**Pathways Project**

Please complete the pre-survey

**College and Career Readiness**

 **Lesson Frames: Writer’s Guidelines**

**A. Lesson Title**

*Student independent research: Data Analysis, Conclusions and Communications.*

**B. Lesson** Description

*Students will analyze the data, draw conclusions and communicate their findings from lesson 2 “Experimental Design and Data Collection” that was conducted to answer their testable question from lesson 1 “Topic Selection and Refining a Testable Question”. If Lesson 2 was not performed, the teacher will provide a data set for students to analyze, draw conclusions and communicate results.*

*This is lesson 3 of a three lesson series that can be performed independently or as a whole.*

 *Final Product: Students are expected to design appropriate visual representations of data, draw reasonable conclusions sighting evidence from data, complete group and self evaluations, and communicate findings utilizing presentation software or low tech tools if necessary.*

**C. Grade Level/Subject Area**

***Cognitive skills-*** *interpret information, communicate learning, practice precision, accuracy, reasoning, intellectual curiosity and problem-solving*

***Content skills-*** *display critical reading skills, display critical writing skills, display critical science skills, scientific inquiry, collaborative and safe working practices, appropriate scientific technology, scientific reading*

***Academic behaviors-*** *practice self-awareness, practice self-management, practice successful study skills, work habits, academic integrity*

***College knowledge-*** *social skills that support collaboration, utilize specific knowledge of the norms, values and conventions in the college context*

*Grade Level(s): 6-12*

*Subject Areas: Science*

**D. Objectives**

*Students are expected to:*

* Design appropriate visual representations of data (charts, tables, graphs, diagrams, etc…)
* Conduct appropriate statistical analysis of data
* Identify patterns, trends, commonalities or variations in data
* Utilize critical thinking skills to interpret the results and draw conclusions
* Collaborate in a group
* Communicate findings
* Evaluate self (metacognition) and group learning

**E. Prior Knowledge**

*Students are expected to:*

* have knowledge of variables and control, if applicable
* understand scientific processes and methodologies
* distinguish between inference and observation
* distinguish between qualitative and quantitative data
* possess skills needed to organize and analyze data
* interpret and synthesize findings to offer a reasonable explanation
* possess note-taking and summarization skills
* have time management skills
* possess collaboration skills
* possess communication skills

**F. Preparation and Materials**

*Teachers will need to:*

* establish a timeline with checkpoints (See Teacher Checklist in Scoring spreadsheet provided.)
* implement rubric use (see Scoring sheet.)
* make copies of handouts: Data and Analysis, Elements of Student Research, Scientific Conclusion Writing, Scoring
* provide opportunity to conduct self and peer reflection (See Scoring sheet)
* provide students with a list of available and appropriate presentation software

**G. Scaffolding/Instructional Support**

*Teachers will need to:*

* keep examples of student work that represent high quality and low quality products (so students know the acceptable expectations)
* provide a list of websites/resources appropriate for the academic level of students (for presentation, images, real world connections, etc…)
* check student progress regularly
* address student misconceptions as needed
* provide specific, guided tutoring to students in need of greater direction and structure
* provide definitions of key vocabulary and concepts related to materials as needed
* encourage student independence and self-management (see scoring sheet)
* provide self and peer reflection pieces (See Scoring sheet)
* coach students in presentation and communication skills

**H. Lesson Design**

1. Connection to College and Career

This lesson cultivates intellectual curiosity, reading and applying critical thinking skills by providing opportunities for students to choose and research their testable question for proper experimental design. In college students are often expected to do independent research based upon self-selection. This lesson requires students to utilize some form of a time management tool. College and career success require students to use strategies to complete their work on schedule and provide time to collaborate with their peers. Successful college students work well in groups by listening to the ideas of others and remaining on task. This lesson also requires that students use technology appropriately to gather information and data, demonstrate academic integrity, and communicate effectively in both oral and written forms. These are all required skills necessary to succeed in college.

1. CCRS Performance Expectations:

**Cross-Disciplinary**

**I. Key Cognitive Skills**

A. Intellectual curiosity

1. Engage in scholarly inquiry and dialogue.
2. Accept constructive criticism and revise personal views when valid evidence warrants.

B. Reasoning

1. Consider arguments and conclusions of self and others.
2. Construct well-reasoned arguments to explain phenomena, validate conjectures, or support positions.
3. Gather evidence to support arguments, findings or lines of reasoning.
4. Support or modify claims based on the results of an inquiry.

C. Problem solving

1. Analyze a situation to identify a problem to be solved.
2. Develop and apply multiple strategies to solve a problem.
3. Collect evidence and data systematically and directly relate to solving a problem

D. Academic behaviors

1. Self-monitor learning needs and seek assistance when needed.
2. Use study habits necessary to manage academic pursuits and requirements.
3. Strive for accuracy and precision.
4. Persevere to complete and master tasks.

E. Work habits

1. Work independently.
2. Work collaboratively.

F. Academic integrity

1. Attribute ideas and information to source materials and people.
2. Evaluate sources for quality of content, validity, credibility, and relevance.
3. Include the ideas of others and the complexities of the debate, issue, or problem.
4. Understand and adhere to ethical codes of conduct.

**Cross-Disciplinary Standard II- Foundation Skills**

A. Reading across the curriculum

4. Identify the key information and supporting details.

5. Analyze textual information critically.

6. Annotate, summarize, paraphrase, and outline texts when appropriate.

8. Connect reading to historical and current events and personal interest.

B. Writing across the curriculum

1. Write clearly and coherently using standard writing conventions.
2. Write in a variety of forms for various audiences and purposes.
3. Compose and revise drafts.

C. Research across the curriculum

5. Synthesize and organize information effectively.

6. Design and present an effective product.

7. Integrate source material.

8. Present final product.

D. Use of data

 1. Identify patterns or departures from patterns among data.

 2. Use statistical and probabilistic skills necessary for planning and investigation and

 collecting, analyzing and interpreting data.

 3. Present analyzed data and communicate findings in a variety of formats.

E. Technology

1. Use technology to gather information.
2. Use technology to organize, manage, and analyze information.
3. Use technology to communicate and display findings in a clear and coherent manner.
4. Use technology appropriately.

**Content (Science)**

**I Nature of Science: Scientific Ways of Learning and Thinking**

A. Cognitive skills in science

 1. Utilize skepticism, logic, and professional ethics in science.

 2. Use creativity and insight to recognize and describe patterns in natural phenomena.

 4. Rely on reproducible observations of empirical evidence when constructing, analyzing, and

 evaluating explanations of natural events and processes which hypotheses are formulated

 and tested.

C. Collaborative and safe working practices

 1. Collaborate on joint projects.

D. Current Scientific Technology.

 1. Demonstrate literacy in computer use.

 2. Use computer models, applications, and simulations.

E. Effective communication of scientific information

 1. Use several modes of expression to describe or characterize natural patterns and

 phenomena. These modes of expression include narrative, numerical, pictorial, symbolic,

 and kinesthetic.

 2. Use essential vocabulary of the discipline being studied.

**II. Foundation Skills: Scientific Applications of Mathematics**

A. Basic mathematics conventions.

 2. Use exponents and scientific notation.

 3. Understand ratios, proportions, percentages, and decimal fractions, and translate from any

 form to any other.

 4. Use proportional reasoning to solve problems.

 5. Simplify algebraic expressions.

 6. Estimate results to evaluate whether a calculated result is reasonable.

 7. Use calculators, spreadsheets, computers, etc., in data analysis.

B. Mathematics as a symbolic language

 1. Carry out formal operations using standard algebraic symbols and formulas.

 2. Represent natural events, processes, and relationships with algebraic expressions and

 algorithims.

D. Scientific Problem Solving

 1. Use dimensional analysis in problem solving.

E. Scientific application of probability and statistics

 1. Understand descriptive statistics.

F. Scientific Measurement

 1. Select and use appropriate Standard International (SI) units and prefixes to express

 measurements for real world problems.

 2. Use appropriate significant digits.

**III. Foundation Skills: Scientific Applications of Communication**

A. Scientific Writing

 1. Use correct applications of writing practices in scientific communications.

B. Scientific Reading

 3. Recognize scientific and technical vocabulary in the field and use this vocabulary to

 enhance clarity of communication.

C. Presentation of scientific/technical information

 1. Prepare and present scientific/technical information in appropriate formats for various

 audiences.

D. Research skills/information literacy

 1. Use search engines, databases, and other digital electronic tools effectively to locate

 information.

 2. Evaluate quality, accuracy, completeness, reliability, and currency of information from

 any source.

**Any of the science content standards V-X.**

1. Timeframe:

 Students are expected to complete the lesson in one and a half to two weeks. The length of time will vary based on length of class periods. Students may need to do part of the assignment outside of class. During this lesson, monitor student progress.

1. Vocabulary:

*Students must understand:*

* hypothesis
* control
* constant factors
* independent and dependent variables
* accuracy versus precision
* qualitative data versus quantitative data
* procedure
* observation and inference
* validity
* reliability
* scientific ethics
* conclusion
* evidence
1. Procedures:
* establish a timeline and explain the structure for the lesson
* have students determine within their groups the best way to organize and represent data
* guide students through the process of interpreting their data
* guide students through the process of conclusion writing
* monitor student progress regularly and provide scaffolding as needed
* discuss options and key points needed for a successful presentations
* establish a timeline for presentations
* have students conduct presentations
* have students complete self and group reflections and turn in organized data and conclusions

*\*During group work time, remind students that college professors will require students to work with others to complete projects, and nearly all careers require employees to work cooperatively with colleagues and interact respectfully with clients and/or other staff members. This is a key skill for college and career success.) College students must be able to do this on their own, so it is good to develop this skill.*

1. Solutions

Please see Teacher Resources:

* Data and Analysis
* Elements of Student Research
* Scientific Conclusion Writing, Scoring

**Note: Handouts**

*Please email any handouts or worksheets associated with this lesson plan to smcandrew@sbcglobal.net. These may include data tables, maps, or graphic organizers students would not be expected to devise themselves.* ***Copyrighted materials may be referenced under Preparation and Materials but cannot be included with the lesson plan.***

Please complete the post-survey

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