**5E Arts Integrated STEM Lesson Plan**

**Lesson Title:** *Balloons Over Broadway*

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**Topic:** Design and Cause/Effect

**Targeted Grade Level:** 5th Grade

**Time Needed:** 3 days

**Subject Integration:** Art, Science, and Engineering

**Justification:** This lesson will include the subject areas art, science, and engineering. The students will be using art materials to draw their balloon design. Science will be incorporated to demonstrate an alternative way to inflate an object. Students will be learning about the engineering design process. In this lesson, the focus for the engineering design process will be on the planning stage. These three subject areas will flow seamlessly together. When the students reach the planning stage of the engineering design process, they will draw a detailed picture of their balloon, and the students will conduct an experiment/investigation to show how to inflate the balloon.

**Standards:**

**National Art Standards:** Creating – Organize and develop artistic ideas and work.

**NGSS:** 5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

**Alabama COS Science Standards:** Investigate whether the mixing of two or more substances results in new substances.

**NGSS Performance Expectations**:

Alabama Courses of Study are found on the Alabama Learning Exchange website: ALEX

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts: |
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| **5-PS1-4. Planning and Carrying Out Investigations**<br><br>Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.<br><br>• Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.<br><br>**3-5-ETS1-3. Planning and Carrying Out Investigations**<br><br>Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 | **5-PS1-4. PS1.B: Chemical Reactions**<br><br>• When two or more different substances are mixed, a new substance with different properties may be formed.<br><br>**3-5-ETS1-3. ETS1.B: Developing Possible Solutions**<br><br>• Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.<br><br>**ETS1.C: Optimizing the Design Solution**<br><br>• Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. | **5-PS1-4. Cause and Effect**<br><br>• Cause and effect relationships are routinely identified and used to explain change.<br><br>**AL COS:** Cause and Effect |

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| experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.<br>• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.<br>**AL COS:** Planning and Carrying out Investigations | **AL COS:** Matter and Its Interactions | |
| **National Art Standards:**<br>Creating – Organize and develop artistic ideas and work. | | |

**Measurable Student Learning Objectives:** The students will be able to:

- Organize ideas to create a balloon design
- Explain the reaction of two elements
- Use art materials to design an inflatable balloon

**Nature of STEM:** This lesson encompasses the nature of STEM because art, science, and engineering are brought together. Students will use art materials and techniques during the planning phase of the engineering process. Also, the lesson incorporates a science investigation.

**Engaging Context/Phenomena:** Ask the students, have you ever wondered how a rocket is put together? What gases are used to propel the rocket into space? Show the short video of the hardware for NASA's Artemis I. Next, have the students complete the rocket activity: heavy lifting from the Jet Propulsion Laboratory.

**Data Integration:** Using the picture from the NASA website, the students will see a photo and a video of how engineers pushed the tank filled with liquid hydrogen to its limits (test tank video).

**Differentiation of Instruction:** Students with special needs may verbally share their ideas to a paraprofessional or peer. To assess the students with special needs understanding of the reaction of two elements, the student(s) may verbally explain their answer. Also, varying sizes of drawing utensils will be available along with paper weights to keep paper stable during the drawing/sketching portion of the lesson.

**Real-life Connection:** Connect the lesson to students by presenting students with black and white pictures of the Macy's Thanksgiving Day parade. Show them more recent pictures from the parade. By comparing the pictures, the students can see how the artists update the balloons each year. Read the book *Balloons Over Broadway*. This book will help the students learn about the puppeteer Tony Sarg, and they will learn how the parade began many years ago.

**Possible Misconceptions:** Most of the misconceptions will be during the science investigation. Possible misconceptions include: the balloon will explode or pop, the balloon will float, helium and CO2 are the same.

**Lesson Procedure:** To begin the lesson, the students will be watch a brief video clip about Artemis I. Next, the students will be building their own rockets. The students will be building a rocket, using art supplies to draw a balloon, and mixing ingredients for a science investigation. An explanation and discussion of the different types of gases will be presented in the lesson. An area will be setup where students can experiment with balloons filled with helium. There will be different size bags, and the students will see how many balloons it takes to lift a bag. The book *Balloons Over Broadway* will be read. The students will write a synopsis to go along with their picture explaining why they chose the specific design.

| 5E Model | 5E Objectives |
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| **Engage**<br><br>Introduce the lesson with an anchoring phenomenon. Facilitate student questions, discussion, etc. as appropriate. Learn about what students already know and want to know. | **Procedure:** First, ask the students the engaging questions: Have you ever wondered how a rocket is put together? What gases are used to propel the rocket into space? Can you think of other gases that could be used to make objects float or move? Show the students the video of Artemis I. Next, the students will work with a partner to begin the rocket activity. Prepare the classroom by setting up "launch pads" consisting of pieces of fishing line suspended from the ceiling (one line per team of students). From the ceiling, binder clips will be attached to the metal frame supporting the ceiling tiles. Tie the fishing line to the clip. Make sure the line is long enough to reach the floor. Provide open working space around each launch pad. Explain how the straw is used for guiding the rockets. The fishing line is fed through the straw and one balloon is attached to it with masking tape. When the balloon is released, the straw will ride up the line. Each group only gets three balloons. Also, explain how to use the straws for stability, and tell the students that they can use any or all of the parts in their supply kits to build and fly their rockets.<br><br>**Modifications:** Students may be allowed extra time to complete this activity.<br><br>**Standards Addressed:** 5-PS1-4, AL COS: Planning and Carrying out Investigations<br><br>**Formative/Summative Assessments:** The students heavy lift rocket report will be used for assessment.<br><br>**Resources:** large binder clips, fishing line, long balloons, 3oz. paper cups, sandwich size plastic |

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| | bags, masking tape, heavy lift rocket mission report, pencils, and balloon pump |
| **Explore**<br><br>Plan for students to engage in hands-on activities that are designed to facilitate conceptual change. | **Procedure:** The students will observe the combining of the elements vinegar and baking soda to inflate a balloon. Using an empty water bottle, pour vinegar to the fill line. Next, carefully add a few Tablespoons of baking soda into the balloon. Attach the balloon securely to the bottle. Pour the baking soda in the balloon into the bottle. Discuss with the students what is happening to the two elements. Tell the students with the combination of baking soda and vinegar, the gas CO2 formed causing the balloon to inflate.<br><br>**Modifications:** Students with vision impairments may sit closer so they are able to see what is happening during the science investigation.<br><br>**Standards Addressed:** 5-PS1-4, 3-5-ETS1-3, 5-PS1-4. PS1.B, ETS1.C, 5-PS1-4<br><br>**Formative/Summative Assessments:** Exit ticket assessment: each student will be given a sticky note to will write what caused the balloon to inflate.<br><br>**Resources:** empty water bottle, vinegar, baking soda, funnel, and Tablespoon |
| **Explain**<br><br>Facilitate opportunities for students to explain their understanding of concepts and processes and make sense of new concepts. | **Procedure:** Explain that NASA engineers use data to help them build the best rocket possible. Using data helps the engineers build a safer and more efficient rocket. Explain how the engineers purposefully filled the engine tank with liquid hydrogen to capacity. The engineers are keeping track of the temperature, stress, and pressure of the tank. Keeping this kind of data is called “test-to-failure”. Why do you think it is called “test-to-failure”? Keeping track of this data and conducting these types of tests will help engineers build rockets in the future. Show the video clip Space Launch System Liquid Hydrogen Tank Test. What do you think will happen to the tank in this video clip? Write your answer on an index card.<br><br>**Modifications:** Students with a paraprofessional will be allowed to tell their ideas and thoughts to the paraprofessional. |

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| | **Standards Addressed:** 5-PS1-4, Cause and Effect, Creating – Organize and develop artistic ideas and work.<br><br>**Formative/Summative Assessments:** Students will share their predictions that were written down on index cards.<br><br>**Resources:** pencils and index cards |
| **Elaborate**<br><br>Provide applications of concepts and opportunities to challenge and deep ideas; build on or extend understanding and skills. | **Procedure:** Read to the class the book *Balloons Over Broadway*. Explain to the class that Tony Sarg was a puppeteer, artist, and engineer. Using the overhead projector, show the students black and white photos of the Macy's Thanksgiving Day parade and recent photos of the parade. As a class, we will discuss how the parade's balloons have changed in artistic design. The first two steps of the engineering design process will be reviewed. The students will focus on the planning phase of the engineering design process. Using pencils, colored pencils, crayons, and markers the students will draw/sketch possible designs for a parade balloon. Students may refer to pictures of the Macy's parade for inspiration.<br><br>**Modifications:** Students with special accommodations may work with a partner to complete this investigation. Also, these students may have the reading quiz read aloud. Paper weights to keep paper stable and varying sizes of art supplies will be available.<br><br>**Standards Addressed:** 5-PS1-4, AL COS: Planning and Carrying out Investigations<br><br>**Formative/Summative Assessments:** To assess the students' comprehension of the story, the students will take an Accelerated Reader quiz.<br><br>**Resources:** helium filled balloons, string, bags, book – *Balloons Over Broadway,* plain paper, pencils, colored pencils, crayons, markers, and paper weights |

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| **Evaluate**<br><br>Assess students' knowledge, skills and abilities. | **Procedure:** Ask the students: What type of gas, CO2 or helium, would you choose to inflate your parade balloon? Students should complete the planning phase of the engineering design process now. This will prepare the students for the next step of the design process: create. Each student must write a paragraph about their parade balloon. Give the students these writing prompts: Does your parade balloon have a name? What inspired your drawing? Are their certain artistic techniques you used in your drawing? How did you decide what colors to use for your parade balloon?<br><br>**Modifications:** Students with a paraprofessional may explain their answer to them. The paraprofessional may write the explanation for the student.<br><br>**Standards Addressed:** ETS1.C, Creating – Organize and develop artistic ideas and work.<br><br>**Formative/Summative Assessments:** The students must write a paragraph detailed giving a description of their parade balloon. The writing rubric will be used to grade the students paragraph. The final drawing must be attached to the paragraph.<br><br>**Resources:** parade balloon picture, pencils and lined notebook paper |

**Teacher Background:** Knowledge of NASA's space launch system should be read and reviewed, particularly the liquid hydrogen tank test. Also, the teacher needs to know the plan for the rocket activity (Rocket Activity: Heavy Lifting). Knowledge of the engineering design process should be known before beginning the lesson NASA Engineering Design Process. The teacher should also know the reaction of the elements vinegar and baking soda and the differences between CO2 and helium. Some history of Tony Sarg would be beneficial before presenting this lesson.

Writing Rubric

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| Ideas | Several details, accurate, and focused | Supporting details | Few details, not on topic | Unclear details, not on topic |
| Organization | Clear beginning, middle, and end with transitions. Correct paragraphing. | Has a beginning, middle, and end with transitions. Correct paragraphing. | Beginning and ending with few transitions. Irregular paragraphing. | Beginning and ending missing with no transitions. No paragraphing. |
| Sentence Fluency | The sentences enhance the writing. | The sentences structure varies. | Some variety. Repetitive sentences. | Incomplete and run-on sentences. |