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Teaching the New High School Biology Content Expectation Using “Our Town”

Introduction

Michigan’s High School Content Expectations for Biology 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 standards.

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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.

Epidemiology and toxicology: Students conduct labs to investigate the impacts of pollutants on organisms and people, conduct research using public health databases, and develop an education campaign to share information with the 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 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.

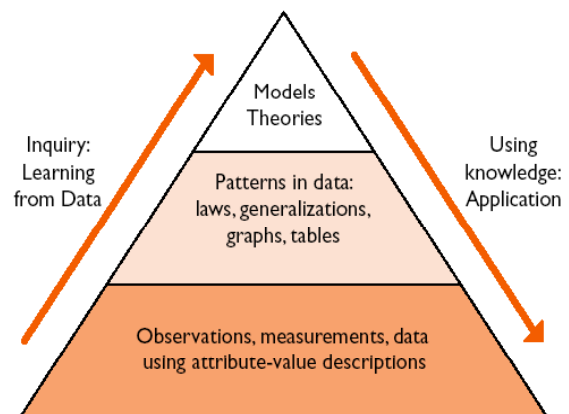
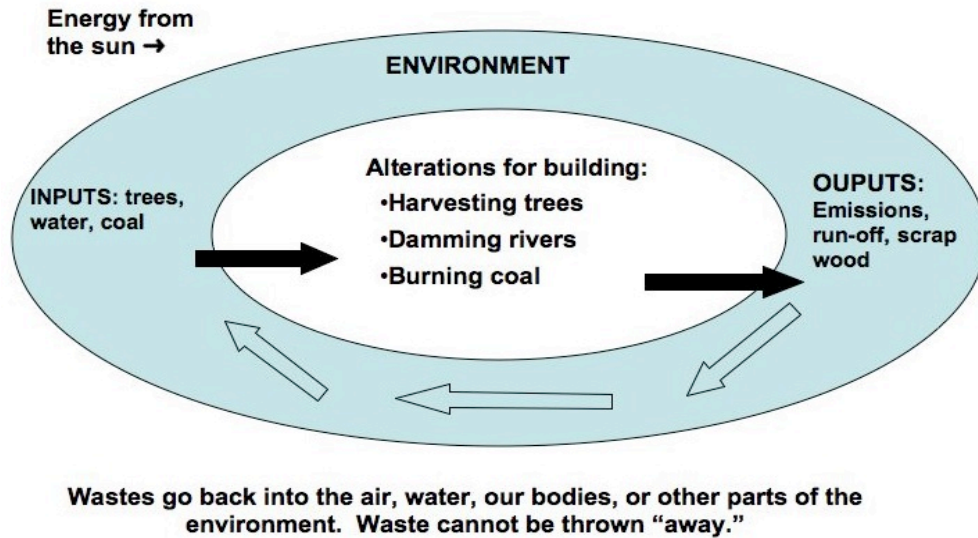


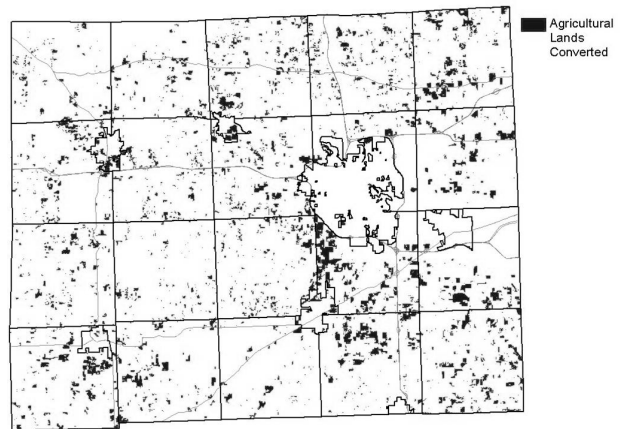
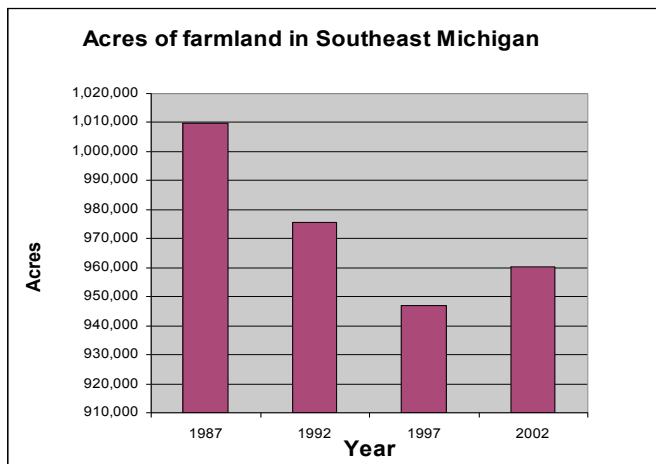
Figure 1: Knowledge and practices of model-based reasoning

“Our Town” develops these skills using content, data, and current issues from students’ communities. Examples:

Identifying and using: 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 “Our Town,” 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 and redevelopment of urban areas. Activities such as developing designs and proposals for increasing native vegetation enable students to strengthen relationships within the school and community.

III. Specific Biology Standards met through “Our Town”

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

STANDARD B1: INQUIRY, REFLECTION, AND SOCIAL IMPLICATIONS

Students will understand the nature of science and demonstrate an ability to practice scientific reasoning by applying it to the design, execution, and evaluation of scientific investigations. Students will demonstrate their understanding that scientific knowledge is gathered through various forms of direct and indirect observations and the testing of this information by methods including, but not limited to, experimentation. They will be able to distinguish between types of scientific knowledge (e.g., hypotheses, laws, theories) and become aware of areas of active research in contrast to conclusions that are part of established scientific consensus. They will use their scientific knowledge to assess the costs, risks, and benefits of technological systems as they make personal choices and participate in public policy decisions. These insights will help them analyze the role science plays in society, technology, and potential career opportunities.

STANDARD B1.1 Scientific Inquiry

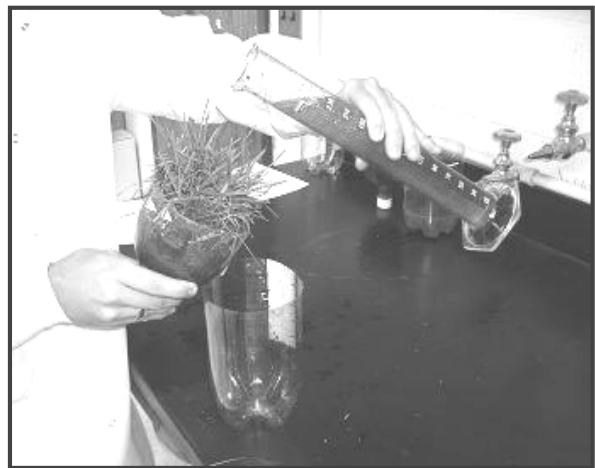
B1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).

B1.1D Identify patterns in data and relate them to theoretical models.

B1.1E Describe a reason for a given conclusion using evidence from an investigation.

B1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.

B1.1h Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.



STANDARD B2: ORGANIZATION AND DEVELOPMENT OF LIVING SYSTEMS

Students describe the general structure and function of cells. They can explain that all living systems are composed of cells and that organisms may be unicellular or multicellular. They understand that cells are composed of biological macromolecules and that the complex processes of the cell allow it to maintain a stable internal environment necessary to maintain life. They make predictions based on these understandings.

B1.2 Scientific Reflection and Social Implications

B1.2A Critique whether or not specific questions can be answered through scientific investigations.

B1.2B Identify and critique arguments about personal or societal issues based on scientific evidence.

B1.2f Critique solutions to problems, given criteria and scientific constraints.

B1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.

B2.3 Maintaining Environmental Stability

B2.3A Describe how cells function in a narrow range of physical conditions, such as temperature and pH (acidity), to perform life functions.

B2.3B Describe how the maintenance of a relatively stable internal environment is required for the continuation of life.

B2.3C Explain how stability is challenged by changing physical, chemical, and environmental conditions as well as the presence of disease agents.

| Pollutant | Source |
|--|---|
| Nutrients (such as phosphorus or nitrogen) | Pet or human waste, livestock waste, fertilizers, septic systems, auto emissions |
| Pathogens (bacteria and viruses) | failing septic systems, human or animal waste, marine sanitation devices |
| Toxic contaminants (motor oil, solvents, paint, pesticides) | industrial, commercial, household and agricultural chemicals; auto emissions |
| Debris (trash, litter, abandoned objects) | illegal dumping, street litter, beach litter, boating waste, camping, hunting, and fishing waste |
| Thermal stress (alteration in water temperature, increased sun exposure) | runoff from heat-absorbing impervious surfaces (roofs, roads, parking lots), removal of streamside vegetation |

STANDARD B3: INTERDEPENDENCE OF LIVING SYSTEMS AND THE ENVIRONMENT

Students describe the processes of photosynthesis and cellular respiration and how energy is transferred through food webs. They recognize and analyze the consequences of the dependence of organisms on environmental resources and the interdependence of organisms in ecosystems.

B3.2 Ecosystems

B3.2C Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed.

B3.4 Changes in Ecosystems

Although the interrelationships and interdependence of organisms may generate biological communities in ecosystems that are stable for hundreds or thousands of years, ecosystems always change when climate changes or when one or more new species appear as a result of migration or local evolution. **The impact of the human species has major consequences for other species.**

B3.4A Describe ecosystem stability. Understand that if a disaster such as flood or fire occurs, the damaged ecosystem is likely to recover in stages of succession that eventually result in a system similar to the original one.

B3.4B Recognize and describe that a great diversity of species increases the chance that at least some living organisms will survive in the face of cataclysmic changes in the environment.

B3.4C Examine the negative impact of human activities.

B3.4x Human Impact

Humans can have tremendous impact on the environment. Sometimes their impact is beneficial, and sometimes it is detrimental.

B3.5 Populations

B3.5A Graph changes in population growth, given a data table.

B3.5x Environmental Factors

B3.5e Recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamics within ecosystems.