

PEWI: A Land Use Simulation Game

Neh Batwara (nbatwara@iastate.edu), Nancy Grudens-Schuck, Scott Smalley, Lisa Schulte Moore, & Richard Magala
Iowa State University, Ames, Iowa, USA



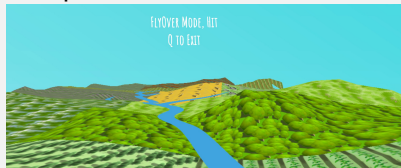
What is PEWI?

- People in Ecosystems Watershed Integration (PEWI) is a digital game-based learning unit that helps students learn about human-landscape interactions.
- Students change land uses to alter biological, physical, chemical, and ecological impacts on water quality, wildlife, and biodiversity.
- PEWI focuses on the US Corn Belt but its lessons apply to agriculture across the globe.

Play PEWI Online

To play, access background information and resources:
nrem.iastate.edu/pewi

PEWI includes a a drone-view “flyover” mode. Students can toggle the 3-D topographical view along with the flyover mode to move around the watershed. Students see the elevation – even the slope of each pixel.



A digital Glossary in the game provides 110 entries that include audio, visual and text-based explanations about the science and ag content.

How does PEWI work?

PEWI gives students the power to simulate multiple land-use configurations. Students can creatively place different land uses across the interactive watershed. The impacts of land use outcomes are calculated instantly and shown in tables and graphs.

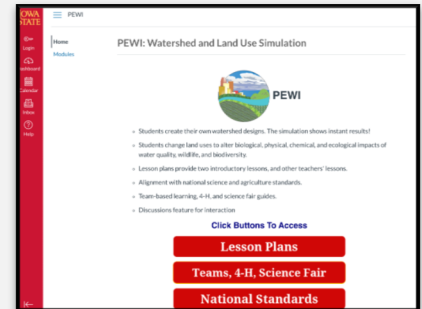
PEWI is designed as a visual interface that includes a watershed area, 15 contemporary land-uses, seven weather maps, five research-based physical features map, and three environmental service maps.



The 6000-acre watershed in PEWI is based on the physiographic characteristics of two Iowa landforms – the Des Moines lobe landform and the Southern Iowa Drift Plain.

PEWI Teachers Guide

- The PEWI **Teachers Guide** is an online resource that is hosted on Canvas, an online Learning Management System.
- The lesson plans and videos in the Teachers Guide are a key resource for educators.



PEWI Teachers Guide Homepage.

National Standards

- PEWI aligns with 9 NGSS student performance expectations, and ten standards and 17 indicators from the AFNR areas of Environmental Service Systems, Natural Resource systems and Plant systems.

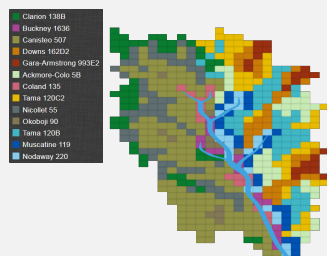


Experiment and Evaluate

A key learning strategy in PEWI is for students to develop land-use scenarios and evaluate results.

While planning scenarios students need to consider the weather variability where they experience one of the 7 precipitation levels randomly.

PEWI provides students with physical feature maps such as soil class (on left).

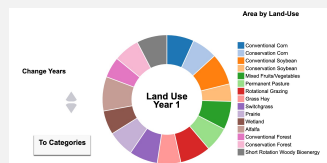


- Beginners are encouraged to follow a simple strategy:
1. Measure original impact of original land use
 2. Change land use
 3. Measure impact of new land uses.



Changing Nitrate (N) levels and evaluating results.

PEWI generates the results of watershed designs instantaneously. The results can be evaluated using numerical tables or visual graphs.



Land Uses in PEWI

Conventional Corn		Conservation Corn	
Conventional Soybean		Conservation Soybean	
Alfalfa		Mixed Fruits & Vegetables	
Grass Hay		Switchgrass	
Permanent Pasture		Rotational Grazing	
Wetland		Prairie	
Conventional Forest		Conservation Forest	
		Short Rotation Woody	
		Bioenergy	

Future Updates

USDA NIFA is funding expansion of the carbon sequestration module and addition of three greenhouse gasses of Carbon Dioxide, Nitrous Oxide, and Methane. This will enable the game to better show greenhouse gasses mitigation under the different land uses. An NSF grant will also fund the development of blockchain exercises to help students learn about food supply chain systems.

References:
1. Anderson, K., Grudens-Schuck, N., Valek, R., Schulte, L. A., & Smalley, S. W. (2020). Alignment of a digital and land use game to national education standards. *Natural Sciences Education, 49*(1), 10.1002/nswatersheds2.20005
2. Channault, C. M., Valek, R. M., Tyndall, J. C., & Schulte, L. A. (2020). PEWI: An interactive web-based ecosystem services model for a broad public audience. *Ecological Modelling, 431*, 109165. 10.1016/j.ecolmod.2020.109165