from sea level rise? Explain your answer.

5) Visit [http://www.ciesin.columbia.edu/hudson-river-flood-map/](http://www.ciesin.columbia.edu/hudson-river-flood-map/) or use the map below with the Sea Level Rise Mapper to explore existing infrastructure and facilities and answer the following questions:

   a) Describe what infrastructure and how many facilities are in the current 100-year flood zone.
b) Using details, describe how infrastructure and facilities will be effected at +36” sea level rise.


c) Using details, describe how infrastructure and facilities will be effected at +72” sea level rise.


d) What other places, facilities and infrastructure would be important to highlight on the map?


6) Using examples and numbers, explain what considerations and steps you think would be important for the City of Kingston to take in order to prepare for sea level rise. Why do you think these are important?
PART 2

1) Go to www.scenichudson.org/slr/mapper and click “Launch the Mapper”

2) Locate and zoom into the location specified by your teacher on the map.

3) Similar to what you did in PART 1, investigate this area and write a one page long summary of what effects this area will experience and how you think the community could prepare for sea level rise.

4) Use your knowledge of this communities waterfront/shoreline or additional websites and resources to help you explain your answer:
   a) http://www.ciesin.columbia.edu/hudson-river-flood-map/
Sea Level Rise in the Hudson Valley Webquest

In this webquest you will use Scenic Hudson’s Sea Level Rise Mapper and other online resources to investigate the effects of climate change on areas along the Hudson River. Follow the instructions and answer the questions. If you can’t figure out an answer based on the page you are on, you might need to use the internet to research.

PART 1

1) Go to www.scenichudson.org/slr/mapper and click “Launch the Mapper”

2) Use the information in the left side panel of the page to answer the following questions:
   a) What is the total range of projected sea level rise for the 2080’s?  
      About 14”-58”
   b) A 100-yr flood occurs during a large storm with a 1% chance of happening in a given year. What color is the 100-yr flood zone designated by on the mapper?  
      Orange/Yellow
   c) Explain how you think the concept and delineation of a 100-yr flood zone will change, or not change, with climate change?  
      With increased precipitation and more frequent extreme storms, 100-yr floods will become more frequent. As sea level rises, the 100-yr flood zone will expand and more areas will be in this zone.
   d) On the map, if you select a sea level rise of 54” and an area is now inundated by 6” of water, how will you know? How will you know if it is now inundated by 48” of water?  
      6” will turn light blue, higher sea level rise, 48” will turn darker blue
   e) Some shorelines are “hard shorelines” (for example: have a cement wall built along them) while others are “natural shorelines” (for example: are gently sloped with natural plants along them). Explain how you think these shorelines will be affected differently by sea level rise.  
      An area with a hard shoreline higher than the level of rise might not see the same daily effects of sea level rise, but will still be effected by storm surge events. An area with a more gradual slope could be infringed upon more significantly by lower levels of sea level rise.
   f) Scroll further down the left panel. Why will shorelines have different inundation water levels by the same level of sea level rise?  
      Differing topography. Different slopes, hills, shoreline structures, etc.
   g) If sea level rise is 12”, will the new shoreline be 12” from the current high tide line? Use examples to explain why or why not.  
      No, it will depend on the topography and type of shoreline. An area that has a high wall or a steep hill will not allow the water to move onto the shore as much as an area with a gradual slope.
3) Focus in on the City of Kingston so your map looks like the picture at the left. Click and drag the map to get the Kingston waterfront in the middle of your shot. Double click or use the - + buttons in the top left corner to zoom in and out.

4) Now, using the sea level rise bar in the left side panel, click through the different levels of Sea Level Rise from “Current 100-year Flood Zone” to “+72 in”. At what level of sea level rise will Kingston’s waterfront start to see significant impacts from sea level rise? Explain your answer. **Answers may vary. At 6” new areas are inundated, around 12”-18” new streets and buildings start to be inundated.**

5) Visit [http://www.ciesin.columbia.edu/hudson-river-flood-map/](http://www.ciesin.columbia.edu/hudson-river-flood-map/) or use the map below with the Sea Level Rise Mapper to explore existing infrastructure and facilities and answer the following questions:

a) Describe what infrastructure and how many facilities are in the current 100-year flood zone. **Answers may vary. At 6” new areas are inundated, around 12”-18” new streets and buildings start to be inundated.**
b) Using details, describe how infrastructure and facilities will be effected at +36” sea level rise. The 100-yr flood zone increases and covers more houses and roads. The waste water treatment plant in now inundated. Houses around Catherine St. are now inundated.

c) Using details, describe how infrastructure and facilities will be effected at +72” sea level rise. Kingston Point Park is now disconnected from the city because Delaware Ave. is inundated. E. Strand St. and RR tracks are now inundated. More houses around Catherine St., Gill St. and North St. are inundated.

d) What other places, facilities and infrastructure would be important to highlight on the map? Answers will vary, should show they are thinking about things that could be inundated/effectected by sea level rise. (Parks, railroads, businesses, habitats, etc.)

6) Using examples and numbers, explain what considerations and steps you think would be important for the City of Kingston to take in order to prepare for sea level rise. Why do you think these are important? Answers will vary, look for:

- Adapting buildings to withstand flooding
- Building water barriers/walls
- Moving buildings/businesses/homes
- Decreasing greenhouse gas emissions
- Preparing/educating the community, homeowners and business owners
PART 2

1) Go to www.scenichudson.org/slr/mapper and click “Launch the Mapper”

2) Locate and zoom into the location specified by your teacher on the map.

3) Similar to what you did in PART 1, investigate this area and write a one page long summary of what effects this area will experience and how you think the community could prepare for sea level rise.

4) Use your knowledge of this communities waterfront/shoreline or additional websites and resources to help you explain your answer:
   a) http://www.ciesin.columbia.edu/hudson-river-flood-map/

Answers will vary depending on the second location of investigation
Objectives:

- Students will be able to explain mitigation and adaptation strategies that communities and individuals can undertake to prepare for climate change and sea level rise
- Students will understand how communities can plan for resiliency

Grades: 7-12

Time frame:

- (20-35 minutes) What can we do about climate change and sea level rise? Carousel Activity
- (20 minutes) What can we do? PowerPoint

Introduction:

Now that students have had a chance to investigate the impacts of climate change and sea level rise in the Hudson Valley, give them some time to explore the best strategies to mitigate and adapt to these impacts. In addition to brainstorming ways to combat climate change, they will learn how valley communities are making their riverfronts more resilient to rising waters and the likelihood of more frequent flooding.

Background Information for Teachers:

Looking to the Future

Learning about the impacts of climate change and sea level rise is the first step in a process of preparing for the future, with a goal of developing climate-resilient communities. A resilient community plans ahead for rising sea levels and severe weather events—investigating and implementing strategies that mitigate flooding and other potential damage, allowing it to bounce back more quickly.

There are two ways we can respond to the threat of climate change and prepare for the future—mitigation and adaptation. Mitigation involves attempts to slow climate change and sea level rise; it usually involves decreasing the output of greenhouse gases. Examples of mitigation include using public transportation and reducing deforestation. Adaptation is taking steps to minimize the impacts of climate change and sea level rise. Examples include retrofitting buildings to withstand floodwaters and moving riverfront buildings and infrastructure that eventually will be underwater.

Waterfront Flooding Task Forces

Kingston, Catskill, Piermont and Stony Point established Waterfront Flooding Task Forces to assess threats they face from sea level rise and flooding—and take steps to confront these challenges. Each group started by envisioning what they wanted their community to be in the future. Then using tools like Scenic Hudson’s Sea Level Rise Mapper, they assessed vulnerable neighborhoods, natural assets and infrastructure, and investigated the costs of mitigation and adaptation strategies to protect them. The work of each task force culminated with a report offering recommendations and strategies to make their community more resilient. Visit http://www.dec.ny.gov/energy/93950.html to view the reports.

Kingston Waterfront Case Study

Between 2012 and 2013, the Kingston Waterfront Flooding Task Force met seven times, with about 25 stakeholders (local officials; leaders of environmental, cultural and business organizations; and concerned citizens) at each meeting. Their work was guided by the following principles: preserving the history and sense of community on the waterfront, promoting economic revitalization, prioritizing health and safety, using natural systems to reduce flood risk, securing infrastructure, and promoting Kingston’s Climate Action Plan. They looked at the future of the waterfronts along the Hudson River and Rondout Creek and assessed their vulnerability to inundation from rising sea levels and storms. After prioritizing the city’s assets, the task force found that the water treatment facility near the creek...
was the most valuable at-risk asset. The group’s final report outlined 24 recommendations—both short- and long-term adaptation and mitigation strategies. Mitigation included implementing Kingston’s Climate Action Plan to reduce the city’s greenhouse gas emissions. Adaptation included using natural buffers and green shoreline infrastructure to reduce flooding and exploring the use of amphibious or floating structures and elevated rights of way. The report also emphasized the need for education and emergency planning to prepare for future severe weather events. The City Council unanimously approved the task forces’ report and has begun to implement some of its strategies. The city of Kingston has received $85,000 in grant money to include flood resilience in their Local Waterfront Revitalization Plan and to examine long term adaptive planning of wastewater infrastructure.

Vocabulary:

- **Resilience**: The ability to plan for, withstand and recover from severe events without suffering permanent loss of functions, devastating damage, reduced productivity or diminished quality of life.

- **Mitigation**: Attempts to slow the process of global climate change, usually by lowering the level of greenhouse gases in the atmosphere.

- **Adaptation**: Actions or steps taken to minimize impacts from stresses, extreme events or changing conditions.

Materials Required:

- 4-6 Large pieces of paper (butcher paper, poster paper, chart paper)
- Markers
- What can we do? PowerPoint
- What can we do? Guided Notes for each student

Procedure:

1. For the carousel activity: On the 4-6 large pieces of paper, write questions to get students thinking about the future of climate change and sea level rise. Questions could include:
   a. How can you decrease carbon pollution at home?
   b. How can businesses/schools mitigate climate change?
   c. What choices can you make each day to decrease your contribution to carbon pollution?
   d. What steps can communities take to prepare for sea level rise?
   e. Besides changing your personal habits, what can you do to make a difference when it comes to climate change?

2. Post the papers on walls around the room so there is adequate space around each for students to stand, write and discuss.

3. Divide students into groups, with one group per poster. Give each group a different colored marker to write with.

4. Tell students they are to review/discuss the question and then write down their thoughts on the paper.

5. After students have had time to talk and record their ideas (4-5 minutes should be sufficient), signal that it’s time for them to move clockwise to the next poster.

6. Repeat this procedure until the groups have provided their input on all posters.

7. Have each group return to the initial question they answered and synthesize information contributed by the rest of the class. They should highlight important details, recurring ideas or anything else they find interesting.
8. Each group then reports out to the class with a brief summary of the responses.

9. You can then go through the What Can We Do? PowerPoint to discuss further and elicit new ideas

Extensions:

Have students research current proposals to deal with climate change and sea level rise and weigh in or debate about proposals like the Army Corps of Engineers proposed storm barriers to close off the Hudson Harbor and Estuary during storm events

Get students involved in teaching others about how to live a more eco-friendly life.

1. Start a recycling campaign if your school doesn’t have one.

2. Have students come up with ways your school can decrease its carbon emissions. They can make presentations to other classes about ways to be more eco-friendly.

3. Go on a field trip to plant trees or clean up your local park/schoolyard.

4. Have students come up with their own project to help curb greenhouse gas emissions.

Sources:


Notes: What Can We Do About Climate Change?

1. _____________________. The ability to plan for, withstand and recover from severe events—without suffering permanent loss of functions, devastating damage, reduced productivity or diminished quality of life.

2. What did the Kingston Waterfront Flooding Task Force consider when making recommendations for resiliency:

3. Does anything surprise you about the task force’s recommendations?
Notes: What Can We Do About Climate Change?

1. **RESILIENCE**: The ability to plan for, withstand and recover from severe events—without suffering permanent loss of functions, devastating damage, reduced productivity or diminished quality of life.

<table>
<thead>
<tr>
<th>Define: <strong>MITIGATION</strong></th>
<th>Define: <strong>ADAPTATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Attempts to slow the process of global climate change, usually by lowering the level of greenhouse gases in the atmosphere</td>
<td>Developing ways to protect people and places by reducing their vulnerability to climate impacts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GIVE EXAMPLES OF <strong>MITIGATION</strong> FOR...</th>
<th>GIVE EXAMPLES OF <strong>ADAPTATION</strong> FOR...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation:</td>
<td>FORTIFICATION:</td>
</tr>
<tr>
<td>• hybrid/electric vehicles</td>
<td>• sea wall</td>
</tr>
<tr>
<td>• public transportation</td>
<td>• levee</td>
</tr>
<tr>
<td>• bicycling</td>
<td>• living shoreline</td>
</tr>
<tr>
<td>• alternative energy (solar, wind, etc.)</td>
<td>• strom barriers</td>
</tr>
<tr>
<td>• green building practices</td>
<td></td>
</tr>
<tr>
<td>Energy:</td>
<td>ACCOMODATION:</td>
</tr>
<tr>
<td>• energy efficiency appliances</td>
<td>• floodproofing</td>
</tr>
<tr>
<td>• alternative energy (solar, wind, etc.)</td>
<td>• elevate on piles</td>
</tr>
<tr>
<td>• green building practices</td>
<td>• protect/move building systems</td>
</tr>
<tr>
<td>Agriculture and Forests:</td>
<td>• floating structures</td>
</tr>
<tr>
<td>• organic farming</td>
<td>• amphibious structures</td>
</tr>
<tr>
<td>• stopping deforestation</td>
<td></td>
</tr>
<tr>
<td>• buy local</td>
<td>RELOCATION:</td>
</tr>
<tr>
<td>Waste:</td>
<td>• relocate/demolish</td>
</tr>
<tr>
<td>• compost</td>
<td></td>
</tr>
<tr>
<td>• recycling</td>
<td></td>
</tr>
<tr>
<td>• buy less stuff</td>
<td></td>
</tr>
</tbody>
</table>

2. What did the Kingston Waterfront Flooding Task Force consider when making recommendations for resiliency:

*Vision for the city, health and safety of community, vulnerability of different areas/assets, need to act in short or long term, value of assets, cost of adaptation strategies*

3. Does anything surprise you about the task force’s recommendations?

*answers may vary*
Objectives:

• Students will use facts and information gathered to write a persuasive letter to an elected official outlining their concerns and ideas about climate change

• Students will demonstrate their knowledge of the effects of climate change on the Hudson River Valley

Grades: 7-12

Time frame:

• (30 minutes) Introduction and explaining how to write a letter to a government official

• (45 minutes or at home) Writing letter

Introduction:

Using information learned in class, including data from Scenic Hudson’s online Sea Level Rise Mapper, students will write a letter to an elected official outlining the risk of sea level rise and explaining proposed solutions. This is a great way to sum up a climate change unit and can serve as a post-assessment of students’ understanding of the topic. The included rubric aligns with Common Core standards.

Background Information for Teachers:

As we have seen in the "EXPLAIN: What Can We Do?" portion of this curriculum, Hudson Valley municipalities have begun making preparations to mitigate the effects of climate change and sea level rise. In many cases, it only takes one concerned citizen speaking up to make changes happen in society. Students’ letters to local officials in their community could ask for specific actions to be taken or simply increase awareness about this pressing issue—the first step in organizing an advocacy campaign. An advocacy campaign begun by concerned citizens is often referred to as a grassroots campaign.

Before writing to an elected official, it is important to outline talking points and determine the goal of your letter. Once you have done research and have solid facts to back up your position, you are ready to explain your concerns and ask the official to take action.

Vocabulary:

• Advocacy: Active promotion of a cause or principle. Taking actions aimed at influencing decisions in support of a given cause.

• Grassroots campaign: A citizen-generated movement to make a change. It relies on the general public to sway political decisions, unlike advocacy done by paid lobbyists.

• Talking Points: Succinct and clear facts to support the side of your argument.

Materials Required:

• Instructions for students on writing a letter to an elected official

Procedure:

1. Give students the instructions for “Writing a Letter to an Elected Official”

2. Go over the format and structure of writing the letter

3. Project the “Sample Letter” up on the board and go through it with students, pointing out the strong points and where the letter could be made stronger. Use the rubric to grade the sample letter.

4. Give students class time to write their letters or assign as a take home assignment.
Extensions:

Have students research local agencies and non-profits that are working on the issue of climate change and sea level rise in the Hudson Valley. Students can learn more about what local organizations are doing to promote climate change preparedness. Encourage students to attend meetings, lectures, town hall meetings, conferences, etc. that focus on the issue.

Sources:

Instructions: Writing a Letter to an Elected Official

Below is a layout of the structure of the letter and information that should be included. Be sure to include facts you have learned in the climate change and sea level rise unit. Use the rubric on the back to complete your letter.

Your Address 1
Your Address 2
Today’s date

Official’s title and full name
Name of municipality
Mailing Address 1
Mailing Address 2

Dear (official’s title and last name):

**Paragraph One:** Introduction and opening statement

Introduce yourself, who you are and where you live. Present the issue you are writing about: Describe the risks of climate change and rising sea levels and the urgency for your community to take action. Conclude with the “ask”—what you specifically would like the official to do.

**Paragraphs Two and Three:** Supporting information

Provide more detail on the issue—why it’s important to you and why it should be important to the elected official. Use facts and personal stories to highlight the need to take action now and the dangers of not acting.

**Paragraph Four:** Closing and restating the ask

Briefly summarize the letter’s important points. You should restate what you are asking for and why you think it is important.

Sincerely,

Your Full Name
<table>
<thead>
<tr>
<th>Rubric for Letter to an Elected Official</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Inadequate</strong></td>
</tr>
<tr>
<td>The letter contains an unidentifiable claim or vague position.</td>
</tr>
<tr>
<td>The letter contains an unclear or emerging claim that suggests a vague position.</td>
</tr>
<tr>
<td>The letter contains limited data on climate change and sea level rise and evidence related to the claim. The conclusion may fail to conclude the argument or position.</td>
</tr>
<tr>
<td>The letter lacks an awareness of the community's needs.</td>
</tr>
<tr>
<td><strong>2 Developing</strong></td>
</tr>
<tr>
<td>The letter introduces a claim that is arguable and takes a position.</td>
</tr>
<tr>
<td>The letter provides data on climate change and sea level rise and evidence that attempts to back up the claim. The conclusion fails to support the claim and evidence.</td>
</tr>
<tr>
<td>The letter illustrates an inconsistent awareness of the community's needs.</td>
</tr>
<tr>
<td>The letter contains few, if any, words, phrases, and clauses to link the major sections of the letter.</td>
</tr>
<tr>
<td><strong>3 Proficient</strong></td>
</tr>
<tr>
<td>The letter introduces a precise claim that is clearly arguable and takes a position on an issue.</td>
</tr>
<tr>
<td>The letter provides sufficient data and evidence on climate change and sea level rise to back up the claim. The conclusion strengthens the claim and evidence.</td>
</tr>
<tr>
<td>The letter considers the community's concerns about the claim. The letter addresses the specific needs of the community.</td>
</tr>
<tr>
<td>The letter contains limited words, phrases, and clauses to link the major sections of the letter.</td>
</tr>
<tr>
<td><strong>4 Skilled</strong></td>
</tr>
<tr>
<td>The letter introduces a compelling claim that is clearly arguable and takes a purposeful position on an issue.</td>
</tr>
<tr>
<td>The letter provides ample convincing data and evidence to back up the claim. The conclusion effectively reinforces the claim and evidence.</td>
</tr>
<tr>
<td>The letter anticipates the community's concerns about the claim. The letter addresses the specific needs of the community.</td>
</tr>
<tr>
<td>The letter uses words, phrases, and clauses to link the major sections of the letter. The letter connects the claim and reasons.</td>
</tr>
<tr>
<td><strong>5 Exceptional</strong></td>
</tr>
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**Claim:**
The letter introduces a compelling claim that is clearly arguable and takes a purposeful position on an issue.

**Development:**
The letter provides ample convincing data and evidence to back up the claim. The conclusion effectively reinforces the claim and evidence.

**Audience:**
The letter anticipates the community's concerns about the claim. The letter addresses the specific needs of the community.

**Cohesion:**
The letter uses words, phrases, and clauses to link the major sections of the letter. The letter connects the claim and reasons.

**Style and Conventions:**
The letter presents an engaging, formal, and objective tone. The letter demonstrates standard English conventions of usage and mechanics.
The Honorable Mayor Ronald Bass  
City of Waterfront  
2 Government Way  
Waterfront, NY 12345  

July 9, 2015

Dear Mayor Bass:

I am a citizen of Waterfront who has seen the tremendous damage severe weather has caused our community over the past decade. I am writing to ask you to take climate change seriously and develop a Sea Level Rise Task Force to help plan for resiliency. If we don’t start planning for the future now, our wonderful city could see millions and millions more dollars put into disaster relief.

I have experienced firsthand the devastating effects of severe storms. My home was flooded during Hurricane Irene. The amount of money I had to spend fixing it up afterwards is nothing compared to the money that would be needed to restore Waterfront if sea levels in the Hudson River continue to rise and we are hit with another storm like Irene. Over the last decade alone, the Hudson’s sea level has risen 12 inches—and the rate of increase is accelerating. The NYS2100 Commission and New York State Sea Level Rise Task Force predict sea level could rise up to 72 inches by the year 2100. This would make the impacts of storm surges exponentially more harmful to our city.

Municipalities up and down the Hudson have been working to include sea level rise in their planning for the future. They have assessed risks and costs of inaction along with mitigation and adaptation strategies to make recommendations to plan for resiliency. Because the City of Waterfront is along the Hudson River and has received significant damage from severe storms in recent years, it is important to start the process of preparing now before it is too late. I do not want to see the loss of our historic downtown to flood damage. Even more important, I want to ensure the health and safety of my family, friends and neighbors.

I appreciate your work in helping Waterfront recover from Hurricane Irene, but again I urge you to take the issue of sea level rise and climate change more seriously and assemble a Sea Level Rise Task Force to assess the situation and plan for our future. I love living in Waterfront and want it to be a more resilient community. We can’t afford to do nothing and keep paying the steep price when severe weather strikes.

Sincerely,

Write signature

Kate Brill