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# K-12 Partnership Lesson Plan

# *Lessons of History: Land Use Change 1830-2013*

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## Overview

Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts (negative and positive) for different living things. Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth, unless the activities and technologies involved are engineered otherwise. In this lesson, students track land use change from a ‘natural’ reference state (1830) to pre-WWII (1938) to the current time (2013), develop predictions, and use qualitative or quantitative data to evaluate the impacts of land use change.

**Objectives**

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

* Given a problem related to human impact on the environment, students use scientific information and principles to generate a design solution that:

i. Addresses the results of the particular human activity.

ii. Incorporates technologies that can be used to monitor and minimize negative effects that human activities have on the environment.

* Students identify relationships between the human activity and the negative environmental impact based on scientific principles, and distinguish between causal and correlational relationships to facilitate the design of the solution.
* Students define and quantify, when appropriate, criteria and constraints for the solution, including:

i. Individual or societal needs and desires.

ii. Constraints imposed by economic conditions (e.g., costs of building and maintaining the solution.

* Students describe how well the solution meets the criteria and constraints, including monitoring or minimizing a human impact based on the causal relationships between relevant principles about the processes that occur in, as well as among, Earth systems and the human impact on the environment.
* Students identify limitations of the use of technologies employed by the solution.

**Length of Lesson**

This lesson would take **one to three** 50 minute class periods.

Day One: a) more extensive background or b) brief background + activity

Day Two: a) activity or b) follow-up/extensions

Day Three (optional): extensions (e.g., design solutions to maximize benefits)

**Grade Levels**

All Grade Levels (elementary only day one, up to high school all three days)

**Standards covered** (additional standards covered by extensions)

**K-ESS3-3.** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.\*

**3-LS4-4.** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.\*

**MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.\*

**HS-ESS3-4.** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.\*

**Materials**

* Powerpoint: “Land Use Lesson” (optional for K-5; **includes graphs of data for land use change using all 100 points on map for presentation**)
* Handouts
  + Land Use Lesson Worksheet (3 pages, Word doc)
  + Land Use Lesson Figures (7 pages, PDF)
  + Land Use Lesson Data Sheet (optional, Excel file)
* Land Use Kit
  + Maps
  + Grids

**Background**

Land cover is simply the physical material that covers the surface of the Earth. This includes natural land cover, such as forests, grasslands, rivers, and lakes; as well as anthropogenic land cover such as urban areas, roads, and agriculture. The way people value different types of land cover influences we use the landscapes we inhabit, therefore the way humans affect land cover is referred to as **land use change**. “Though humans have been modifying land to obtain food and other essentials for thousands of years, current rates, extents and intensities of **land-use and land-cover change** are far greater than ever in history, driving unprecedented changes in ecosystems and environmental processes at local, regional and global scales” (<http://www.eoearth.org/view/article/154143/>).

While humans derive obvious immediate benefits through converting natural land cover to uses such as urban development and agriculture, this type of land use change necessarily reduces available habitat and resources for most non-human organisms. Maintaining some amount of natural land cover is also important for insuring the supply of many ecosystem services, “the benefits humans obtain from nature,” such as water quality, clean air, and crop pollination. Therefore, it is necessary to track land use change, in order to prevent the degradation of habitat for wildlife and for human wellbeing, alike. By understanding patterns of land use change, we can predict potentially adverse impacts, as well as make better choices about future land use that can maximize human wellbeing without destroying valuable wildlife habitat.

### Activities of the session

A. Powerpoint + Discussion: background and rationale for impacts of land use change

1. *Discussion*: ask students what **humans** need. Make list on board [ex.= oxygen, (clean) water, food, recreation]. Next ask what **other organisms** need, and put check marks next to ideas already listed on board when students identify that humans and other organisms need the same things.
2. *Slides 3-9*: Major changes to landscapes occurred over millions/billions of years, resulting in the (mostly) natural landscape encountered by European settlers in the 1800s. This “natural” change will be contrasted with “anthropogenic” land use change.
3. *Discussion*:what is readily available in this landscape that humans/other organisms need? (refer to list on board, explore what in landscape provides these things). These provide **ecosystem services**.
4. Siides 10-15: Survey of the types of habitats found in historical landscape, showing students what the landscape may have looked like.
5. *Discussion*:What is NOT IN this landscape that humans/other organisms need? [Compare to modern landscape and think about what is readily available (ex. food from agriculture, housing, etc.)]
6. Slides 16-20: Contrasting the amenities of the modern landscape with the habitat destruction that was necessary for us to obtain them, raising the specter of values – how do we make the choices to maintain our standard of living, and balance habitat destruction?

B. Map Activity [**K-5**, analyze maps visually; **6-12**, analyze maps visually (predictions) and quantitatively]

1. How has land use changed between 1830 and 2013?
   1. Hand out maps, grids, and worksheet
   2. Make predictions from visual estimation: *What types of land cover do you think increased/decreased during these time spans?*
   3. Collect data. 2 options:
      1. Subsample using only 10 squares, and teacher presents full data for comparison
      2. Sample all 100 squares, and students create bar graphs
   4. Look for evidence of predictions.
2. What are the impacts of land use change?
   1. Make predictions visual estimation: *Which 1938 land cover types change to which different land cover types by 2013?*
   2. Collect data. 2 options:
      1. Subsample using only 10 squares, and teacher presents full data for comparison
      2. Sample all 100 squares, and students create bar graphs
3. Discuss results
   1. Which land use changes (1830-1938, 1938-2013) are positive? Negative? Why?
      1. For humans?
      2. For other organisms?
   2. If you could designate future land use changes, how would you modify 2013 map?

**Resources**

* Overview and land use/land cover change (<http://www.eoearth.org/view/article/154143/>)
* Land use change and climate change (<http://www.usgs.gov/faq/node/5601>)
* MDEQ MEECS land use lesson (<http://www.michigan.gov/deq/0,4561,7-135-3307_3580_29678-115602--,00.html>)
* Michigan Natural Features Inventory (<http://mnfi.anr.msu.edu/>)
  + Land Cover Change 1800s-1978 Maps (<http://mnfi.anr.msu.edu/data/landchng78.cfm>)
  + Vegetation Circa 1800 Maps (<http://mnfi.anr.msu.edu/data/veg1800.cfm>)
  + Natural Community Descriptions (<http://mnfi.anr.msu.edu/communities/index.cfm>)
* Foley et al. 2005, “Global Consequences of Land Use” (<http://science.sciencemag.org/content/309/5734/570.short>) – available in Google Scholar

**Extensions and Modifications**

1. For elementary students, you may visually track changes in particular grid-squares

2. *Design solutions*

* Students can create a **model** or **design** that describes how they would manage the landscape for the benefit of both humans and other organisms

3. *Look for evidence of circa 1800 landcover in area*

* Take a hike around the schoolyard and look for trees or other vegetation that is consistent with what the 1830 map showed

4.

5. *Associated lessons from KBS K-12 Partnership*

* BEST Plot Landscape Protocol (<http://kbsgk12project.kbs.msu.edu/blog/2011/09/14/landscape-level-protocols/>)
* BEST Plot Landscape Protocol: Landscape Legacy Application (<http://kbsgk12project.kbs.msu.edu/blog/2013/10/01/best-plot-landscape-protocol-landscape-legacy-application/>)
* Land Conservation Debate (<http://kbsgk12project.kbs.msu.edu/blog/2013/08/15/land-conservation-debate/>)
* “Ecosystem Services Hike” (forthcoming)
* Farming for Ecosystem Services (<http://kbsgk12project.kbs.msu.edu/blog/2015/06/10/farming-for-ecosystem-services/>)
* Dividends from Diversity (<http://kbsgk12project.kbs.msu.edu/blog/2012/11/07/dividends-from-diversity/>)
* Groundwater Conceptions and Processes (<http://kbsgk12project.kbs.msu.edu/blog/2013/08/16/groundwater-conceptions-and-processes/>)
* Wetlands: Not just a Swampy Place (<http://kbsgk12project.kbs.msu.edu/blog/2013/12/19/wetlands-not-just-a-swampy-place/>)

**Assessment** *(in progress)*

* Can students design solutions to improve water quality, etc.?
* Randomly select another 10 grids, and assess student’s predictions
* Essays to address the following questions:
  + Which land use changes (1830-1938, 1938-2013) are positive? Negative? Why?
    - For humans?
    - For other organisms?
  + If you could designate future land use changes, how would you modify 2013 map?