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# K-12 Partnership Lesson Plan

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***BEST Plot Landscape Protocol***

*Landscape Legacy Application*

## Overview

Understanding the landscape surrounding our school districts, cities, and homes can help us understand how the landscape is impacting our local environment and watershed. This lesson uses the Google Earth application to gain a better understanding of how a parcel of land has changed through time. This exercise offers a unique opportunity for any classroom to take part in BEST plot research even if BEST plots are not present or accessible.

**Objectives**

At the conclusion of the lesson, students will be able to:

* Develop a better understanding of how the land surrounding the school district, or area of interest, has changed through time
* Use Google Maps, read maps and satellite images, and recognize Michigan landscapes/landforms

**Length of Lesson**

30 minutes, but can be extended to two class periods when the Landscape Legacy lesson is coupled with the small- and large-scale BEST plot protocols.

**Grade Levels**

5th – 12th grade (Notes for grade-level appropriate content or extension are noted throughout lesson plan).

**Standards covered (NGSS)**

Disciplinary Core Ideas:

* **MS-ESS2-2**: construct an explanation based on evidence for how geosciences processes have changed Earth’s surface at varying time and spatial scales
* **MS-ESS3-4**: construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems

Cross Cutting Concepts:

* Patterns
* Scale, proportion, and quantity
* Stability and change of systems

Science and Engineering Practices

* Asking questions and defining problems
* Planning and carrying out investigations
* Engaging in argument from evidence

***Previous Michigan Standards Met:***

* **E1.1A**: Generate new questions that can be investigated in the laboratory or field.
* **E1.1B:** Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.
* **E1.1C**: Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).
* **E1.1D**: Identify patterns in data and relate them to theoretical models.
* **E1.1E**: Describe a reason for a given conclusion using evidence from an investigation.
* **E1.1f**: Predict what would happen if the variables, methods, or timing of an investigation were changed.
* **E1.1g**: Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation.
* **E1.1h**: Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.
* **E2.4B**: Explain how the impact of human activities on the environment (e.g., deforestation, air pollution, coral reef destruction) can be understood through the analysis of interactions between the four Earth systems
* **E3.p1A**: Explain the origin of Michigan landforms. Describe and identify surface features using maps and satellite images.

**Materials**

* Prezi Presentation conceptualizing the overall BEST Plot Research Network and how the Landscape Protocol and Landscape Legacy Application fits into the overall network. Log in to Prezi with Username: nalleyja@msu.edu Password: GK12algae.
* Short PowerPoint presentation on using Google Earth
* Printed off images of the landscape of interest (ex. School, homes, businesses, etc.) from 3 different time periods from Google Earth
* 10x10 square grids on overhead projector sheets (or 20x20 depending on how in-depth you desire)
* Download Google Earth
* Colored Expo Markers
* Large Scale Landscape Rubric to show what color corresponds to what category of land-use

**Background**

The human population has a noticeable impact on our natural environment. This impact has, through time, increased exponentially as the number of humans continues to balloon. Monitoring environmental changes on a small temporal scale (weeks or a single year) may be very unfruitful, but if we focus our attention on larger changes in time (decades, centuries) it becomes quite easy to recognize how we are impacting our environment.

Here we aim to give students the tools (and technology) to pick a piece of land, such as their school district or even their personal neighborhoods, and like a zombie warbler, travel through time monitoring how the landscape has changed. Using Google Earth, we can snapshots of a single landscape spanning several decades and with our grid system classify and quantify the makeup of the landscape at each point in time. We can then conclude with comparing how the landscape makeup has changed through time through constructing a simple bar plot (see example below).

### Activities of the session

The Best Plot Overview**:**

*Open Prezi, and select BEST Plot Protocol Conceptualization.*

1. Introductory slide
2. On The Surface – Shows a broad overview of the objectives hoped to be realized through the BEST Plot Network
3. Under the Surface – Shows all the different protocols that must be performed such that we gain all the necessary data to begin answering our main question, “Can we grow our fuel and have our flowers and butterflies too?”
4. Fertilization Protocol – A GK-12 Fellow performs this protocol.
5. Biomass and Biodiversity Protocol – Plant Biomass, Plant Biodiversity and Insect Biodiversity are all protocols that must be performed once a year. All protocols are laid out in detail in the BEST plot binders.
6. Soils Protocol – All performed once a year, and again they are laid out in the BEST plot binders.
7. Landscape Protocol – Large Scale and Small Scale are both integral in our understanding of how the landscape influences our plots.
8. Large Scale – Depicts the steps of the large scale protocol.
9. Data from the Large Scale – As an example of what the landscape could look like.
10. **LARGE SCALE LEGACY – Returned to later**
11. Small Scale Protocol – Shows an overview of the small-scale protocol (laid out in the BEST plot binders)
12. Small scale example of the data collected from the small scale protocol.

Landscape Legacy Outline

*\*\*Suggestion, perform steps 1-9 prior to starting the lesson so you have available copies to provide the students of the area of interest you have chose to work with. Still perform steps 1-9 in front of the classroom with the students, but have the copies available after completing this step with students.*

1. Open the PowerPoint written for the Landscape Legacy protocol
2. Open Google Earth, and type in an address of interest.
3. In the bottom right corner, zoom until the view is set to an interesting altitude (ex. Eye Altitude: ~ 1500-2500ft)
4. Find an area of interest that has been documented through several past decades, such that a significant landscape change can be observed through time. This can be located in the top left corner of the Google Earth application (see PPT slide). Scroll back and forth to see the change through time.
5. Print the images at the different times of interest.
6. An example of a large change through time.
7. An example of a large change through time.
8. An example of a large change through time.
9. Land Use Changes through time. This shows an example of how the land use changed over a period of 60 years. In this instance we see that the land went from being dominated by grassland to highly developed over these 60 years.
10. The final step is to perform the large-scale landscape protocol as outlined in the BEST plot binders.
* Place transparent grid on top of the Google Earth image. (Can be a 10x10 grid or for more advanced students 100x100 is also an option)
* Classify the land cover category that fill the majority of the square (does not have to fill 100% of the square just a majority of the square)
* Locate the corresponding color assigned to that land cover category and fill in the square with the appropriate color.
* Perform this procedure on all of the available squares until all have been filled with a color.
* Simply add up the fill squares by color.
* Perform this procedure on all past and present images that you have captured and insert all of the data into an Excel spreadsheet.
* Utilizing Excelʼs plotting features, construct a bar plot for each time frame to illustrate change in land cover through time (see graph below as an example).



Follow Up Questions After the Activity:

1. Are there any noticeable changes that you can see from looking at the plot we generated?
2. What land use category increased the most through time? Decreased the most?
3. Can you think about what a plot would look like in 50 years? 100 years?
4. In this example, we see that agricultural related land decreased by 30%, but we also see that developed areas increased by 70%. Can you think of some technological changes that have take place in the past 60 years that have allowed us, as a race, to decrease our agricultural land use but still feed the growing number of humans on the planet?

There are many more questions that can be developed from your collected data, so it may be a good idea to complete the protocol prior to performing the activity to properly prepare questions for your group.

**Resources**

* PowerPoint created by Cheryl Hach
* Prezi presentation created by Jakob Nalley (nalleyja@msu.edu)
* Powerpoint, land use categories document, student datasheet and BEST plots landscape protocol available on the “BEST plots landscape legacy application” lesson page on the KBS GK-12 website.