Middle School Science
Experimental Design – Egg Drop!!!!!
New York State Learning Standards

Math, Science, Technology Standard 1: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions

Performance Indicators:

Scientific Inquiry (2) - Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of convectional techniques and procedures and requiring considerable ingenuity

Scientific Inquiry (3) - The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights to scientific phenomena

Engineering Design - Engineering is an interactive process involving modeling and optimization finding the best solution within given restraints which is used to develop technological solutions to problems given constraints

Objectives:

- Students will use scientific inquiry to solve a problem (Creation of an apparatus to protect an egg when dropped out of a second story window)
- Students will analyze and reflect on the outcome of their egg drop, and develop through reflection, modifications to increase the success of their apparatus
- Students will reflect on their growth and understanding of the experimental design and scientific inquiry processes
**Purpose and Audience:**

The purpose of this portfolio is to reflect student growth throughout an experimental design project. I have chosen a growth portfolio because in the beginning stages of this project, the students will have little experience in this field. However, by the end of the project, it is truly awesome to see the development and growth of the students' use of scientific inquiry and their ability to reflect, critically think, and problem solve.

I find that it is extremely important for my students to also witness this growth, so both I and the individual students will have access to the portfolios. The students will see development from an idea through brainstorming, to the construction and development, to execution through experiment, to the analysis. This process is very rewarding for the students to witness because they are awarded the independence through this experimental design process to implement their own original ideas, and not only able to see the final product, but appreciate the process, a central idea in the field of science education.
**Procedure:**

This growth portfolio will correspond with the experimental design unit, and take approximately two weeks in time. The students will initially be given the task of creating an apparatus that will protect an egg when dropped from a second story window. With few limitations in terms of materials, the students will initially be given the task of brainstorming ideas for an apparatus, including materials needed for construction, a labeled diagram of the intended apparatus, and a “written proposal” explaining how the construction will be executed and the intended outcome. This will be the first artifact in the student’s portfolio. I will give each student feedback regarding their proposal, and the students will be required to begin the construction of their apparatus. The students will only be allotted two class periods for construction. At the end of the third day, the students will be required to complete a “Class-Time Management” reflection, which will consist of questions and a rating scale, in which the students will complete, reflecting how well they managed their allotted time to construct their project. I will also complete a similar rating scale to authentically assess how effective class time was used. The purpose of this reflection is to allow the students to grow and develop as self-regulated learners, develop better time management skills, and allows myself and the student to compare reflections and discuss any discrepancies. After the egg drop experiments are complete, the students will be required to complete a more detailed reflection regarding the process.
Artifacts to be Included in the Student’s Growth Portfolio:

1.) Initial Proposal of Apparatus
2.) Labeled diagram of apparatus
3.) Student "Class-time Management" reflection
4.) Teacher "Class-Time Management" reflection
5.) Conclusion Reflection
6.) Evaluation rubric completed by the teacher
**Sample Artifact:**

![Egg-cellent Experiment!!](image)

**OBJECTIVE:** To create an apparatus that will protect a raw egg enclosed in a plastic bag when released from a second story school window. Success will be determined by your ability to protect the egg from breaking, along with reflection of the scientific experimental design process.

**GUIDELINES:** I will provide you with the raw egg enclosed in a plastic bag on the day of the drop. Please bring in cheap, reusable materials found around your home in the construction of your apparatus. *If you need help locating a specific item, please let me know.*

**MATERIALS THAT CANNOT BE USED INCLUDE** PARACHUTES, MOTORS, PILLOWS ON THE GROUND, AND ANY GLASS OR MATERIALS WITH SHAPED EDGES.

1.) *Brain storm the creation of your apparatus and list materials that you plan to use when creating your apparatus:*

2.) *Write one, well written paragraph (complete sentences), describing the plan that you have devised and explaining why you think it will be successful:*
Reflection:

Reflection and analysis is a huge part of the experimental design process, and will also be a main theme in terms of this growth portfolio. The students will have two requirements in which they will engage in reflection. As mentioned in the procedure, the first reflection requirement asks the students to reflect how effectively they managed their allotted time in regards to productively in the creation of their apparatus. I also complete a similar checklist, and the student and I will meet to compare time-management sheets, and discuss this reflection. This serves many purposes — 1.) Allows the students learn and develop time management skills, which then further their development of self-regulated learners, 2.) Meeting with students makes them aware of my expectations, and by discussing the reflection together, I can provide feedback in terms of developing reflection skills (also contributing to students ability to be a more self-regulated learner), and 3.) I am able to authentically assess this reflection.

The second reflection will be a more in depth analysis of the experimental outcome. This will be an assignment in which the students will be able to analyze their construction and success of their apparatus, discuss changes that can be made to increase successful future drops of the apparatus, critically think about different scenarios for the egg drop and what alterations will need to be made, reflect on their growth regarding experimental design and their development as self regulated learners.
Sample Reflection:

Conclusion Reflection of the Egg-cellent Experiment!!!

Directions: Answer the following questions in approximately 3 or more complete sentences. Please provide an in-depth reflection for each question, as a simple yes or no answer will not be sufficient. You will be assessed on your ability to evaluate your experimental design of your apparatus, and your ability to reflect on that design and the experimental design process.

1.) Did you egg survive the impact of being dropped from the window and why do you think it did or did not?

2.) What was successful about the design of your egg-craft, and why do you feel that it was successful?

3.) What would you change about your egg container if you were to conduct this experiment again and how will those changes affect the success of your apparatus?

4.) If your egg container was released from a fourth story window, what modifications would you make to make your egg craft successful? Please describe and explain.
5.) How did gravity and air resistance affect the egg drop experiment?

6.) Name three things that you have learned about experimental design through the creation of this portfolio.

7.) Did you like having to critically think and brainstorm on your own (without being told what to do), to solve a problem given to you? Why or why not???

8.) In the future, do you think you are better prepared to solve experimental design problems after completing this portfolio?
**Evaluation:** At the middle school level, the students will earn a numerical grade for this portfolio and be evaluated based on the rubric below:

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental Design</strong></td>
<td>Experimental design is a well-constructed test of the stated hypothesis.</td>
<td>Experimental design is adequate to test the hypothesis, but leaves some unanswered questions.</td>
<td>Experimental design is relevant to the hypothesis, but is not a complete test.</td>
<td>Experimental design is not relevant to the hypothesis.</td>
</tr>
<tr>
<td><strong>Drawings/Diagrams</strong></td>
<td>Clear, accurate diagrams are included and make the experiment easier to understand. Diagrams are labeled neatly and accurately.</td>
<td>Diagrams are included and are labeled neatly and accurately.</td>
<td>Diagrams are included and are labeled.</td>
<td>Needed diagrams are missing OR are missing important labels.</td>
</tr>
<tr>
<td><strong>Proposal</strong></td>
<td>Plan is neat with clear components, appropriate materials were chosen, and well written and thought out.</td>
<td>Plan is neat with mostly clear components, well written and thought out, and most materials were appropriately chosen.</td>
<td>Plan provides some clear components, some appropriate materials were chosen, some parts of the proposal were well written and well thought out.</td>
<td>Plan does not explain intended construction, and inadequately written and thought out.</td>
</tr>
<tr>
<td><strong>Class Time Management</strong></td>
<td>Used time well in lab and focused attention on the experiment. Additionally, during teacher meeting, student shows good insight in terms of reflection on construction</td>
<td>Used time pretty well. Stayed focused on the experiment most of the time, and during teacher discussion, student appropriately reflects on construction.</td>
<td>Did the lab but did not appear very interested. Focus was lost on several occasions, and during teacher discussion, did not provide adequate reflection on construction.</td>
<td>Participation was minimal OR student was hostile about participating. Additionally, little to no reflection of construction.</td>
</tr>
<tr>
<td>Error Analysis</td>
<td>Experimental errors, their possible effects, and ways to reduce errors are discussed.</td>
<td>Experimental errors and their possible effects are discussed.</td>
<td>Experimental errors are mentioned.</td>
<td>There is no discussion of errors.</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------</td>
<td>----------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Summary/ Conclusion Reflection</td>
<td>Summary describes the skills learned, the information learned and some future applications to real life situations.</td>
<td>Summary describes the information learned and a possible application to a real life situation.</td>
<td>Summary describes the information learned.</td>
<td>No summary is written.</td>
</tr>
</tbody>
</table>
**Storage and Organization:**

The students will be asked to complete a paper portfolio that will be kept in the back of the classroom. Each student will be supplied a manila folder to keep the contents of their portfolio. I have chosen paper portfolios because given the demographic of my student population, many students have limited to no computer access, and therefore unfair of me to require an electronic portfolio. Additionally, given the grade level of my students, and the fact that many are still working on their organizational skills, by keeping their materials within a personal folder in the classroom reduces the chance of a lost portfolio. When our experimental design unit is completed, the students will be welcome to take their folders home.

**Publishing:**

This is a personal portfolio in which the individual student and I will reflect on student progress. If the student wishes to share the portfolio with parents or peers, that would be their own, personal decision.

I may also share examples of student portfolios with my colleagues to demonstrate how I incorporated the use of portfolios within the experimental design unit.

Additionally, examples of student portfolios may also be shared with my administration in to demonstrate how I am able to incorporate the use of portfolios within my class, and how I am encouraging my students to become more self-regulated learners.