



Digital Preservation of Natural and
Cultural Resources
ND EPSCoR Lesson Plan

Lesson Title: Digital Preservation of Natural and Cultural Resources

Lesson Overview:

The lesson will allow students to analyze their community and see how natural features have changed overtime and how cultures try and preserve them.

Lesson Objectives:

- Use digital tools to analyze present and past landscapes
- Analyze how the environment can affect natural and cultural resources
- Understand how digital tools can help preserve natural and cultural landscapes

NSF Subject Classification: Technology

National Next Gen Standards:

- HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
- HS-ESS2-2 Earth's Systems: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- HS-ESS2-7 Earth's Systems: Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
- HS-ESS3-1 Earth and Human Activity: 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.

North Dakota Standards:

- HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
- HS-ESS2-2 Earth's Systems: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- HS-ESS2-7 Earth's Systems: Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
- HS-ESS3-1 Earth and Human Activity: 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.

Grade or Grade Band: 7-12

Time Needed (estimate) 2-3 50-minute class periods

Lesson Author: Jessi Kjemhus

Teaches 7-12 science at Northwood Public School since 2015 and 9-12 science at North Border Public School prior. She graduated in 2012 with a Composite Chemistry degree from Mayville State University and then with her Master's from Valley City State University in 2015. She can be contacted at jessi.kjemhus@northwoodk12.com

Scientist/K12 Collaborator & University: Stephanie Day, NDSU

Scientist Bio/Research: My research focuses on understanding how humans shape the environment. I specialize in using lidar and terrestrial laser scanning to understand how landscapes change. My research is highly interdisciplinary and I enjoy working with archaeologists, engineers, artists, architects, and natural resource scientists.

Preparation/Materials

Background knowledge students must have to be successful

- Students will need a background of how the environment can change either by nature or human activity.
- Students will need a background about changes in societies and what may cause them.
- Students will need a background in chemical weather and erosion

Essential Terminology

- Environment- the natural world, as a whole or in a particular geographical area, especially as affected by human activity
- Natural resources- materials or substances such as minerals, forests, water, and fertile land that occur in nature and can be used for economic gain.
- Culture- the customs, arts, social institutions, and achievements of a particular nation, people, or other social group.
- Preservation- the action of protecting or maintaining something.

Resources

- Preserving African Heritage
- Preserving Global Sites
- Preserving the Smithsonian
- Fighting against the loss of cultural heritage
- Word Cloud

Websites:

- <https://www.ndepscor.ndus.edu/ndep/nature/sunday-academy/stem-module-topics/>
- <https://aerial.swc.nd.gov/>
- <http://www.zamaniproject.org/>
- <http://www.lib.usf.edu/dhhc/>
- <https://3d.si.edu/>
- <https://www.globalexplorer.org/>
- <https://www.wordclouds.com/>

Materials needed:

Lesson 1

- Computer and Projector for Teacher
- Student computer

Lesson 2

- Note cards (stack for each group)
- Student Computer

Lesson 3

- Structure from Motion (SfM) and Terrestrial Laser Scanning (TLS) from NDSU
- Student Computer
- Optional: Legos, Model Magic, Play Dough, Lincoln Logs, popsicle sticks- anything for students to make a model of something important culturally to them

PowerPoint – found as separate attachment

Procedure/Activities

Lesson 1: If having website or download issues with Activity 1, an option is using Google Maps to see current conditions and Google Search for what feature had looked like.

- Slide 1-4
 - Hand out Activity 1 sheet
 - Recommend going through a different location to show students what to do
- Discuss different things they noticed and changes seen

Lesson 2:

- Go over vocab words
- Hand out Activity 2- slide 5 and 6
 - Give groups note cards
 - Allow for 2-5 minutes for them to write on them. Share a few of them.
 - Pair up groups together and have them create a word cloud
 - Share them with the class
- Slide 7
 - Give students time to work, 5-10 minutes, then share some of what the groups came up with
- Slide 8
 - Give students 5 minutes to work then share what the groups came up with
- Slide 9
 - Give students 5 minutes to work then share what the groups came up with
- Slide 10-11
- Loss of cultural sites research in the extension if time allows or want to add it

Lesson 3: There are two options for this activity based on materials available.

- Hand out correct Activity 3 option
 - Slides 12-14
 - Give students 10-15 minutes to work then go through slides 13 and 14
- Slide 15 and introduce next project based on option you choose
 - Project campaign could be something quick or turned into an in-depth project, or cross-curricular project with a history or computer class
- Slide 16
 - Give groups a chance to discuss then discuss as a class

Extensions for above average students:

- Research loss of a cultural site

- Describe the cultural background and importance behind it.
- Why is it degrading/or why it was ruined?
- Ways to prevent it from being destroyed if it is still around? What could have been done differently before it was destroyed?
- How can we preserve its memory so it isn't lost for future generations?

Mediation/Support for students that need it:

- Step by step instruction for activities
- Frequent check-ins

Lesson Outline (for research-based lessons)

- 1) Observe Phenomena
- 2) What questions should we be able to answer?
- 3) Write a Hypothesis
- 4) Come up with a Research Plan
- 5) Carry out investigation
- 6) Revisit the Background Research
- 7) Construct Explanations. (TASKS-Publish/Communicate Findings)

Standards Alignment

ND Science Standard(s):

- HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-ESS2-2 Earth's Systems: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- HS-ESS2-7 Earth's Systems: Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
- HS-ESS3-1 Earth and Human Activity: 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.

Disciplinary Core Idea: e.g. Technology

North Dakota DPI Standards:

ND ELA

- W.7 Conduct short as well as more sustained research projects to answer questions (including self-generated questions) or solve problems.
 - Develop a research question.
 - Narrow or broaden the inquiry when appropriate.
 - Synthesize multiple source
- SL.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest

ND Technology Standards

- Computing in Society- Past, present, and possible future impact of technology on society
- 10.A.1 Curate relevant information from digital resources using a variety of tools and methods.

ND History Standards

- SOC.6_12.1-2.D2.1 Define and provide examples of culture.
- SOC.6_12.1-2.D2.2 Explain the relationship between culture and society. Ethnocentrism vs. cultural relativism, culture shock, values and beliefs Family, school, government, religion, economy, social statuses, roles SOC.6_12.2 Practically apply concepts of sociology.
- SOC.6_12.1-2.D2.3 Explain important institutions in society. Historical context of social change, countercultures, social movements

Next Gen Standards:

- HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
- HS-ESS2-2 Earth's Systems: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- HS-ESS2-7 Earth's Systems: Construct an argument based on evidence about the simultaneous

coevolution of Earth's systems and life on Earth.

- HS-ESS3-1 Earth and Human Activity: 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.

Science and Engineering Practices

- Developing and Using Models

Cross Cutting Concepts

- Much of science deals with constructing explanations of how things change and how they remain stable.
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
- Much of science deals with constructing explanations of how things change and how they remain stable.
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Unit Objectives

- Students will analyze aerial photos to see how both natural and cultural environments change a community and land around it.

Assessment

- Students will examine aerial photos to compare how a community has change and express how preservation of a cultural and the environment can occur.

Daily Plans and Assessments

Learning Target for each day/activity

- Lesson 1/Day 1- Students will learn to carry out a digital search for aerial photos of a selected area
- Lesson 2/Day 2- Students will learn about the culture behind features a place has
- Lesson 3/ Day 3- Students will see how through technology, cultural and natural resources that are disappearing can be preserved

Criteria for Success/Assessment for each activity

- Lesson 1- Students analyze collected photos for a specific area
- Lesson 2- Students analyze different cultural practices and view points people may have for an area
- Lesson 3- Students explain how preservation takes places for different cultures and natural resources

Additional Lesson Resources / Materials

References:

Day, S. "Digital Preservation of Natural and Cultural Resources". Web. 6 July 2020.
<https://www.ndepscor.ndus.edu/ndep/nature/sunday-academy/stem-module-topics/>

Websites for purchasing materials

If need general supplies:

Nasco

<https://www.enasco.com/c/Education-Supplies/Science>

Flinn

<https://www.flinnsci.com/>

Carolina

<https://www.carolina.com/lab-supplies-and-equipment/science-lab-supplies/science-lab-classroom-supplies/10300.ct>

School Specialty

<https://www.schoolspecialty.com/science-supplies-and-products>

Amazon

www.amazon.com

Activity 1 – Aerial Photographs

Students will download aerial photographs for their community from different times and examine them either in ArcGIS or simply as photographs on their computer. Students will have time to examine the photographs on their own and will be encouraged to look for what has changed through time, what is new, what is missing, etc.

Materials:

- Computer

Finding and Examining Historic Aerial Photographs

- Go to this site: <https://aerial.swc.nd.gov/>
- Find your community and zoom to the area you are most interested in exploring



- Go to the polygon tab and click on each corner of the area you are interested in to draw a polygon. If you make a mistake simply click the “Reset Drawing” button.
- Click “Query in Polygon” Below the photographs from your polygon will show up.
- Select “Download all air photo projects within your drawn polygon” and a list of all photographs will show up. Select the photographs you would like to examine and download them.

Examining Aerial Photos in ArcGIS

- Open

Open ArcMap on your computer.

- Click

Click to open ArcCatalog

- Click

Click and link to your downloads folder

- Find

Find the photographs you downloaded and drag them into the map area

- Use

Use to explore your photographs

1. What are the main differences you are finding among the pictures?
2. What could be the reasons behind these changes?

Activity 2 – Identifying Cultural Resources Teacher Notes

Materials

- Note cards
- Student computer

Students will be given a stack of note cards and encouraged to think about what they value most in their community, and what makes their community special. Students will be encouraged to think of specific places or items that they value. To initiate their thinking on this we will remind them to think about what places they looked for in the aerial photographs, we are likely to look at those places we value most first. Students will be given ~2 minutes to complete this task.

Students will then organize their cards by the places they mentioned. This will ensure that a place isn't miscounted simply because it is not described with the same language. Students will be given ~2 minutes for this activity. After this somebody assisting that day could enter all the places into a word cloud creator to generate a word cloud showing the places and things that are valued. Those mentioned many times will be shown as larger. Because a word cloud generator works by mentions of a given word each place will need to be entered into the text as many times as it is mentioned in the card, this can be done simply with copy and paste. As these data are being entered, we will discuss community vs personal values and how culture varies in time and space. Students will be encouraged to reflect on what places or things were mentioned most and why some places were only important to one or very few people while others are widely viewed as a valuable community resource. Students will then be asked to consider what resources their parents or grandparents might value most or consider community resources. We will discuss how these are similar or different from their own values. We will emphasize that personal values and culture do not always align, yet both are important and both should be considered worth protecting. After this discussion students should be able to examine the word cloud generated, and after the first group they will have the opportunity to compare with other groups across the state to see how things vary.

After this discussion students will receive a brief presentation about the loss of cultural resources in ND, North America, and around the world due to natural and anthropogenic effects.

Activity 2 – Identifying Cultural Resources

Materials

- Note cards
- Student computer

Think about what you value most in your community, and what makes your community special. Try and think of specific places or items that you value. Reflect on what you saw in the aerial photographs. We are likely to look at those places we value most first.

- *What resources in your community do you value?*
 - What makes your community special?
 - What places or things do you miss when you are gone?
 - If you need help thinking of something, start with the places you looked for with the aerial photographs.

Take about 2 minutes, use as many cards you need.

Join with other groups and go over your cards, make a list of what is valued and create a word cloud (<https://www.wordclouds.com/>) and share with the class. If you have the same words, add them multiple times to the list for your word cloud.

Culture is, by definition, a set of collective values. Our values reflect both our culture and our personal experiences.

- What resource mentioned reflects a cultural value?
- Why might these be culturally important compared to those places that are primarily personally valued?

Cultural changes through time

- What are those things you might expect your parents or grandparents to most value?
- How are these the same or different from your values?

Cultural changes through space

- How might values differ across the state?
- How might values differ across the country?

Activity 3 – Digital Preservation Teacher’s Notes

Materials:

- Structure from Motion and Terrestrial Laser Scanning if available from NDSU
- Optional: Legos, Model Magic, Play Dough, Lincoln Logs, popsicle sticks- anything for students to make a model of something culturally important to them
- Computer

This section will begin with a brief presentation on how we can preserve cultural resources and will highlight groups and places that are doing this. This will also remind students of the vast online resources that allow them to explore areas that may be difficult to reach. We will discuss traditional methods including all forms of art that capture elements of culture, and photographs that can help preserve a place at a specific moment in time. We will then highlight some of the modern methods including Structure from Motion (SfM) and Terrestrial Laser Scanning (TLS). We will highlight how both methods work, as well as the benefits and limitations of each method.

After the presentation students will have the opportunity to create a SfM and a TLS model. Students will work on groups of 2-4 depending on the class size. Each group will select something to build an SfM model of. These will ideally be supplied by the college and will be culturally relevant items. The basic technique of taking photographs from a variety of angles will be explained so students can begin working on this process. Students will learn how shadows impact their model, and the need to reference points in each photograph. As the groups begin working on an SfM model of their object, one group at a time will use the TLS scanner to take one scan of the classroom. This will give each student an opportunity to use the scanner. The TLS group will then take the data they collected and upload it to a central computer and will have the opportunity to explore the point cloud they helped make. They will be able to see where shadows exist and can help to suggest the next scan location. After students collect sufficient data from their SfM models they will begin to build their models using Agisoft Photoscan. Students will be encouraged to make a model with a medium to low resolution to ensure that they can complete the process.

After TLS data have been collected by each group the final model will be built using all the data. This will be done as a group to save time. The process of building the model will be quickly demonstrated as students take a break from the model they are working on. As the computer is doing what it does students can keep working on their own models. Once the process is complete each group will have an opportunity to manipulate the TLS model.*

Wrap-Up & Discussion:

The wrap-up will be focused on a discussion of what technique would be best for preserving the site identified as the most valued community resource. We will discuss what should be considered for the site, what obstacles might exist, what other technologies might be helpful. Finally, we will create a plan for a digital perseverance campaign.

*Option 2: If SfM and TLS are not available, an option would have students create a model from the town, something culturally important to them, or a historical monument. Provide background about it, what geological or human activity is affecting this monument. What techniques can be used to save the monument. Make a campaign for it.

Activity 3 – Digital Preservation Option 1

Materials:

- Structure from Motion and Terrestrial Laser Scanning
- Computer

Research: Structure from Motion and Terrestrial Laser Scanning.

What is there difference between the two?

Next research the following:

- Preserving African Heritage: <http://www.zamaniproject.org/>
- Preserving Global Sites: <http://www.lib.usf.edu/dhhc/>
- Preserving the Smithsonian: <https://3d.si.edu/>
- Fighting against the loss of cultural heritage: <https://www.globalexplorer.org/>

With your group and make a model of one of the objects in the room, or something culturally important to them, or a past historical monument.

- Things to remember:

Your equipment cannot see past a solid surface, try to get data from all angles to avoid shadows
Capture at least three reference points in each picture

1. How would you digitally preserve the site you decided was most important?

2. What obstacles should you consider?

3. Are there other technologies that would help?

Now.... create a plan for a digital perseverance campaign.

Provide background about it, what geological or human activity is affecting this monument.

What techniques can be used to save the monument. Make a campaign for it.

Activity 3 – Digital Preservation Option 2

Materials:

- Optional: Legos, Model Magic, Play Dough, Lincoln Logs, popsicle sticks- anything for students to make a model of something culturally important to them
- Computer

Research: Structure from Motion and Terrestrial Laser Scanning.

What is there difference between the two? How are they used?

Next research the following:

- Preserving African Heritage: <http://www.zamaniproject.org/>
- Preserving Global Sites: <http://www.lib.usf.edu/dhhc/>
- Preserving the Smithsonian: <https://3d.si.edu/>
- Fighting against the loss of cultural heritage: <https://www.globalexplorer.org/>

1. How would you digitally preserve the site you decided was most important?

2. What obstacles should you consider?

3. Are there other technologies that would help?

Now.... create a plan for a digital perseverance campaign.

Provide background about it, what geological or human activity is affecting this monument.

What techniques can be used to save the monument. Make a campaign for it.