OSP Interactive Educational Programming

Lesson Title: The production of swamp gas through the anaerobic decomposition of peat	**Grade Level(s):** 9 – 12
OSP Educational Programming: Enhance our understanding of ecological processes which make the Okefenokee Swamp unique.	**Teacher:** Joe Eichfeld **Duration:** 105 min (45 min pre-lab; 60 min lab)

Essential Questions:

1. What biological process produces swamp gas in the Okefenokee Swamp?
2. What is the difference between anaerobic and aerobic processes?
3. What is the role of decomposing organisms in the Okefenokee Swamp ecosystem?
4. What types of organisms are responsible for decomposition in the Okefenokee Swamp?
5. What is the chemical composition of swamp gas?
6. What are the chemical properties of swamp gas?
7. How does the production of swamp gas affect the ecology of the Okefenokee Swamp?
8. What are the standard safety practices that should be employed when conducting experiments in the laboratory and in the field?

Georgia Performance Standards

Environmental Science

SEV1. Students will investigate the flow of energy and cycling of matter within an ecosystem and relate these phenomena to human society.

a. Interpret biogeochemical cycles including hydrologic, nitrogen, phosphorus, oxygen, and carbon cycles. Recognize that energy is not recycled in ecosystems.
d. Relate the cycling of matter and the flow of energy to the Laws of Conservation of matter and energy. Identify the role and importance of decomposers in the recycling process.
e. Distinguish between abiotic and biotic factors in an ecosystem and describe how matter and energy move between these.

SEV2. Students will demonstrate an understanding that the Earth is one interconnected system.

a. Describe how the abiotic components (water, air, and energy) affect the biosphere.
c. Characterize the components that define a Biome.
Abiotic Factors – to include precipitation, temperature and soils.
Biotic Factors – plant and animal adaptations that create success in that biome.
d. Characterize the components that define fresh-water and marine systems.
Abiotic Factors – to include light, dissolved oxygen, phosphorus, nitrogen, pH and substrate.
Biotic Factors – plant and animal adaptations characteristic to that system.

SEV3. Students will describe stability and change in ecosystems.
Explain succession in terms of changes in communities through time to include changes in biomass, diversity, and complexity.

Biology

SB3. Students will derive the relationship between single-celled and multi-celled organisms and the increasing complexity of systems.

a. Explain the cycling of energy through the processes of photosynthesis and respiration.
b. Compare how structures and function vary between the six kingdoms (archaebacteria, eubacteria, protists, fungi, plants, and animals).

SB4. Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems.

b. Explain the flow of matter and energy through ecosystems by arranging components of a food chain according to energy flow. Comparing the quantity of energy in the steps of an energy pyramid. Explaining the need for cycling of major nutrients (C, O, H, N, P).
c. Relate environmental conditions to successional changes in ecosystems.

Ecology

SEC1. Students will analyze how biotic and abiotic factors interact to affect the distribution of species and the diversity of life on Earth.

a. Characterize the biotic and abiotic components that define various biomes and aquatic life zones.
d. Relate the role of natural selection to organismal adaptations that are specific to their habitats and describe some examples of coevolution.

SEC3. Students will explore and analyze community interactions.

b. Explore ecological niches and resource partitioning.
e. Evaluate ecological succession in terms of changes in communities over time and the impact of disturbance on community composition.

SEC4. Students will analyze biogeochemical cycles and the flow of energy in ecosystems.

a. Compare and contrast the carbon, water, oxygen, phosphorus, nitrogen, and sulfur cycles, describing their flow through biotic and abiotic pools, including human influences.
b. Apply the first and second laws of thermodynamics and the law of conservation of matter to the flow of energy and matter in ecosystems.

Chemistry

SC1 Students will analyze the nature of matter and its classifications.

b. Identify substances based on chemical and physical properties.

SC2 Students will relate how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions.

a. Identify and balance the following types of chemical equations:
   • Synthesis
   • Decomposition
   • Single Replacement
   • Double Replacement
   • Combustion
b. Experimentally determine indicators of a chemical reaction specifically precipitation, gas evolution, water production, and changes in energy to the system.

Microbiology

SMI1. Students will analyze different types of microorganisms and their defining characteristics.

a. Distinguish between different kinds of microorganisms based on cellular structure, molecular biology and biochemical composition.

SMI3. Students will examine different ways in which microbial cells generate energy for growth and reproduction.

a. Explain different types of energy generation used by microbes, including respiration, photosynthesis, and lithotrophy.

SMI6. Students will analyze the impact of microorganisms in the environment and the use of microbes in biotechnology, agriculture, and industry.

a. Explain the prevalence and diversity of microbes in various environments (e.g., hot springs, arctic ice, hypersaline environments, alkaline soils, acid mine drainage.)
b. Relate biotic and abiotic factors to the development of microbial populations and diversity.
c. Describe the importance of microorganisms in global nutrient cycling within both soil, freshwater, and marine habitats

Key Vocabulary	• abiotic factor • adaptation • aerobic • anaerobic • anoxic • archaebacteria • biotic factor • chemical cycle • decomposer • decomposition • ecological succession • flow of energy (food chain) • lithotrophy • methanogen • methanogenesis • photosynthesis • respiration
Teacher Materials	• gas collection apparatus • long stick (to release gas from the peat) • quart mason jars (12) • swamp gas combustion apparatus (12) • grill lighters (12) • methanogenesis power point
Student Materials	• power point outline • methanogenesis assignment (handout) • swamp gas lab handout • lab safety handout
Teaching Strategies/ Procedures	• guided lecture • power point presentation • hands-on activity: lab – swamp gas collection and combustion • methanogenesis assignment • summarization discussion and Q and A session
Differentiation	• power point outline • visuals (models, pictures, diagrams) • hands-on activity • internet research
Summarizing Strategy	• summary discussion • students will summarize and state in their own way what they have learned about the production of swamp gas in the Okefenokee Swamp to the class/group (various media) *note: this can be done as an extension activity on site or when students return to their classroom*
Assignment(s)	• summary presentation
Assessment for and of learning	• methanogenesis assignment • summarization activity
Internet Resources	• https://sites.google.com/site/mresapeswebsite/ • http://en.wikipedia.org/wiki/Marsh_gas • http://www.ncbi.nlm.nih.gov/pubmed/12833210 • http://en.wikipedia.org/wiki/Methanogenesis