International Baccalaureate
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MARIETTA CITY SCHOOLS

Marietta City Schools

2024–2025 District Unit Planner

Grade & Course: Environmental Science	**Topic:** Unit 1 - Science and Engineering Practices	**Duration:** 2 Weeks
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Georgia Standards and Content:

Summary: Integrating the Science and Engineering Practices (SEPs) into the Environmental Science Georgia Standards of Excellence helps students build the skills necessary to understand and engage with scientific concepts in a meaningful way.

Georgia Standards of Excellence Environmental Science and the Next Gen Science SEPs:

1. **Asking Questions and Defining Problems (SEP 1)**
    a. Environmental Science Standard SEV1: Developing models to analyze biological organization and predict energy transfers requires students to ask pertinent scientific questions about ecosystems.
    b. SEV4: Constructing claims about the effects of human activities on natural resources involves defining and investigating environmental problems.
2. **Developing and Using Models (SEP 2)**
    a. SEV1: Students develop and use models based on the Laws of Thermodynamics to predict energy transfers in ecosystems, enhancing their understanding of biogeochemical cycles.
    b. SEV3: Models help students evaluate the sustainability potential of energy resources.
3. **Planning and Carrying Out Investigations (SEP 3)**
    a. SEV1 and SEV2: Investigations into the impact of physical and chemical properties on aquatic biomes and the stability of Earth's ecosystems help students gain hands-on experience and understand natural processes.
    b. SEV4: Planning investigations to study the impact of human activities on natural resources promotes critical thinking and scientific inquiry.
4. **Analyzing and Interpreting Data (SEP 4)**
    a. SEV2: Students analyze data related to natural cyclic fluctuations and atmospheric changes to understand climate change impacts.
    b. SEV3: Interpreting data on energy resources helps students communicate their findings effectively and construct arguments based on evidence.
5. **Using Mathematics and Computational Thinking (SEP 5)**
    a. SEV1: Applying mathematical principles to analyze energy flow and biogeochemical cycles in ecosystems enhances students' quantitative skills.
    b. SEV2: Computational thinking is used to predict changes in ecosystems based on data analysis.
6. **Constructing Explanations and Designing Solutions (SEP 6)**
    a. SEV2: Constructing explanations for ecosystem changes and designing sustainable solutions for energy use encourages problem-solving and application of scientific principles.
    b. SEV4: Designing solutions to reduce human impact on the environment involves applying scientific knowledge to real-world problems.
7. **Engaging in Argument from Evidence (SEP 7)**
    a. SEV2: Constructing arguments about ecological succession and biodiversity resilience requires evaluating evidence and reasoning.
    b. SEV5: Arguments about the relationship between human population growth and environmental impact are based on interpreting data and constructing evidence-based claims.
8. **Obtaining, Evaluating, and Communicating Information (SEP 8)**
    a. SEV1: Obtaining and communicating information about energy flow in ecosystems helps students share their scientific findings.
    b. SEV5: Evaluating information about global population growth and human innovations involves critical analysis and effective communication of complex concepts.

https://www.nextgenaset.org/science-and-engineering-practices-seps/
https://www.georgiastandards.org/Georgia-Standards/Documents/Science-Environmental-Science-Georgia-Standards.pdf

Narrative / Background Information

Prior Student Knowledge: (REFLECTION – PRIOR TO TEACHING THE UNIT)

Summary: The SEPs are inherently embedded within the 7th grade GSE, as they emphasize the importance of scientific inquiry and the engineering design process.

S7L1: Investigate the diversity of living organisms and how they can be compared scientifically.

- **SEP Connections**: Asking questions and defining problems (SEP 1), Developing and using models (SEP 2), Analyzing and interpreting data (SEP 4), Constructing explanations and designing solutions (SEP 6).

S7L2: Analyze how biological traits are passed on to successive generations.

- **SEP Connections**: Developing and using models (SEP 2), Analyzing and interpreting data (SEP 4), Using mathematics and computational thinking (SEP 5), Constructing explanations and designing solutions (SEP 6).

S7L3: Explore the effects of natural selection on adaptations and diversity in organisms.

- **SEP Connections**: Asking questions and defining problems (SEP 1), Analyzing and interpreting data (SEP 4), Constructing explanations and designing solutions (SEP 6), Engaging in argument from evidence (SEP 7).

S7L4: Investigate the interdependence of organisms and their environments.

- **SEP Connections**: Asking questions and defining problems (SEP 1), Planning and carrying out investigations (SEP 3), Analyzing and interpreting data (SEP 4), Constructing explanations and designing solutions (SEP 6), Engaging in argument from evidence (SEP 7).

S7L5: Explore how human activities affect the environment.

- **SEP Connections**: Asking questions and defining problems (SEP 1), Developing and using models (SEP 2), Analyzing and interpreting data (SEP 4), Constructing explanations and designing solutions (SEP 6), Engaging in argument from evidence (SEP 7), Obtaining, evaluating, and communicating information (SEP 8).

Year-Long Anchoring Phenomena: (LEARNING PROCESS)
Human activities have negatively affected ecosystems, global climate, energy resources, and population.

Unit Phenomena (LEARNING PROCESS)

The misuse and overuse of antibiotics have led to the emergence of antibiotic-resistant bacteria, posing a significant threat to global health.

MYP Inquiry Statement:

The acquisition and application of scientific knowledge rely on the systematic use of evidence and method, driving innovation and understanding of the natural world.

MYP Global Context:

Scientific and technical innovation

Approaches to Learning Skills (SEPs):

SEP

- Asking Questions and Defining Problems
- Develop and use Models
- Plan and Carry Out Investigation
- Analyzing and Interpreting Data
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Obtain, Evaluate, and Communicate Information

CCC

- Patterns
- Cause and Effect
- Scale, Proportion, and Quantity
- Systems and System Models
- Energy and Matter: Flows, Cycles, and Conservation
- Structure and Function
- Stability and Change

ATL

- Research Skills
- Thinking Skills
- Collaboration Skills
- Communication Skills

Disciplinary Core Ideas: (KNOWLEDGE & SKILLS)

- Develop skills in asking scientific questions and defining problems.
- Practice planning and carrying out investigations.
- Learn to analyze and interpret data.
- Understand the importance of constructing explanations and designing solutions.
- Engage in arguments from evidence.
- Obtain, evaluate, and communicate scientific information.

Crosscutting Concepts: (KNOWLEDGE & SKILLS)

- Stability and Change
- Energy and Matter
- Scale, Proportion, and Quantity
- Structure and Function
- Cause and Effect

MYP Key and Related Concepts:

- Communication
- Connections
- Creativity
- Form
- Logic
- Systems
- Cause and Effect

Possible Preconceptions/Misconceptions: (REFLECTION – PRIOR TO TEACHING THE UNIT)

When teaching this unit it is important to note that students come in with previous knowledge on Science and Engineering Practices,but may not have sufficient practice implementing and identifying these SEPs.

Key Vocabulary: (KNOWLEDGE & SKILLS)

Observation: The act of noting and recording an event, characteristic, or behavior using the senses or scientific tools.

Hypothesis: A testable prediction or explanation for a scientific question or problem.

Experiment: A systematic procedure carried out to test a hypothesis, collect data, or demonstrate a known fact.

Variable: Any factor, trait, or condition that can exist in differing amounts or types in an experiment.

- **Independent Variable**: The variable that is changed or controlled in a scientific experiment to test its effects on the dependent variable.
- **Dependent Variable**: The variable being tested and measured in an experiment.
- **Control Variable**: Variables that are kept constant to accurately test the impact of an independent variable.

Data: Information gathered from observations or experiments, which can be qualitative (descriptive) or quantitative (numerical).

Analysis: The process of interpreting data to find patterns, relationships, or trends.

Conclusion: A summary of the results of an experiment and a statement of how the results relate to the hypothesis.

Scientific Method: A systematic approach to inquiry that includes making observations, forming a hypothesis, conducting

experiments, collecting and analyzing data, and drawing conclusions.

Theory: A well-substantiated explanation of some aspect of the natural world that is based on a body of evidence and has been repeatedly tested and confirmed.

Law: A statement based on repeated experimental observations that describes some aspect of the world.

Model: A representation of an object, system, or process that helps to explain and predict its behavior.

Inference: A logical interpretation or explanation of observations based on prior knowledge and experience.

Peer Review: The evaluation of scientific work by others who are experts in the same field to ensure the validity and reliability of the findings.

Replication: Repeating an experiment or study to verify results and ensure accuracy.

Measurement: The process of obtaining the size, quantity, or degree of something, typically using standard units.

Precision: The consistency of repeated measurements or results.

Accuracy: The closeness of a measurement to the true value.

Bias: A systematic error that can affect the outcome of an experiment and lead to incorrect conclusions.

Qualitative Data: Descriptive data that can be observed but not measured.

Quantitative Data: Numerical data that can be measured and quantified.

Inquiry Questions:

What is the scientific method, and why is it important in scientific investigations?

- This question introduces the systematic approach scientists use to conduct research and emphasizes its importance in ensuring reliable and valid results.

How do scientists formulate and test hypotheses?

- This question encourages students to understand the process of developing a hypothesis and designing experiments to test it.

What are the different types of variables in an experiment, and how do they affect the outcome?

- This question helps students identify and differentiate between independent, dependent, and control variables, and understand their roles in experiments.

How can observations and inferences be distinguished in scientific investigations?

- This question focuses on the difference between direct observations and interpretations based on those observations, fostering critical thinking.

Why is it important to have precise and accurate measurements in scientific research?

- This question highlights the significance of precision and accuracy in obtaining reliable data and drawing valid conclusions.

How does peer review contribute to the scientific process?

- This question explains the role of peer review in validating research findings and maintaining the integrity of scientific work.

MYP Objectives	Summative assessment	
Sciences A. Knowing and Understanding In order to reach the aims of sciences, students should be able to: i. explain scientific knowledge ii. apply scientific knowledge and understanding to solve problems set in familiar and unfamiliar situations iii. analyze and evaluate information to make scientifically supported judgments **B. Inquiring and designing** In order to reach the aims of sciences, students should be able to: i. explain a problem or question to be tested by a scientific investigation ii. formulate a testable hypothesis and explain it using scientific reasoning iii. explain how to manipulate the variables, and explain how data will be collected iv. design scientific investigations	Assessment Task: **Criterion A:** - Two Summative Assessments - Create A Animal: Adaptations - Common Formative Assessments **Criterion B.** - Adaptations to a terrestrial biome- Criterion A - Testing the chemical and physical properties of aquatic biomes, predicting the outcomes- Criterion B - Building biomass and ecological pyramids- Criterion C - Biogeochemical cycles, discussing the impacts of excess fertilizer use- Criterion D	Relationship between summative assessment task(s) and statement of inquiry: *Science:* Criterion B & C: What factors affect population growth in yeast?-Design Lab Criterion D: Case Study: Search for the missing Sea Otters-An ecological detective story The Case Study focuses on how a population of sea otters has decreased due to changes in the environment.

Unit Objectives:

1. **Develop and use a model to compare and analyze the levels of Biological Organization.**
2. **Analyze and interpret data to construct an argument of the necessity of biogeochemical cycles to support a sustainable ecosystem. (Hydrologic, nitrogen, phosphorus, oxygen, and carbon)**
3. **Plan and carry out an investigation of how the chemical and physical properties impact aquatic biomes in Georgia.**

Learning Activities and Experiences	Inquiry & Obtain: (LEARNING PROCESS)	Evaluate: (LEARNING PROCESS)	Communicate: (LEARNING PROCESS)
Week 1: SEP1 - SEP4	**Question Refinement**: Groups refine their questions to make them more specific and testable. Introduce concepts like independent and dependent variables. (SEP1) **Experience**: Engage students in a hands-on activity where they observe a phenomenon (e.g., plant growth under different light conditions) and generate questions about it. (SEP1) **Model Analysis**: Students analyze and present their models, discussing how well they represent the real-world phenomena and what limitations they have. (SEP2) **Experience**: Use computer simulations to allow students to manipulate variables and see the effects on the model (e.g., PhET simulations on natural selection and graphing populations). (SEP2) **Investigation Design Basics**: Presentation on the steps of designing an experiment (hypothesis, materials, procedure). (SEP3) **Experience**: Conduct a guided investigation where the whole class follows a pre-planned experiment, focusing on understanding the steps and importance of each part (e.g., Testing the buoyancy of different liquids and objects). (SEP3) **Data Interpretation Practice**: Provide students with sample data sets related to their investigations and guide them through the analysis process. (SEP4) **Experience**: Conduct a simple experiment in class where students collect data (e.g., measuring reaction time under different conditions, graphing the results on a large	**Asking Questions (SEP 1)** 1. **Question Generation**: ○ **Rubric**: Use a rubric to evaluate the quality of questions based on criteria such as specificity, testability, relevance, and clarity. ○ **Peer Review**: Have students provide feedback on each other's questions, which can also be assessed for constructive criticism and engagement. **Developing and Using Models (SEP 2)** 1. **Model Analysis**: ○ **Worksheet**: Provide a worksheet with prompts to guide students in analyzing their models and identifying limitations and areas for improvement. ○ **Peer Review**: Have students review and provide feedback on each other's models, assessing their ability to critically evaluate and suggest improvements. **Planning and Carrying Out Investigations (SEP 3)** 1. **Investigation Plan**: ○ **Planning Template**: Use a structured template for students to submit their investigation plans. Evaluate based on completeness, clarity, logical sequence, and feasibility. ○ **Rubric**: Use a rubric to assess the hypothesis, identification of variables, control group, materials list, and procedure. **Analyzing and Interpreting Data (SEP 4)**	**General Evaluation Methods for All Activities** **Formative Assessments**: ● **Exit Tickets (Closers)**: At the end of each class, students will submit an answer for the days closer (Schoology AMP). **Summative Assessments**: ● **Unit Test**: At the end of the unit, a test will be administered that includes questions on scientific methods, model development, investigation planning, and data analysis. **Self and Peer Assessments**: ● **Reflection Journals**: Students keep a journal reflecting on their learning process and self-assess their progress and understanding. ● **Peer Feedback**: Incorporate peer feedback sessions where students assess each other's work, promoting collaborative learning and critical thinking.

	sticky paper sheet with dots) and analyze it in real-time. (SEP4)	1. **Data Analysis**: ○ **Worksheet**: Provide a data analysis worksheet using their collected data from the in class experience and prompts for students to interpret results.	
Week 2: SEP5 - SEP8	**Mathematics/Computational Thinking (SEP 5).** **Data Set Analysis**: Provide students with a data set relevant to environmental science (e.g., population growth, pollution levels). Have students use mathematical tools to analyze the data *(mean, median, mode, range, and graphing)*. **Constructing Explanations and Designing Solutions (SEP 6)** **Design Challenge:** Pose a real-world problem (e.g., designing a water filtration system). Students work in groups to propose solutions, using scientific principles and evidence to support their designs. **Engaging in Argument from Evidence (SEP 7)** **Class Debate:** Conduct a structured debate *(ex. Snickers is the best candy bar, Football is the best sport, Navy Blue is the best color, etc.*) where each group presents their arguments and responds to counterarguments. *Emphasize the use of evidence and logical reasoning.* **Obtaining, Evaluating, and Communicating Information (SEP 8)** **Information Evaluation:** Provide a mix of credible and non-credible sources on a topic (e.g., effects of pollution on health). Have students evaluate the sources for reliability and bias. **Scientific Presentation**: Assign students to create a presentation or poster on a chosen environmental science topic. Students should obtain information from credible sources, evaluate its accuracy, and present their findings clearly.	**Constructing Explanations & Designing Solutions (SEP 6)** 1. **Design Challenge**: ○ **Written Explanation**: Students write a scientific explanation based on a case study, using the claim-evidence-reasoning framework. Assess the clarity of their claim, the appropriateness and sufficiency of evidence, and the logical connection between evidence and reasoning. **Engaging in Argument from Evidence (SEP 7)** **Class Debate:** ● **Debate Performance:** Use a rubric to evaluate students' participation in the debate, including their ability to present arguments, respond to counter arguments, and use evidence effectively. ● **Peer Feedback:** Have students provide feedback on each other's arguments, assessing the quality of their evaluations and constructive criticism. **Obtaining, Evaluating, and Communicating Information (SEP 8)** **Scientific Presentation**: Assign students to create a presentation or poster on a chosen environmental science topic. Students should obtain information from credible sources, evaluate its accuracy, and present their findings clearly.	**General Evaluation Methods for All Activities** **Formative Assessments**: ● **Exit Tickets (Closers)**: At the end of each class, students will submit an answer for the days closer (Schoology AMP). **Summative Assessments**: ● **Unit Test**: At the end of the unit, a test will be administered that includes questions on scientific methods, model development, investigation planning, and data analysis. **Self and Peer Assessments**: ● **Reflection Journals**: Students keep a journal reflecting on their learning process and self-assess their progress and understanding. ● **Peer Feedback**: Incorporate peer feedback sessions where students assess each other's work, promoting collaborative learning and critical thinking.

Resources (hyperlink to model lessons and/or resources):
Discovery Education Science Techbook

Reflection: Considering the planning, process and impact of the inquiry

Prior to teaching the unit	During teaching	After teaching the unit
Familiarizing students with the Science and Engineering Practices is essential for their continued growth in the curriculum of all Georgia High School Science courses, including Environmental Science. The lab-type preparation and evaluation of student understanding will be paramount in this unit.		