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Teaching the MI Earth Science Content Expectations Using "Our Town"

Introduction

Michigan's new High School Content Expectations for Earth Science identify demanding skills, practices, and knowledge needed by students. This document describes how teachers can meet these new requirements using "Our Town," a curriculum on land use, sustainable communities, and brownfields redevelopment developed by Creative Change Educational Solutions in partnership with Washtenaw County government and Purdue University.

"Our Town" uses **regional land use trends** as a context for examining earth systems, water quality, and human-environmental interactions. The lessons are based on the same research, data, and models used by scientists. Students then apply their knowledge to address practical water quality problems in the community. In these ways, the program demonstrates the "rigor, relevance, and relationships" at the heart of the new standards.

Contents

Learn more about the program and getting the curriculum through our Curriculum and Resource Center at www.creativechange.net

I. Selected Lessons

Southeast Michigan: People, places, land and water: Students gain an overview of the region's people, geography, and built environment.

Regional Trends: Data Analysis and Interpretation: Working in groups, students analyze, graph, and interpret data on environmental, demographic, and land use trends.

Land use and the Environment; Land use and water quality: Through a lab and other hands-on activities, students examine the environment as the basis for human activities and the impacts of land use trends on the physical and biological aspects of the watershed. Students then develop strategies to improve water quality in the school or community.

***Decisions, Decisions: Land use planning, water quality, and local government*:** Through a role-playing activity, students debate a fictional land use proposal from the perspectives of various stakeholders. Students then transfer the insights as they learn about the process of land use decision-making and wetland regulation.

Urban Redevelopment: Students investigate case studies of successful revitalization efforts that combine economic, environment, and community well-being.

II. Practices of Scientific Literacy Developed Through "Our Town"

The 2006 Michigan High School Content Expectations define four performances related to scientific literacy:

- **Identifying:** Stating models, theories, and patterns inside the triangle in Figure 1.
- **Using:** Using scientific models and patterns to explain or describe specific observations.
- **Inquiry:** Finding and explaining patterns in data.
- **Reflection and Social Implications:** Reflecting on the application of models and theories to practical problems.

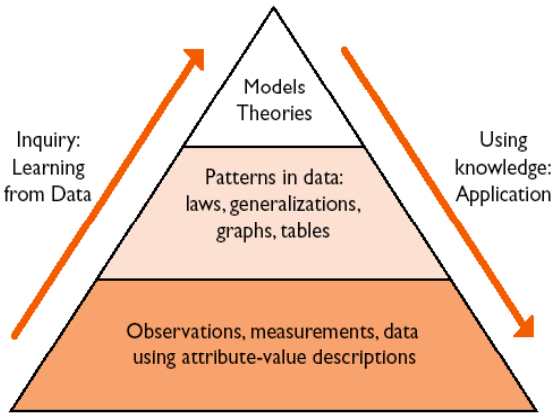
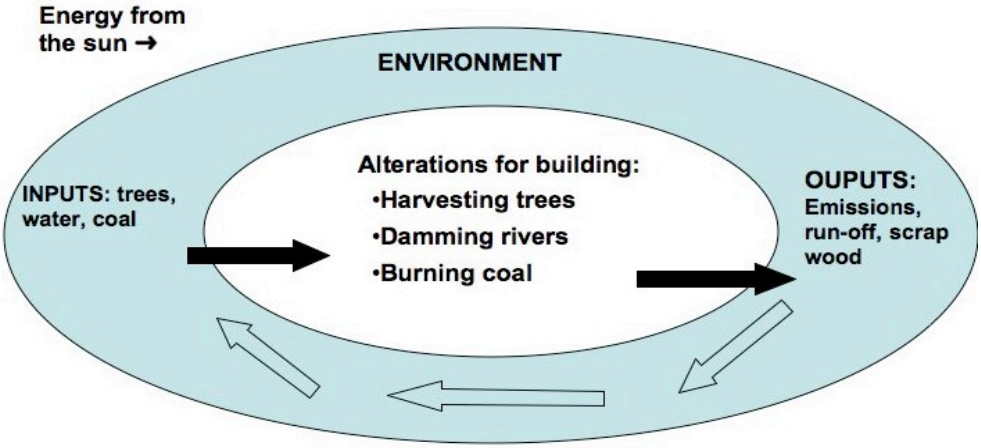


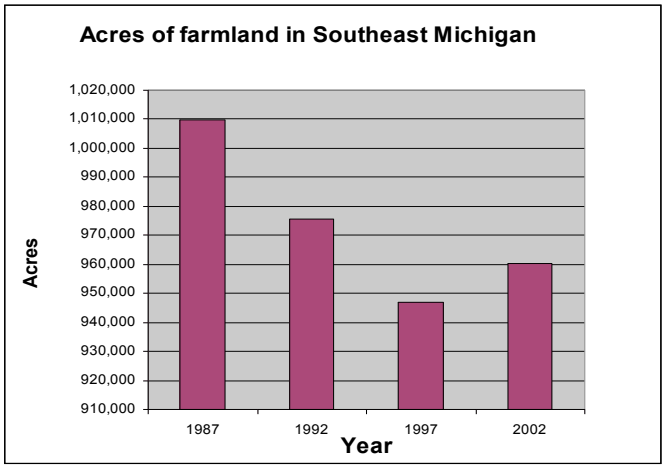
Figure 1: Knowledge and practices of model-based reasoning

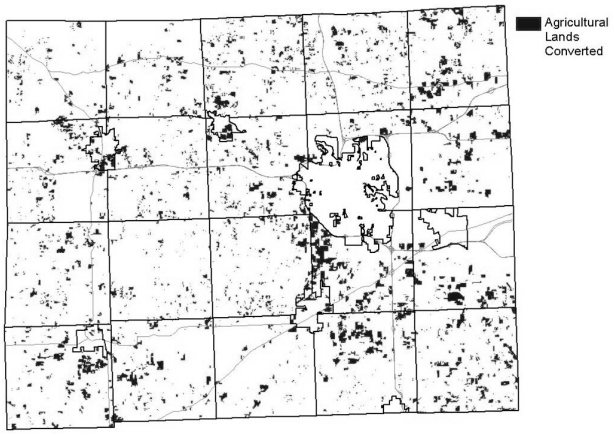
"Our Town" develops these skills using content, data, and current issues from students' communities. Examples:

- **Identifying and using scientific models:** Students **use a scientific model** of the earth as a closed system **to explain and describe specific observations** about alterations to the earth resulting from land use changes.



- **Inquiry:** Students **find and explain patterns in data** through analysis and interpretation of environmental and land use trends affecting Southeast Michigan.





- **Reflection and Social Implications:** Throughout "Lessons from the Land," students **reflect** on the social and scientific impacts of land use decisions and apply their knowledge by identifying steps they can take to promote **the sustainability of the watershed**. Activities such as developing strategies to increase native vegetation and presenting policy papers to local officials enable students to strengthen **relationships** within the school and community.

III. Specific Standards Met through "Our Town"

Underlined and bolded text identify areas of very specific and direct links with standards.

STANDARD E2: EARTH SYSTEMS

Students describe the interactions within and between Earth systems. **They will describe the relationship between physical process and human activities and use this understanding to demonstrate an ability to make wise decisions about land use.**

E2.1 Earth Systems Overview

E2.1A Explain why the Earth is essentially a closed system in terms of matter.

E2.1B Analyze the interactions between the major systems (geosphere, atmosphere, hydrosphere, biosphere) that make up the Earth.

E2.1C Explain, using specific examples, **how a change in one system affects other Earth systems**.

E2.2 Energy in Earth Systems

E2.2B Identify differences in the origin and use of renewable (e.g., solar, wind, water, biomass) and nonrenewable (e.g., fossil fuels, nuclear [U-235]) sources of energy.

E2.4 Resources and Human Impacts on Earth Systems

The Earth provides resources (including minerals) that are used to sustain human affairs. The supply of nonrenewable natural resources is limited and their extraction and use can release elements and compounds into Earth systems. They affect air and water quality, ecosystems, landscapes, and may have effects on long-term climate. **Plans for land use and long-term development must include an understanding of the interactions between Earth systems and human activities.** Standard:

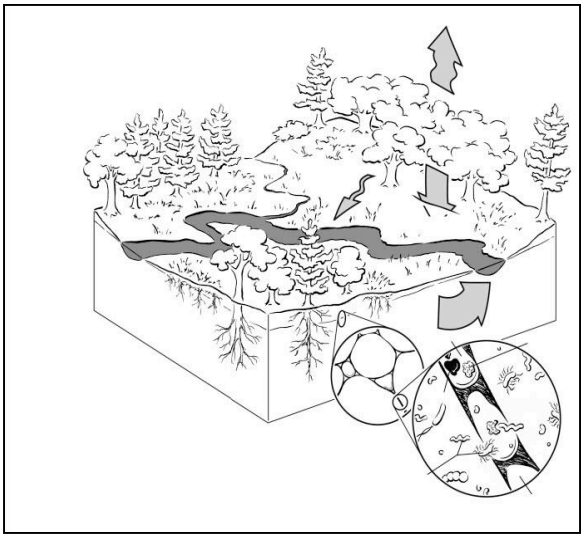
E2.4B Explain how the impact of human activities on the environment can be understood through the analysis of interactions between the four Earth systems.

STANDARD E4: THE FLUID EARTH

Students explain features and processes related to surface and groundwater and describe the sustainability of systems in terms of water quality and quantity.

E4.p1 Water Cycle

The recharge and movement of groundwater depends on porosity, permeability, and the shape of the water table. The movement of groundwater occurs over a long period time. Groundwater and surface water are often interconnected.



- **E4.p1A** Describe that the water cycle includes evaporation, transpiration, condensation, **precipitation, infiltration, surface runoff, groundwater, and absorption**.
- **E4.p1B Analyze the flow of water between the elements of a watershed**, including surface features (lakes, streams, rivers, wetlands) and groundwater.
- **E4.p1C Describe the river and stream types, features, and process including cycles of flooding, erosion, and deposition as they occur naturally and as they are impacted by land use decisions**.
- **E4.p1D** Explain the types, process, and beneficial functions of wetlands.

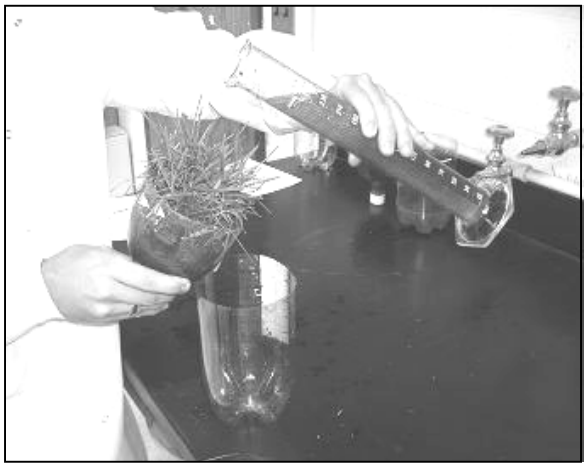
E4.1 Hydrogeology

Natural surface water processes shape the landscape everywhere and are affected by human land use decisions.

- **E4.1B** Explain the features and processes of groundwater systems and how the sustainability of North American aquifers has changed in recent history (e.g., the past 100 years) qualitatively using the concepts of recharge, residence time, inputs, and outputs.
- **E4.1C Explain how water quality in both groundwater and surface systems is impacted by land use decisions**.

E1.1 Scientific Inquiry

In "Science Lessons from the Land" (Lesson 3), students conduct experiments to identify the impacts of impervious surfaces on infiltration and run-off, and the quality and quantity of surface and ground water. The experiments are grounded in data, trends, and changes in students' own communities. 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.