iPlan Curriculum Catalog

Table of Contents

Mass Audubon

Climate Change

Theme: Urban/City/Community Planning as it relates to Climate Change
Goal: Introducing students to how different types of land use plays a part in global warming
Objective:

- Discuss global warming, land use, the role of plants in climate change
- Identify two land-use codes that can have negative climate impacts on a community and explain why
- Provide examples of three land use changes that can lead to climate change solutions and why

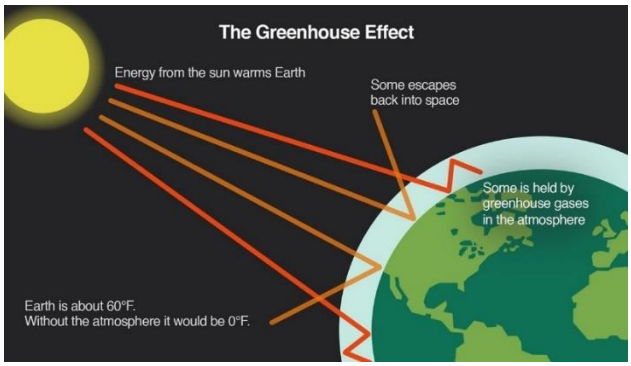
Scenario/End goals for map: You are a climate scientist working toward mitigating global warming. Create a land use plan that decreases greenhouse gasses by changing the land use of the parcels, while pleasing as many stakeholders as you can.

Indicators Suggested:

- Heat Advisory Days
- Butterflies
- Greenhouse gasses
- Housing
- Population

Class 1: Introduction to global warming and iPlan game

- iPlan is a game created by a team at the University of Wisconsin and Mass Audubon
- Ask students: What do you know about climate change?
- Describe climate change
    - Climate change includes both the global warming driven by human emissions of greenhouse gases, and the resulting large-scale shifts in weather patterns.
- Describe GHG
    - A greenhouse gas is a gas that absorbs and emits radiant energy within the thermal infrared range. Greenhouse gases cause the greenhouse effect on planets. The primary greenhouse gases in Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.



- Short Ted Talk on global warming: https://www.ted.com/talks/kristen_bell_giant_ant_why_is_the_world_warming_up?language=en&referrer=playlist-countdown_session_1_urgency
- Ask students: What are the effects of climate change?
    - Fires, flooding, warming temperatures, sea level rise, drought, heavy rain, habitat loss, severe weather, heat waves
- Can you think of how plants are important to mitigate global warming?
    - CO2 sinks, areas of cooling, flood mitigation/absorbs water
- What is net zero/carbon neutral?
    - Carbon neutrality refers to achieving net zero carbon dioxide emissions by balancing carbon dioxide emissions with removal or simply eliminating carbon dioxide emissions altogether.
    - Short Ted Talk on what is net zero: https://www.ted.com/talks/kristen_bell_giant_ant_what_is_net_zero?language=en&referrer=playlist-countdown_session_1_urgency
- Draw down your climate impact
    - Type in the chat one/say thing you will do
    - Top GHG decreasing habits are:
        - Eating less meat and dairy- even just cutting out one day of no meat helps
        - Decreasing food waste- meal planning, only taking what food you need, eat leftovers, compost
        - Decreasing transportation- walking/biking, public transit, if you have to drive don't speed up and slow down quickly, buy a hybrid, carpool
        - Smaller families
        - Voting for local and national officials that support green laws
        - Shop locally to reduce shipping of goods
    - Small things like: take shorter showers, use energy efficient light bulbs, don't use single use plastic, attend town meetings and vote on local changes like preserving land
    - Larger things like: becoming a city planner and designing net zero community, architect that designs green buildings, currently work toward making change at your school
- iPlan tutorial- Follow "Kira" tutorial
    - Create a map using the indicators above and send link to students
    - Have students open map and go through the "Kira" tutorial
        - Click the hamburger icon in the bottom left, click "tutorial"
    - Describe land use codes and give students a time to read each description
    - Click through each indicator
        - Indicators are real data we used on these topics to create the map database and will change based on how you change your land use
    - Give students time to read about each stakeholder and indicators

- Show how to change parcel and submit map and view stakeholder data
- Show how to submit a map and read stakeholder feedback
- Show stakeholder indicator graphs and how to set targets

Class 2: Run iPlan with the challenge:

You are a climate scientist working toward mitigating global warming. Create a land use plan that decreases greenhouse gasses by changing the land use of the parcels, while pleasing as many stakeholders as you can.

- Practice changing parcels in the map focusing on how land use changes cause indicators to change
- Reflection/ Share out on what worked and didn't work to cause indicators to change
- Run iPlan submitting maps to stakeholders
  - Show again how to submit map to stakeholders and remind the students the number of submissions is limited
  - Remind them they only have a certain number of chances for feedback, so don't do them all every time
  - Tell students they may take a screen shot of their map submissions so they can go back and remember what it looked like
- Pause class to show how to set targets on the indicator graphs

Class 3: Wrap up

- Finishing iPlan game and have students make their final map submission
- Have students take the survey
  - https://tinyurl.com/iplan2021survey
- Ask for volunteers to share their maps either in groups or with class
  - Talk about similarities and differences in each map
  - What was it like trying to please all the stakeholders?
  - How many were you able to please while decreasing GHG?
- Wrap up videos:
  - https://www.ted.com/talks/angel_hsu_cities_are_driving_climate_change_here_s_how_they_can_fix_it?utm_campaign=tedspread&utm_medium=referral&utm_source=tedcomshare
  - https://www.ted.com/talks/yvonne_aki_sawyerr_the_city_planting_a_million_trees_in_two_years?utm_campaign=tedspread&utm_medium=referral&utm_source=tedcomshare
- Review discussion questions as a class
  - How does land use affect climate change?
    - Identify two land-use codes that can have negative climate impacts on a community and explain why
    - Provide examples of three land use changes that can lead to climate change solutions and why
  - Explain what role plants have in climate change

Mass Audubon

Ecological Restoration

Theme: Restoration of degraded ecosystems is an important action to increase biodiversity and mitigate the impacts of climate change, and how land use plays a part.
Goal: To introduce students to the science of ecosystem restoration and why it's important to our understanding.
Objective:

- Define the term restoration and identify locations in the school yard that could undergo restoration in order to improve ecosystem health and habitat connectivity.
- Create a map that increases ecosystem function, specifically butterfly population, and connectivity while balancing community development needs.

LEM Scenario/End goals for map: You are an ecologist. Create a land use plan that restores ecosystem functions for the community. Specifically, increasing butterfly populations by changing the land use of the parcels, while pleasing as many stakeholders as they can.

Indicators Suggested:

- Greenhouse gas emissions
- Bird Population
- Butterfly Population
- Open Space Access
- Population

Class 1: Introduction to Restoration Ecology and iPlan

- iPlan is a game created by a team at the University of Wisconsin and Mass Audubon
- Introduce restoration ecology
    - What do you think of when you here "ecology"?
    - Ecology: Relationship of organisms to one another and to their physical surroundings
    - Do you know what ecological restoration is/involves?
        - Ecological restoration: renewing and restoring degraded, damaged, or destroyed ecosystems and habitats in the environment by active human intervention and action
        - Ex. Removing an old mill dam and restoring the river
        - "Ecological restoration aims to recreate, initiate, or accelerate the recovery of an ecosystem that has been disturbed. Disturbances are environmental changes that alter ecosystem structure and function. Common disturbances include logging, damming rivers, intense grazing, hurricanes, floods, and fires. Restoration activities may be designed to replicate a pre-disturbance ecosystem or to create a new ecosystem where it had not previously occurred. Restoration ecology is the scientific study of repairing disturbed ecosystems through human intervention."- Restoration Ecology by K.J. Vaughn

- Activity: Students go outside and assess the land use at the school/home
    - Assess what the land is being used for: building, open space, agriculture, residential
    - How much human impact is there?
    - What is the ecology of the school yard/backyard?
    - How can we increase pollinators at the school yard/ in your backyard? Can we restore an area by creating a new monarch habitat area?
        - Why is this beneficial?
            - Increase plant populations which helps grow the food chain
            - More green space = less temperature rise/less greenhouse gas emissions
            - Pollinations to make more flowers/fruit and attract more pollinators
        - What hurtles might we face trying to do that?
            - Time, money, would the board and principle/your parents agree or do they have something else in mind for the land, land availability
    - Brainstorm ideas of how to restore pollinators, specifically monarchs.
        - Draw/design elements of a restoration in groups
        - Share with the class
- iPlan tutorial- Follow "Kira" tutorial
    - Create a map using the indicators above and send link to students
    - Have students open map and go through the "Kira" tutorial
        - Click the hamburger icon in the bottom left, click "tutorial"
    - Describe land use codes and give students a few minutes to read each description
    - Click through each indicator
        - Indicators are real data we used on these topics to create the map database and will change based on how you change your land use
    - Give students time to read about each stakeholder and indicators
    - Show how to change parcel and submit map and view stakeholder data
    - Show how to submit a map and read stakeholder feedback
    - Show stakeholder indicator graphs and how to set targets

Class 2: Run iPlan with the challenge:

You are an ecologist. Create a land use plan that restores ecosystem functions for the community. Specifically, increasing butterfly populations by changing the land use of the parcels, while pleasing as many stakeholders as they can.

- Practice changing parcels in the map focusing on how land use changes cause indicators to change
- Reflection/ Share out on what worked and didn't work to cause indicators to change
- Run iPlan submitting maps to stakeholders

- Show again how to submit map to stakeholders and remind the students the number of submissions is limited
- Remind them they only have a certain number of chances for feedback, so don't do them all every time
- Tell students they may take a screen shot of their map submissions so they can go back and remember what it looked like
- Pause class to show how to set targets on the indicator graphs

Class 3: Wrap up

- Finishing iPlan game and have students make their final map submission
- Wrap up
  - Have students take the survey
    - https://tinyurl.com/iplan2021survey
  - Split students into groups to talk about similarities and differences in each map, then share as a class
  - Review discussion questions as a class:
    - How does land use affect a restoration project?
    - How does stakeholder input affect a restoration project?
    - How does the restoration of degraded landscapes help address climate change vulnerabilities that affect local communities?

Resources:

Restoration Ecology: https://www.nature.com/scitable/knowledge/library/restoration-ecology-13339059/
Conservation and Restoration Ecology: Crash Course
https://www.youtube.com/watch?v=Kaeyr5-O2eU
Habitat Restoration at NOAA: https://www.youtube.com/watch?v=uIbts7gms0Q
Mass DER Interactive Site Map https://www.mass.gov/service-details/the-division-of-ecological-restoration-project-map

Mass Audubon

Sustainability

Theme: Sustainability; use of alternative energy for clean air
Goal: Introducing students to alternative energy and how land use plays a role in clean air
Objective:

- Discuss sustainability, alternative energy, clean air related to alternative energy, GHG
- Identify two land-use codes that can have negative impacts on clean air
- Provide examples of three land use changes that can lead to clean air
- Explain what role alternative energy has in climate change

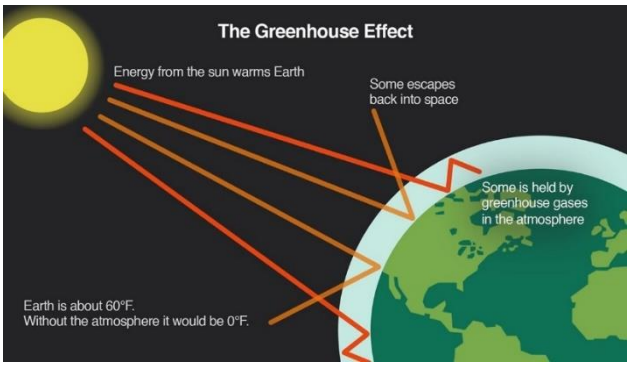
Scenario/End goals for map: You are an engineer working toward mitigating global warming by using alternative energy. Create a land use plan that decreases greenhouse gasses by changing the land use of the parcels, while pleasing as many stakeholders as you can.

Indicators Suggested:

- Heat Advisory Days
- Birds
- Greenhouse gasses
- Housing
- Population or sales

Class 1: Introduction to sustainability and introduction to iPlan

- iPlan is a game created by a team at the University of Wisconsin and Mass Audubon
- Describe sustainability
    - Avoidance of the depletion of natural resources in order to maintain an ecological balance
- Alternative energy
    - Avoid depletion of natural resources by creating energy through renewable sources rather than conventional. They have lower carbon emissions. Renewable sources are naturally replenished on a human time scale.
    - Have the students name some examples of alternative energy
        - Sun, wind, rain, tides, waves, geothermal heat
    - The most successful types of alternative energy that we use today are wind turbines and solar panels
- Why is it good to use alternative energy compared to conventional (coal, natural gas, oil)?
    - Produces no carbon or other pollutants into the air; clean air
- Greenhouse Gas:
    - A gas that contributes to the greenhouse effect by absorbing and then re-radiating infrared rays



- Carbon dioxide is a greenhouse gas (GHG)
- GHG contribute to global warming
- Alternative energy can help mitigate global warming because it doesn't produce these GHGs

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Class 2: Run iPlan with the challenge:

You are an engineer working toward mitigating global warming by increasing alternative energy. Create a land use plan that decreases greenhouse gasses by changing the land use of the parcels, while pleasing as many stakeholders as you can.

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  - https://www.ted.com/talks/angel_hsu_cities_are_driving_climate_change_here_s_how_they_can_fix_it?utm_campaign=tedspread&utm_medium=referral&utm_source=tedcomshare
- Review discussion questions as a class:
  - Identify two land-use codes that can have negative impacts on clean air
  - Provide examples of three land use changes that can lead to clean air
  - Explain what role alternative energy has in climate change

Mass Audubon

Urban Ecology

Theme: Urban ecology relating to birds
Goal: Introducing students to how different types of land use, urban and not urban, plays a part in ecology relating to birds
Objective:

- Discuss land use, ecology, urban ecology, bird ecology
- Create a map that increases bird population while balancing community development needs
- Define urban ecology and why it's important to understand it
- List two ways that land use is related to urban ecological issues
- Explain the role stakeholders have in how an urban landscape is developed

LEM Scenario/End goals for map: Create a land use plan that increases bird populations by changing the land use of the parcels, while pleasing as many stakeholders as you can.

Indicators Suggested:

- Birds
- Butterflies
- Greenhouse gasses
- Housing
- Population

Class 1: Intro to urban ecology and intro to LEM (Local Environmental Modelling) tool

- iPlan is a game created by a team at the University of Wisconsin and Mass Audubon
- What is one word you think of when you hear "ecology"?
    - What have you learned or do you know about urban ecology?
- Urban Ecology
    - What is urban ecology?
        - The relationship between living organisms and their surroundings in an urban setting
    - One word of an example of land zoned as urban
        - The urban land use refers to environments dominated by high-density residential and commercial buildings and paved surfaces
    - The goal of urban ecology is to achieve a balance between human culture and the natural environment
    - The study of urban ecology carries increasing importance because more than 50% of the world's population today lives in urban areas
    - We need to understand how animals survive in this type of habitat
    - Ask the students what ecological issues are caused by urban land use?
        - Decrease diversity in animals due to habitat removal
        - Increased greenhouse gasses
        - Urban heat island effect

        - Acid rain and pollution
        - (Explain each)
    - Migratory birds in urban habitats
        - How might urban habitats affect migratory birds?
            - Urban land use destroys their habitat, so they will know longer make cities their home
            - Heat in the city will change their migratory patterns; the time of year they migrate
- iPlan tutorial- Follow "Kira" tutorial
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    - Show stakeholder indicator graphs and how to set targets

Class 2: Run iPlan with the challenge:

Create a land use plan that increases bird populations by changing the land use of the parcels, while pleasing as many stakeholders as you can.

- Practice changing parcels in the map focusing on how land use changes cause indicators to change
- Reflection/ Share out on what worked and didn't work to cause indicators to change
- Run iPlan submitting maps to stakeholders
    - Show again how to submit map to stakeholders and remind the students the number of submissions is limited
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Class 3: Wrap up

- Finishing iPlan game and have students make their final map submission
- Have students take the survey
    - https://tinyurl.com/iplan2021survey
- Ask for volunteers to share their maps either in groups or with class
    - Talk about similarities and differences in each map

- What was it like trying to please all the stakeholders?
- How many were you able to please while still increasing bird populations?

- Wrap up video: https://www.ted.com/talks/noah_wilson_rich_every_city_needs_healthy_honey_bees?utm_campaign=tedspread&utm_medium=referral&utm_source=tedcomshare
  - Talks about urban ecology related to bees
- Review discussion questions as a class:
  - Explain the role stakeholders have in how an urban landscape is developed
  - How does land use affect climate change?
  - How does climate change affect migratory birds?

Resources:
https://pubmed.ncbi.nlm.nih.gov/29210224/

Urban Island Affects and Genetic Diversity

Theme: Urban Heat Island Affects and Genetic Diversity
Goal: Introducing students to how different types of land use relate to urban heat island affects
Objective:

- Discuss heat island affects, land use, natural corridors, genetic diversity
- Identify two land-use codes that can lead to urban heat island
- Provide examples of three land use changes that can lead to a natural corridor

LEM Scenario/End goals for map: You are an ecologist studying how urban islands affect genetic diversity in animals. Create a land use plan that decreases heat advisory days and impervious surfaces by changing the land use of the parcels, while pleasing as many stakeholders as you can.

Indicators Suggested:

- Heat Advisory Days
- Impervious surfaces
- Birds
- Butterflies
- Population

Class 1: Introduction to urban islands and natural corridors

- iPlan is a game created by a team at the University of Wisconsin and Mass Audubon
- Urban Islands and natural corridors
    - What is one memory you have of being particularly hot and not having the ability to cool down and where were you?
    - Heat islands are urbanized areas that experience higher temperatures than outlying areas. Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies.
    - How can we prevent a heat island from occurring?
        - Green corridor, conservation natural areas, urban parks
    - Green corridor is an area of habitat connecting wildlife populations separated by human activities or structures (such as roads, development, or logging).
    - What types of land use would cause a heat island?
    - What types of land use would create a green corridor?
    - Review websites as a visual for urban heat islands
        - https://www.climate.gov/news-features/features/detailed-maps-urban-heat-island-effects-washington-dc-and-baltimore
        - https://www.nationalgeographic.org/encyclopedia/urban-heat-island/
- Genetic Diversity
    - How might having heat islands affect the plants and animals that live there?
        - They will leave, not be able to grow/ live in the place they used to, migration patterns will change, become less diverse

- Informational video on climate change in cities: https://www.ted.com/talks/angel_hsu_cities_are_driving_climate_change_here_s_how_they_can_fix_it

Class 2: iPlan tutorial- Follow "Kira" tutorial

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Class 3: Run LEM with the challenge:

You are an ecologist studying how urban islands affect genetic diversity in animals. Create a land use plan that decreases heat advisory days and impervious surfaces by changing the land use of the parcels, while pleasing as many stakeholders as you can.

- Practice changing parcels in the map focusing on how land use changes cause indicators to change
- Reflection/ Share out on what worked and didn't work to cause indicators to change
- Run iPlan submitting maps to stakeholders
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Class 4: Wrap up

- Finishing iPlan game and have students make their final map submission
- Have students take the survey
    - https://tinyurl.com/iplan2021survey
- Ask for volunteers to share their maps either in groups or with class
    - Talk about similarities and differences in each map
    - What was it like trying to please all the stakeholders?
    - How many were you able to please while decreasing heat and impervious surfaces?

- Wrap up video: https://www.ted.com/talks/stefan_al_what_happens_if_you_cut_down_all_of_a_city_s_trees
- Review discussion questions as a class:
    - How does land use cause urban islands?
    - Identify two land-use codes that can lead to urban heat island.
    - Provide examples of three land use changes that can lead to a natural corridor.
    - How do urban islands contribute to climate change?
    - What can you do?
        - Top GHG decreasing habits are:
            - eating less meat and dairy, even just cutting out one day of no meat helps
            - decreasing food waste- meal planning, only taking what food you need, eat leftovers, compost
            - decreasing transportation- walking/biking, public transit, if you have to drive don't speed up and slow down quickly, buy a hybrid
            - smaller families
            - voting for local and national officials that support green laws

Water Quality

Theme: Restoring degraded ecosystems to improve water quality and to mitigate the impacts of climate change. Discuss how land use types improve water quality.
Goal: To introduce students to the science of ecosystem restoration relating to water quality and how land use plays a part
Objective:

- Discuss restoration, water quality, surface water runoff, phosphorous pollution and land use
- Create a map that increases water quality while balancing community development needs

LEM Senario/End goals for map: Create a land use plan that restores ecosystem functions for the community by increasing water quality. Specifically, decrease impervious surfaces and phosphorous pollution by changing the land use of the parcels, while pleasing as many stakeholders as you can.

Indicators Suggested:

- Greenhouse gas emissions
- Heat advisory days
- Phosphorous
- Impervious Surfaces
- Population

Class 1: Introduction to water quality compared to land use and introduction to iPlan

- iPlan is a game created by a team at the University of Wisconsin and Mass Audubon
- Water Quality
    - What have you previously learned about water quality?
    - What is one word you think of when you hear “water quality”?
    - Water quality: the condition of water relating to chemical and physical characteristics with respect to its suitability for purposes such as swimming and drinking
    - What causes poor water quality, examples?
        - Pollution
        - Surface runoff
        - Global warming- increased heat advisory days, increased water temperatures
            - warm water holds less dissolved oxygen (DO), so chemical reactions increase
- Water quality indicators on the map: phosphorous pollution and impervious surfaces
    - Phosphorous
        - Phosphorous is a common constituent of agricultural fertilizers, manure, and organic wastes in sewage and industrial effluent

        - When the levels of the chemicals phosphorous and nitrogen are too high in water they speed up eutrophication (a reduction in dissolved oxygen in water bodies caused by an increase of mineral and organic nutrients) of rivers and lakes
        - It is an essential element for plant life, but when there is too much of it in water it reduces the dissolved oxygen
        - Soil erosion is a major contributor of phosphorus to streams
    - Impervious surfaces
        - What do you think of when you hear "Impervious"
        - Impervious: not allowing fluid to pass through
        - more impervious surface=more runoff=more pollution/extra nutrients in a stream
        - As students for examples of impervious surfaces
            - Parking lot, buildings, paved roads, etc.
- Activity: Use tool to demo: https://runoff.modelmywatershed.org/
    - What surfaces increase surface runoff the most?
        - Decrease?
    - How does soil type/size influence surface runoff?
        - Size of the particles causes the ability for some soils to absorb more than others
    - Whats the difference between clay, silt, sand?
        - Size of the sediment particals
    - Which soil types do you think cause more runoff?
        - More permeable like sand, more infiltration; less permeable like clay, more runoff
    - What habitats would cause the least runoff?
        - Forests, wetlands, etc.
        - Why? What kind of surfaces do they have?
        - Wetlands and other habitat types, like forests, are valuable because they are great sponges for runoff and could be priority habitat types for restoration projects
- Scientists and community members take on restoration projects of wetlands such as rivers to improve water quality
    - Ecological restoration
        - Ecology- relationships of organisms to one another and their habitat
        - Renewing and restoring degraded, damaged, or destroyed ecosystems and habitats in the environment by active human intervention and action

iPlan tutorial- Follow "Kira" tutorial

- Create a map using the indicators above and send link to students
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Class 2: Run LEM with the challenge:

Create a land use plan that restores ecosystem functions for the community by increasing water quality. Specifically, decrease impervious surfaces and phosphorous pollution by changing the land use of the parcels in RI, while pleasing as many stakeholders as you can.

- Practice changing parcels in the map focusing on how land use changes cause indicators to change
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Class 4: Wrap up

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- Ask for volunteers to share their maps either in groups or with class
    - Talk about similarities and differences in each map
    - What was it like trying to please all the stakeholders?
    - How many were you able to please while still decreasing phosphorous pollution and impervious surfaces?
- Review discussion questions as a class:
    - How does land use and stakeholder input affect a restoration project (restoring the water quality)?
    - How does the restoration of degraded landscapes, in this case water quality, help address climate change vulnerabilities that affect local communities?

Resources:

Conservation and Restoration Ecology: Crash Course
https://www.youtube.com/watch?v=Kaeyr5-O2eU

Mass DER Interactive Site Map https://www.mass.gov/service-details/the-division-of-ecological-restoration-project-map

Restoration Ecology: https://www.nature.com/scitable/knowledge/library/restoration-ecology-13339059/

USGS: https://www.usgs.gov/special-topic/water-science-school/science/phosphorus-and-water?qt-science_center_objects=0#qt-science_center_objects