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Using a Case Study Approach to Teach Invasive Species and Climate Change

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i-LEARN TEACHING RESOURCES

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Using a Case Study Approach to Teach Invasive Species and Climate Change

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Abstract: In this teaching module, students will explore an emerald ash borer (EAB), its impacts on the ash trees, and how warming temperatures could affect EAB populations. The emerald ash borer is a green buprestid or jewel beetle native to north-eastern Asia that causes devastating disease in ash trees.

Lesson Description:

Grade Level: Grade 9-12
Estimated Time for Completing Activity: Two 45 minute class periods, or One 90 minute block
Learning Outcomes: • To identify trees affected trees affected by the EAB • To explore the life cycles of the EAB • To determine the growth hardiness of the EAB • To evaluate climate change data • To predict potential impacts of the EAB in the Midwest • To determine treatment options for trees affected by EAB
National Standards: • Science Content A: Science as Inquiry • Science Content D: Earth and Space Science
South Dakota Standards of Learning:
• FNR 1.1, FNR 1.2, FNR 2.1, FNR 2.2, FNR 2.5, FNR 4.1, FNR 4.3, WF 1.1, WF 1.2, WF 1.3, ANR 3., ANR 3.2, ITA 3.1 **Standards (Acronym definitions are at the end of this paper)** • **Next Generation Science Standards (NGSS: HS-LS2-1,** HS-LS2-6, HS-LS2-7, HS-ESS2-4, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-5; https://www.nextgenscience.org/**)**

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- **South Dakota Standards of Learning:** HS-ESS2-3, HS-ESS3-1, HS-ESS3-4, HS- ESS3-5, HS–LS2-2, HS-LS2-6, HS-LS2-7, HS-LS4-4, HS-LS4-5 (https://doe.sd.gov/contentstandards/documents/sdSciStnd.pdf)
- **Oceti Sakowin Essential Understandings and Standards (*https://indianeducation.sd.gov/documents/OcetiSakowinEUS.pdf*)**

  ESSENTIAL UNDERSTANDING 1: Grade 9-12, Indicator 1 and 3; definitions on the last page)

Oceti Sakowin Essential Understandings and Standards

Prerequisite: A general understanding of invasive species, basic plant form and function.

Materials:

- Case Study
- Internet access to reach primary documents

Vocabulary:

- Invasive species
- Climate
- Weather
- Larva

Lesson Links:

- http://msue.anr.msu.edu/uploads/files/e2942.pdf
- https://plants.usda.gov/core/profile?symbol=FRPE
- https://hort.uwex.edu/articles/my-ash-tree-worth-treating-emerald-ash-borer/
- https://ento.psu.edu/extension/trees-shrubs/emerald-ash-borer/factsheets/EAB2955.pdf
- http://www.myminnesotawoods.umn.edu/2014/01/will-winter-cold-save-us-from-emerald-ash-borer/
- https://hortnews.extension.iastate.edu/2014/01-17/eab_supercooling.html
- https://blogs.mprnews.org/updraft/2014/01/extreme-cold-may-wipe-out-high-percentage-emerald-ash-borer-larvae/
- https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5191794.pdf

Background: Emerald ash borer (EAB), a species of metallic wood boring beetle is an introduced invasive insect species to the United States, responsible for devastating disease of ash trees. It is native to east Asia and was accidentally introduced to Detroit area in 2002. The EAB is expanding its range, perhaps due to climate change processes and recently been reported in Eastern South Dakota. Through this lesson, students learn problem-solving skill through engaging themselves in studying scientific processes affecting a contemporary issue related to global change.

Procedure:

1. Prior to this lesson, students will watch the YouTube video on EAB, available at https://www.youtube.com/watch?v=100k0pRJc5g
2. Pass out the case study. Supporting information can be provided to students via Google Classroom, Schoology, email, printed out, or have them seek information independently.
3. Assist as needed.

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4. Provide internet access for document and prepare extended activity.

Conclusion:

1. Students will complete the worksheet embedded in the case study.

Extensions: Select an additional invasive species and write a research paper or create a presentation on the impacts of the chosen invasive species on the environment and how climate change affects the invasive species

Teacher Notes:

Link/Document references & resources for each section of the case study:

i. Tree Identification
- http://homeguides.sfgate.com/fast-ash-trees-grow-53147.html
- https://treedoctor.msu.edu/ash/ashtree_id
- http://msue.anr.msu.edu/uploads/files/e2942.pdf

ii. Problem Identification
- http://www.ksfy.com/content/news/Emerald-Ash-Borer-infestation-confirmed-in-Sioux-Falls-was-only-a-matter-of-time--482241811.html
- https://www.argusleader.com/story/news/2018/05/09/ash-quarantine-place-destructive-insect-invades-sioux-falls/595507002/
- http://www.siouxfalls.org/parks/forestry/ash-borer

iii. Insect Identification & Information
- https://www.arborday.org/trees/health/pests/emerald-ash-borer.cfm
- http://www.siouxfalls.org/parks/forestry/ash-borer
- http://www.emeraldashborer.info/documents/eab_id_guide.pdf

iv. Insect Cold Hardiness
- http://www.myminnesotawoods.umn.edu/2014/01/will-winter-cold-save-us-from-emerald-ash-borer/
- https://hortnews.extension.iastate.edu/2014/01-17/eab_supercooling.html
- https://blogs.mprnews.org/updraft/2014/01/extreme-cold-may-wipe-out-high-percentage-emerald-ash-borer-larvae/

v. Climate Information (graphs/charts from iLEARN resources)

vi. EAB Treatment Options
- https://hort.uwex.edu/articles/my-ash-tree-worth-treating-emerald-ash-borer/
- https://ento.psu.edu/extension/trees-shrubs/emerald-ash-borer/factsheets/EAB2955.pdf

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Assessment:

1. Questions within the case study (see below) serve as the assessment.

Invasive Species and Climate Case Study

A. *As a South Dakota homeowner, you have several trees on your property including a mid-sized deciduous with diamond-patterned bark. The tree was planted shortly before you bought the property 20 years ago and can grow up to 60' tall. Visit this plant fact sheet at* https://plants.usda.gov/factsheet/pdf/fs_frpe.pdf *for the plant features. The tree has mostly opposite branches with compound leaves featuring 5-11 leaflets with smooth or gently toothed margins. You begin to notice some dead branches at the top of the tree, and more woodpeckers in the area and specifically on this tree. The birds have caused some flecking of the bark, or missing strips, and there are vertical cracks. In addition, you might spot tiny D-shaped holes in the bark.*
   i. Identify the tree species of concern:

   ii. Brainstorm three problems that could be causing the symptoms you observe:

   iii. What are two possible next steps you could take to determine the problem facing your tree?

B. *The next week you find the attached/linked articles in your local newspaper. Read and utilize this information for the questions below.*
   i. Based on this new information, what problem do you think your tree has? How do you come to this conclusion?
   ii. Find and list two different reliable sources of information you can use to help find information about this pest? How do you know they are reliable?

C. *Using your resources identified in #5, and others provided by your teacher, complete the following information about this pest.*
   i. What is the scientific name of the pest inhabiting your tree?
   ii. Typically, what color are the adult insects? How big are they?
   iii. What is the best way to identify whether an insect is an EAB or something similar?
   iv. When do the adults typically emerge from the tree?
   v. At what stage of life does the insect cause the most damage to the tree? Explain what they do.

D. *Your local SDSU Extension Educator directs you to the attached/linked documents to help understand this pest and the research that has been done so far. Use these documents to help answer the questions below.*
   i. What research has been done on the cold hardiness of this pest? Summarize the

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information you find.

ii. The research suggests warmer winter weather may have what type of impact on this insect and its survival?

iii. Do you think cold winters would be enough to stop this insect from spreading across the region? Why or why not?

iv. Based on your knowledge of other organisms, what is a possible outcome if only cold hardy insects are able to live and reproduce? Provide an example you are familiar with.

E. *Intrigued by this new information, and wanting to understand as much as possible to protect the trees on your property, you continue this line of questioning. Use the graphs below to help answer the following questions.*

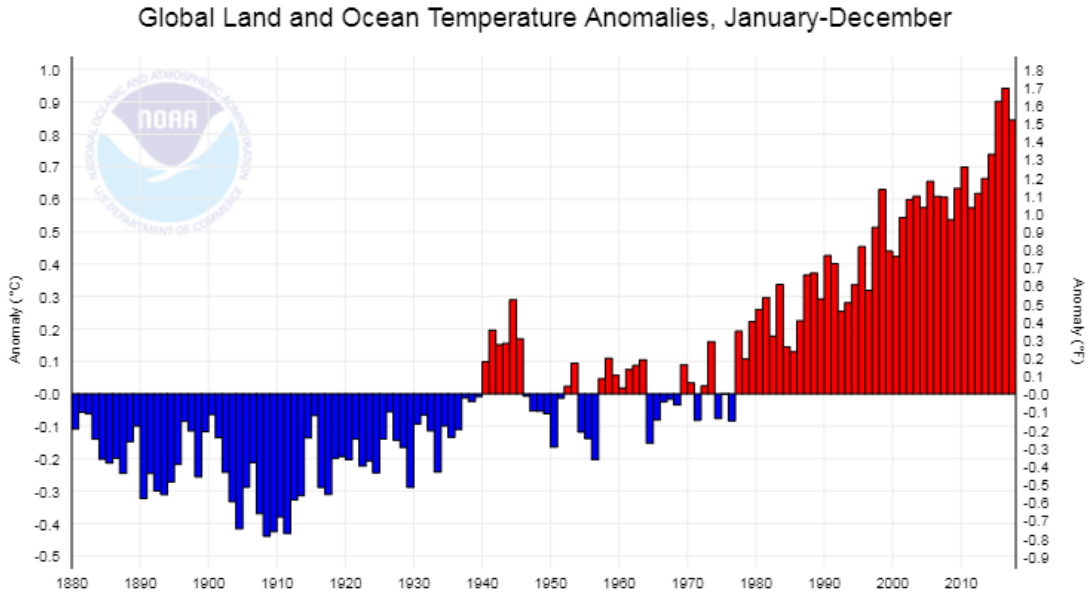

Figure 1 *- Global Land and Ocean Temperature Anomalies (Image credit: National Centers for Environmental Information (NCEI).*

i. Describe the relationship between the two graphs shown above.

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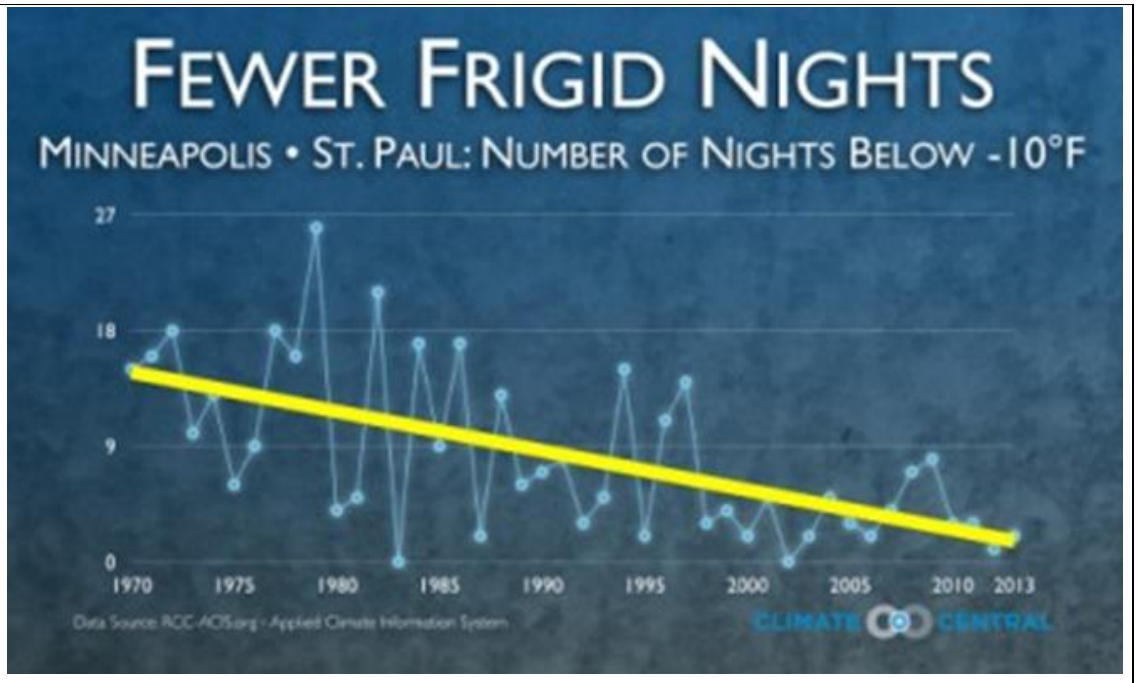

Figure 2 *- Number of frigid nights in Minneapolis/St. Paul (*Image Credit*; http://www.climatecentral.org/ipcc-roundup-2*

ii. Based on the data shown above, how has the global climate changed over the last century?

iii. Based on what you know about the hardiness of the insect bothering your tree, how does the change in temperatures affect its population?

F. *With a better understanding of the threat to your specific tree and others in the region, you start exploring your options. Using the resources you identified in #5, as well as those attached/linked, determine how you will move forward.*

i. Is it possible to save your tree once this pest is detected? yes / no

ii. Describe two different options for a homeowner to treat their tree without hiring a professional service.

iii. Many homeowners and municipalities cut down infected trees to prevent the spread of this pest, rather than treating the trees. What will you choose to do with your tree? Explain how and why you come to that decision.

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Standards

National Standards: Next Generation Science Standards (NGSS: HS-LS2-1, HS-LS2-6, HS-LS2-7, HS-ESS2-4, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-5; www.nextgenscience.org; definitions on the last page**)**

- HS-LS2-1: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions; but changing conditions may result in a new ecosystem.
- HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-ESS2-4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
- HS-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- HS-ESS3-3 Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- HS-ESS3-5 Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

South Dakota Standards of Learning: HS-ESS2-3, HS-ESS3-1, HS-ESS3-4, HS- ESS3-5, HS–LS2-2, HS-LS2-6, HS-LS2-7, HS-LS4-4, HS-LS4-5 (Available at https://doe.sd.gov/contentstandards/documents/sdSciStnd.pdf)

- HS-ESS2-3 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
- HS-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- HS- ESS3-5 Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
- HS–LS2-2 Use mathematical representations to support and revise explanations based on evidence about IE affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms under stable

conditions; however, moderate to extreme fluctuations in conditions may result in new ecosystems.

- HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-LS4-4 Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
- HS-LS4-5 Evaluate the evidence supporting claims that changes in environmental conditions may result in:
    - increases in the number of individuals of some species
    - the emergence of new species over time
    - the extinction of other species

Oceti Sakowin Essential Understandings and Standards
(https://indianeducation.sd.gov/documents/OcetiSakowinEUS.pdf)

ESSENTIAL UNDERSTANDING 1: The original land base and natural resources of the Oceti Sakowin were under communal stewardship prior to immigrant settlement. The Oceti Sakowin tribes have a distinct and unique interrelationship with the environment that contributes to South Dakota.

- Indicator #1: Analyze the land base and natural resources of the nine reservations in South Dakota
  Standard: Students are able to identify the physical geographical changes to explain the causes that impacted the land base and boundaries.
- Indicator #3: Evaluate the strategies in which the tribal governments and other leaders are taking action to improve the lands and natural gifts.
  Standard: Students are able to identify and explain how a tribal government manages the ecosystem and its natural gifts.

Reference:

- http://msue.anr.msu.edu/uploads/files/e2942.pdf
- https://plants.usda.gov/core/profile?symbol=FRPE
- https://hort.uwex.edu/articles/my-ash-tree-worth-treating-emerald-ash-borer/
- https://ento.psu.edu/extension/trees-shrubs/emerald-ash-borer/factsheets/EAB2955.pdf
- http://www.myminnesotawoods.umn.edu/2014/01/will-winter-cold-save-us-from-emerald-ash-borer/
- https://hortnews.extension.iastate.edu/2014/01-17/eab_supercooling.html
- https://blogs.mprnews.org/updraft/2014/01/extreme-cold-may-wipe-out-high-percentage-emerald-ash-borer-larvae/
- https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5191794.pdf
- http://www.emeraldashborer.info/infested-trees.php

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