

5E Integrated STEM Lesson Plan – Template

This template serves as a guide for developing a lesson that integrates across subject areas and includes the components of a quality STEM lesson. Please use it to support your work and engage in discussions with your instructors and peers when you have questions.

Lesson Title: Paper Airplanes!

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Topic: Forces and their effects on the motion of an object

Targeted Grade Level: 7th

Time Needed: 2-3 class periods

Subject Integration: Science, Reading/Writing, and Math

Justification: The topic being investigated is a science topic related to the force and motion standards. The engineering comes into play when they design paper airplanes to test out what forces affect the flight of an object and how best to overcome them. Math will play an important role because the students will be taking measurements related to their planes and their flights, as well as calculating the averages across multiple trials then analyzing that data to determine changes that need to be made to their design and how those changes affect the data. They will also be using their measurements to calculate the kinetic energy of their plane.

Standards:

MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

RST.6-8.3 - Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks

7.EE.B.4 - Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

NGSS, Common Core, or related State standards. Write out (or copy and paste) standards completely. Please identify the point when each standard is addressed in the 5E template below. Each standard should be explicitly addressed within the lesson if it is to be included. Example: Reading aloud a non-fiction text does not solely qualify for ELA integration. Making a graph does not solely qualify for math integration. What concept is explicitly being taught?

NGSS Performance Expectations

MS-PS2-2. Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
<p>Planning and Carrying Out Investigations</p> <p>Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to</p>	<p>PS2.A: Forces and Motion</p> <p>The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. All positions of objects and the directions of forces and motions</p>	<p>Stability and Change</p> <p>Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.</p>

<p>do the gathering, how measurements will be recorded, and how much data is needed to support a claim. ----- -----</p> <p>Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence Science knowledge is based upon logical and conceptual connections between evidence and explanations.</p>	<p>must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.</p>	
<p>Common Core State Standards: <i>Use your state standards if Common Core is not applicable in your state. You are encouraged to list the CCSS and your state standards.</i></p> <p>Math: 7.EE.B.4 - Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p> <p>ELA: RST.6-8.3 - Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks</p>		

CCSS.ELA.WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

CCSS.ELA-LITERACY.WHST.6-8.8

Gather relevant information from multiple print and digital sources, using search terms effectively

CCSS.ELA-LITERACY.WHST.6-8.7

Conduct short research projects to answer a question (including a self-generated question), drawing on several sources

ITEEA Standards *(If applicable)*

Other Standards *(as needed)*

Measurable Student Learning Objectives:

Students will be able to follow the procedure and steps necessary to complete the investigation.

Students will be able to design a paper airplane that flies the length of the room.

Students will be able to take measurements and calculate the average flight speeds using their distance and time measurements.

Students will be able to write a synopsis of their experience, their airplane flights, the changes they made and why they made them referencing their measurements and calculations in the process.

Nature of STEM:

This lesson addresses the Nature of STEM because it incorporates multiple disciplines, bridges the gap between classroom content and real world phenomena, and allows the students to engage in a “minds on” activity that requires them to collaborate and communicate with their group members, think critically, and be creative in order to solve problems.

Engaging Context/Phenomena:

The hook for this lesson is literally the miracle of flight. That it's harder than it looks to make a successful aircraft even though we have thousands of flights happening across the nation daily, they are still looking for ways to make them more efficient and effective. I have a NASA New Aviation Horizons that I will show to the students to let them see all the amazing types of aircraft there are and that many are not just for commercial purposes but also to help us study things about our planet.

Data Integration:

The data used in this lesson will be what the students collect. They will have the room measurement, their flight time, their airplane, and the averages of their flight times. They will use that data to calculate the kinetic energy of their plane. They will also use that data to decide if improvements need to be made to their plane and if so what needs to be improved.

Differentiation of Instruction:

The differentiation during this lesson will be through the use of small groups, using job assignments so that students with learning difficulties are still engaged but in ways they can be successful but also so that all students are taking equal part in what is being explored throughout the activity. There will be writing, calculations, illustrations, and hands on design

throughout this process so there should be something that each student will feel comfortable doing for their team. Groups or teams will be formed in advance by the general education teacher and special education collaborative teacher.

Real-life Connection:

The real-life connection for this lesson is airplane flight and the forces at work that affect it. My students live in an area with multiple small airports, a major airport and UPS hub right down the road, farm planes, and an Army base, they are extremely used to seeing airplanes and helicopters in the sky. So much so that they probably take the feat this is for granted. I want them to see, in a small scale, how much thought and design tweaking goes into the development of successful and efficient aircraft and how those designs are different depending on what you are creating them to be able to do.

Possible Misconceptions:

A KWL chart will be used to figure out what the students think they already know about how planes fly. Based on their responses I can address any misconceptions that come up in the statements they make.

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><u>Engage</u></p> <p><i>Introduce the lesson with an anchoring phenomenon. Facilitate student questions,</i></p>	<p>Procedure:</p> <p>During this phase, the students will be shown a video that lets them see various types of aircraft, including insides the cockpit, snapshots of the airplanes in development, etc. We will then have a discussion about what they saw, what they have maybe seen before, what they thought was cool/interesting, and if any of them have ever flown or want to fly.</p>

<p><i>discussion, etc. as appropriate. Learn about what students already know and want to know.</i></p>	<p>Modifications</p> <p>Because the main resource is a video, very few modifications will need to be made except to provide closed captioning in Spanish for my ELA students.</p> <p>Standards Addressed; No standard is being explicitly taught at this point as this is the engage portion where the students will view and discuss the phenomena</p> <p>Formative/Summative Assessments</p> <p>Assessment will be observational based on student discussion. Checking for engagement with phenomena, general understanding of what airplanes are and what they can do, etc.</p> <p>Resources</p> <p>NASA New Aviation Horizons video</p>
<p><u>Explore</u></p> <p><i>Plan for students to engage in hands-on activities that are designed to facilitate conceptual change.</i></p>	<p>Procedure:</p> <p>Students will conduct research to help their team come up with an optimal design. Students may watch videos on YouTube or read information online (a list of videos and links to get them started will be provided). Each member will do research on their own so that they can have information to share with their group when they start sketching their design. Each member will have their own sketch with labels and explanations based on the research they did individually. We will discuss what types of sites they should be visiting to get relevant and reliable information and the types of video posts they should watch to help them with their airplane design. Reminders about staying on task and citing their sources will also be given.</p> <p>Modifications</p>

For students that need more guidance, a sheet with prompts of what to be looking for in their research will be provided. A Spanish copy for my ESL students will also be provided.

Standards Addressed;

CCSS.ELA-LITERACY.WHST.6-8.8

Gather relevant information from multiple print and digital sources, using search terms effectively

CCSS.ELA-LITERACY.WHST.6-8.7

Conduct short research projects to answer a question (including a self-generated question), drawing on several sources

Formative/Summative Assessments

Completion of guided research sheet

First sketch of proposed plane design

Resources

A guided research sheet (with Spanish version)

List of links/videos to start their research will be posted on Google Classroom.

<p><u>Explain</u></p> <p><i>Facilitate opportunities for students to explain their understanding of concepts and processes and make sense of new concepts.</i></p>	<p>Procedure:</p> <p>The teacher will display diagrams that show the forces that act on the plane, unbalanced forces and their effect on the plane's flight. A video will also be shown showing those forces in action with an explanation. The students will then read a short article and complete the questions sheet.</p> <p>Modifications</p> <p>Readers will be provided as well as extended time for those students whose IEP/504 require it. Spanish versions of and handouts will be available to ESL students. Students in the collaborative special ed group may do the reading and question sheet with a partner if they choose.</p> <p>Standards Addressed</p> <p>PS2.A: Forces and Motion</p> <p>The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change.</p> <p>Formative/Summative Assessments</p> <p>Completion of questions on handouts with at least 80% accuracy.</p> <p>Resources</p> <p>Diagrams showing the four forces acting on an airplane and the unbalanced forces and their effects</p> <p>Video</p> <p>Short reading with explanations and vocabulary</p> <p>Question sheet</p>
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<p><u>Elaborate</u></p> <p><i>Provide applications of concepts and opportunities to challenge and deep ideas; build on or extend understanding and skills.</i></p>	<p>Procedure:</p> <p>Student teams will come together and share their prototype sketches. They will share why they chose them and what would make them a good design choice. Ultimately, the teams will need to choose one of the designs to test. They will then select a paper type to create a plane with, keeping in mind how the mass of the plane may affect its flight. They will then fold their plane to match their chosen design, measure its mass on the scale and record it, then commence flying their plane across the room. They will time its flight and measure its distance recording all of those numbers in their data table. They will complete the flight three times with the same person in charge of launching the plane each time. After they have completed their flights, they will determine if their plane met the criteria of being able to fly across the given space. If not, what do they think is the problem and what do they need to modify in order to improve their plane's flight. They may decide to choose one of the other sketches their group members initially dismissed, change the type of paper, etc. in order to improve their plane. Once that is complete, they will then repeat the test process and take their measurements again. This is repeated until they create a plane that is successful in flying across the room. They will finish their data collection by calculating their planes, average speed and KE. They will compare the numbers of all their planes to see if their data have any correlation to the success or failure of their plane's flight.</p> <p>Modifications</p> <p>Calculators will be available for all students to use. Help with timers and measuring tape will also be provided if necessary.</p> <p>Standards Addressed</p> <p>Math: 7.EE.B.4 - Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p>
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	<p>ELA: RST.6-8.3 - Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks</p> <p>MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.</p> <p>Formative/Summative Assessments</p> <p>Completion of the data table and calculations.</p> <p>Resources</p> <p>Data sheet</p> <p>Measuring tape, calculators, timers, paper for plane design</p>
<p>Evaluate</p> <p><i>Assess students knowledge, skills and abilities.</i></p>	<p>Procedure:</p> <p>Students will write about how they're testing process went. How did their planes do, what design did they choose and why, what changes they made and why, how did those changes help or hinder their plane, did the data correlate with what they saw in the overall flight success or failure, etc. They will also include a final sketch of their successful plane indicating on the sketch what/where they made changes from their initial design.</p> <p>Modifications</p> <p>Students will be allowed to either write or type their reports depending on how they are better able to express themselves and if they need assistive technology like talk to text or help with grammar/spelling, etc.</p> <p>Standards Addressed</p>

	<p>CCSS.ELA.WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>Formative/Summative Assessments</p> <p>Completion of the write up addressing all parts and inclusion of their sketch with labels</p> <p>Resources</p> <p>Report outline for them to follow with guiding questions</p>
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Teacher Background:

Teachers should review the principles of flight themselves. Using the same links above that the students will also use would serve as a good review of those concepts. Also, knowing the needs of the students (IEP/504/ESL) etc will be necessary to plan teams and provide accommodations as needed throughout the lesson.