Grade: 9-12 (Earth Science, Biology, Environmental Science, etc.)

Program Title: Developing Watershed Solutions

Related Iowa Core Performance Expectations:

HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [*Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.*]

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Future Considerations: Blend this program with the unit storyline developed by the classroom teacher.

Program alignment with the Iowa Core Science Standards:

Disciplinary Core Ideas (DCIs)	Investigative Question	Investigative Phenomena	Practices (SEPs) Students will:	Cross Cutting Concepts (CCCs) Students will identify:
ESS3.C: Human Impacts on Earth Systems The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. **ETS1.A: Defining and Delimiting Engineering Problems** Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. **ETS1.B: Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints,	Should we drink the water in this body of water? 1) What is our watershed? 2) What are the potential pollutants in our watershed? 3) How could we improve the quality of the water in this river/creek?	Students view video story relating how a local individual waded in a water body and ended up in the hospital for three days with an E. coli infection.	**Ask questions** and record observations in field notebook about the quality of water bodies in a watershed and the factors that might influence water quality. **Analyze and interpret data** using IOWATER tests and data sheets. **Construct explanations and design solutions** related to sustainable management of Iowa's natural resources. **Obtain, evaluate, and communicate information** about the ways in which	**Cause and effect** when they relate changes in water quality to influencing factors. **Systems and system models** when they discuss watershed impacts of land use **Scale, proportion, and quantity** when we apply the observations and induce the global problems associated with it, such as dead zone.

including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.			surficial water sources are impacted by human activity.	

Program components: The presenter will have students use the CCCs, the SEPs and the phenomena to figure out how to answer the investigative question and to grasp the disciplinary core ideas.

Classroom

Students view video of an individual who waded in a water body and ended up with an E. coli infection.

The teacher facilitates a class discussion about the video. Could this happen in our local community and how do experts determine if a local river or creek is safe? Students discuss what might make the water unhealthy, leading to land use/watershed discussion. Use maps to find local watershed. Students create a "need to know" list. Teacher introduces a naturalist who will assist in collecting data on a local river or creek.

Field Experience

Students visit a local river or creek. Students write initial observations, thoughts, and questions about the water and the adjacent land in field notebooks. Students share their initial thoughts. Based on initial observations, do you think this water body is safe for recreation, swimming, or drinking? How will you determine if this water is safe?

Naturalists lead chemical, biological, physical, and/or habitat assessments. Students record data using IOWATER tests and data sheets. The students analyze the data back in their classroom and then report back to the naturalist. The naturalist concludes with watershed map and discussion of the health of the watershed and possible solutions to perceived problems.

Extension activities:

Teachers facilitate student compilation and analysis of data. Students create a product to present their findings and possible solutions to the naturalist during a follow-up classroom visit. Naturalist suggests local outlets for students to take action with solutions in community (such as presenting to town council or county board of supervisors, creating a neighborhood awareness campaign, fundraising to solve a specific water quality problem).

Additional PE: **HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems**. [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).