Readington Township Public Schools

Experimental Design and Inquiry

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Readington Township Public Schools
www.readington.k12.nj.us

I. OVERVIEW (Summary of what students will learn, Narrative)

Experimental Design and Inquiry is designed to provide students with a foundational understanding of the scientific method and how to apply it in real-world settings. This course aims to develop students' critical thinking, problem-solving, and analytical skills through hands-on experiments and inquiry-based learning activities. By engaging in the process of experimental design, students will learn how to formulate research questions, develop hypotheses, design controlled experiments, collect and analyze data, and draw conclusions based on evidence. The course also promotes collaboration and communication skills through peer review and presentation of findings. Overall, the course is intended to empower students to think like scientists and prepare them for future scientific inquiry and research.

II. STUDENT OUTCOMES (NJSLS Standards)

The course objectives will cover but are not limited to these standards:

Science and Engineering Practices

1. Asking questions and defining problems
2. Planning and carrying out investigations
3. Analyzing and interpreting data
4. Using mathematics and computational thinking
5. Constructing explanations and designing solutions
6. Obtaining, evaluating, and communicating information

Crosscutting Concepts

1. Patterns
2. Cause and effect: mechanism and explanation
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter: flows, cycles, and conservation
6. Structure and function
7. Stability and change

The Nature of Science

1. Scientific Investigations Use a Variety of Methods
2. Scientific Knowledge is Based on Empirical Evidence
3. Scientific Knowledge is Open to Revision in Light of New Evidence
4. Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
5. Science is a Way of Knowing
6. Scientific Knowledge Assumes an Order and Consistency in Natural Systems
7. Science is a Human Endeavor
8. Science Addresses Questions About the Natural and Material World

Life Literacies and Key Skills

1. 9.4.8.CT.1: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
2. 9.4.8.CT.2: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1)
3. 9.4.8.GCA.2: Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
4. 9.4.8.IML.4: Ask insightful questions to organize different types of data and create meaningful visualizations.
5. 9.4.8.IML.5: Analyze and interpret local or public data sets to summarize and effectively communicate the data.

III. COURSE OBJECTIVES

Introduction to Experimental Design

- Safety, Measurement, and the Scientific Method
  Students will be able to:
  - Identify and practice safety procedures
  - Know when and how to use appropriate safety and lab equipment
  - Measure length, volume, and mass using various lab equipment
  - Convert metric units
  - Identify the steps in the scientific method
  - Identify the importance of ethical guidelines in experimental design

- Variables and Controls
  Students will be able to:
  - Identify variables in experiments (independent, dependent, and controlled)
  - Understand the importance of variables and controls in experiments

- Data Collection and Analysis
  Students will be able to:
  - Follow multi-step directions to carry out experiments in each science domain (physical, life, and earth science)
  - Collect and record data accurately
  - Communicate information based on scientific data

Experimental Design and Inquiry in Practice

- Final Project
  Students will be able to:
  - Plan and carry out an experiment based on interest
  - Analyze data and draw conclusions based on the data collected
  - Present findings to classmates
  - Receive and provide constructive feedback on peers' experimental designs
  - Revise experimental designs based on feedback
  - Reflect on the experimental design process

IV. STRATEGIES

Strategies may include but are not limited to:

- Group discussions
- Teacher presentation
- Student projects
- Guided groups
- One-to-one instruction
- Interactive SmartBoard lessons
- Tutorials
- Online practice
- Inquiry labs

V. EVALUATION

Assessments may include but are not limited to:

- Teacher Observations
- Class Participation
- Class Discussions
- Class Assignments
- Homework Assignments
- Notebooks
- Student Projects
- Tests and Quizzes
- Anecdotal Records
- Presentations
- Science experiment design, analysis, performance, and report

VI. REQUIRED RESOURCES

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Supplemental Resources may include, but are not limited to:

- YouTube
- Online simulations (PhET, Amplify, etc…)
- Newsela
- CK-12
- EdPuzzle
- Teacher created materials

VII. SCOPE AND SEQUENCE

- <u>Introduction to Experimental Design (30 days)</u>
    - Safety, Measurement, and the Scientific Method
    - Variables and Controls
    - Data Collection and Analysis
- <u>Experimental Design and Inquiry in Practice (10 days)</u>
    - Final Project