

**5E Arts Integrated STEM Lesson Plan**

**Lesson Title:** *Paper Ball Run*

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**Topic:** *STEAM*

**Targeted Grade Level:** *Grades 6-8*

**Time Needed:** *3-5 Days*

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

**Justification:** Students will use science and engineering concepts to design and build a ball run with paper and tape.

**Standards:** *National Art Standards, NGSS*

**NGSS Performance Expectations**

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
<p><b>Asking Questions and Defining Problems</b>  <i>Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.</i></p> <ul style="list-style-type: none"> <li>Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)</li> </ul> <p><b>Developing and Using Models</b>  <i>Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</i></p> <ul style="list-style-type: none"> <li>Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)</li> </ul> <p><b>Analyzing and Interpreting Data</b>  <i>Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</i></p> <ul style="list-style-type: none"> <li>Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)</li> </ul> <p><b>Engaging in Argument from Evidence</b>  <i>Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.</i></p> <ul style="list-style-type: none"> <li>Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)</li> </ul>	<p><b>ETS1.A: Defining and Delimiting Engineering Problems</b></p> <ul style="list-style-type: none"> <li>The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)</li> </ul> <p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)</li> <li>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)</li> <li>Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)</li> <li>Models of all kinds are important for testing solutions. (MS-ETS1-4)</li> </ul> <p><b>ETS1.C: Optimizing the Design Solution</b></p> <ul style="list-style-type: none"> <li>Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)</li> <li>The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)</li> </ul>	<p><b><u>Influence of Science, Engineering, and Technology on Society and the Natural World</u></b></p> <ul style="list-style-type: none"> <li>All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1)</li> <li>The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)</li> </ul>

### Common Core State Standards:

*Common Core State Standards Connections:*

*ELA/Literacy -*

- RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)
  - RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ETS1-3)
  - RST.6-8.9** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3)
  - WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2)
  - WHST.6-8.8** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.(MS-ETS1-1)
  - WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)
  - SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.(MS-ETS1-4)
- Mathematics -*
- MP.2** Reason abstractly and quantitatively. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4)
  - 7.EE.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)
  - 7.SP** Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)

### ITEEA Standards *(If applicable)*

### National Art Standards

**Measurable Student Learning Objectives:** *Students will be able to make designs for a ball run based on specific criteria; choose which design will perform better based on the criteria; and build and iteratively test the designs.*

**Nature of STEM:** *Summarize how your lesson addresses the “nature of” science, technology, engineering, math, etc. as discussed in the Methods of STEM course.*

**Engaging Context/Phenomena:** <https://youtu.be/fAt5B29lzql>

**Data Integration:**

**Differentiation of Instruction:** *How can you adjust this lesson to meet the unique needs of students in your classes? What needs should be addressed? Think about and make these modifications PRIOR to the lesson so all students have the greatest ability to participate.*

**Real-life Connection:** *Is there a real-life connection to this lesson? If so, what is it? How have you considered culturally responsive teaching practices? How will students connect to the lesson in their everyday lives?*

**Possible Misconceptions:** *Are there any previous ideas or thoughts you anticipate students having about this concept? List them here as it will help you consider ideas to include in your lesson.*

**Lesson Procedure:** *This is where you include each phase of the 5E. They should be extremely clear, well organized, and ready to be used by another educator. Be sure that each learning experience meets the guidelines for each “E”. The template below will help you.*

5E Model	5E Objectives
<p><b>Engage</b></p> <p><i>Introduce the lesson with an anchoring phenomenon. Facilitate student questions, discussion, etc. as appropriate. Learn about what students already know and want to know.</i></p>	<p><b>Procedure:</b> <i>(What happens during this phase? What is the teacher doing? What is the student doing?)</i></p> <p><b>Modifications</b> <i>(What student needs must be addressed? How can you make each experience accessible for ALL learners?)</i></p> <p><b>Standards Addressed</b> <i>(Which standards are being explicitly taught in this section?)</i></p> <p><b>Formative/Summative Assessments</b> <i>(How will you assess in each phase?)</i></p> <p><b>Resources</b> <i>(List all resources and materials used in this part of the lesson.)</i></p>

<p><b>Explore</b></p> <p><i>Plan for students to engage in hands-on activities that are designed to facilitate conceptual change.</i></p>	<p><b>Procedure:</b> <i>(What happens during this phase? What is the teacher doing? What is the student doing?)</i></p> <p><b>Modifications</b> <i>(What student needs must be addressed? How can you make each experience accessible for ALL learners?)</i></p> <p><b>Standards Addressed</b> <i>(Which standards are being explicitly taught in this section?)</i></p> <p><b>Formative/Summative Assessments</b> <i>(How will you assess in each phase?)</i></p> <p><b>Resources</b> <i>(List all resources and materials used in this part of the lesson.)</i></p>
<p><b>Explain</b></p> <p><i>Facilitate opportunities for students to explain their understanding of concepts and processes and make sense of new concepts.</i></p>	<p><b>Procedure:</b> <i>(What happens during this phase? What is the teacher doing? What is the student doing?)</i></p> <p><b>Modifications</b> <i>(What student needs must be addressed? How can you make each experience accessible for ALL learners?)</i></p> <p><b>Standards Addressed</b> <i>(Which standards are being explicitly taught in this section?)</i></p> <p><b>Formative/Summative Assessments</b> <i>(How will you assess in each phase?)</i></p> <p><b>Resources</b> <i>(List all resources and materials used in this part of the lesson.)</i></p>

<p><b><u>Elaborate</u></b></p> <p><i>Provide applications of concepts and opportunities to challenge and deep ideas; build on or extend understanding and skills.</i></p>	<p><b>Procedure:</b> <i>(What happens during this phase? What is the teacher doing? What is the student doing?)</i></p> <p><b>Modifications</b> <i>(What student needs must be addressed? How can you make each experience accessible for ALL learners?)</i></p> <p><b>Standards Addressed</b> <i>(Which standards are being explicitly taught in this section?)</i></p> <p><b>Formative/Summative Assessments</b> <i>(How will you assess in each phase?)</i></p> <p><b>Resources</b> <i>(List all resources and materials used in this part of the lesson.)</i></p>
<p><b><u>Evaluate</u></b></p> <p><i>Assess students knowledge, skills and abilities.</i></p>	<p><b>Procedure:</b> <i>(What happens during this phase? What is the teacher doing? What is the student doing?)</i></p> <p><b>Modifications</b> <i>(What student needs must be addressed? How can you make each experience accessible for ALL learners?)</i></p> <p><b>Standards Addressed</b> <i>(Which standards are being explicitly taught in this section?)</i></p> <p><b>Formative/Summative Assessments</b> <i>(How will you assess in each phase?)</i></p> <p><b>Resources</b> <i>(List all resources and materials used in this part of the lesson.)</i></p>

**Teacher Background:** *What background information does the teacher need to effectively teach this lesson? If you can provide links to resources, please do so.*