Grade 8 STEM Unit 2: Flight

Content Area: **STEM**
Course(s): **STEM Grade 8**
Time Period: **MP1**
Length: **7 days**
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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.
MS-PS2-4	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
MS-ETS1-1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
MS-ETS1-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Science and Engineering Practices

Asking Questions and Defining Problems

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)

Developing and Using Models

Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs (MS-ETS1-4)

Analyzing and Interpreting Data

Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

Engaging in Argument from Evidence

Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)

Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

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)

ETS1.B: Developing Possible Solutions

A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)

There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MSETS1-2), (MS-ETS1-3)

Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MSETS1-3)

Models of all kinds are important for testing solutions. (MS-ETS1-4)

ETS1.C: Optimizing the Design Solution

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)

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)

PS2.A: Forces and Motion

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. (MS-PS2-2)

All positions of objects and the directions of forces and motions 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. (MS-PS2-2)

PS2.B: Types of Interactions

Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4)

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

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)

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)

Systems and System Models

Models can be used to represent systems and their interactions— such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-4)

Stability and Change

Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2)

Scientific Knowledge is Based on Empirical Evidence

Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2-2), (MS-PS2-4)

Rationale and Transfer Goals

This unit delves into the scientific principles behind flight, helping students understand the dynamics of aircraft and the forces that allow them to stay airborne. By studying flight, students will gain insight into the physics of motion and the engineering challenges involved in creating successful aircraft designs.

Enduring Understandings

Flight is achieved through a balance of aerodynamic forces, including lift, thrust, drag, and weight.

Understanding the principles of flight informs the design and operation of various aircraft.

Essential Questions

What are the fundamental principles of flight and the aerodynamic forces that allow aircraft to stay airborne?

How do different aircraft designs optimize lift, thrust, and control to achieve successful flight?

How can knowledge of flight principles be applied to real-world aviation and aerospace engineering challenges?

Content - What will students know?

- Principles of lift and control
- Bernoulli’s Principle
- Aerodynamic forces (Lift, Gravity, Drag, and Thrust) and principles

- Real-world aviation and aerospace engineering

Skills - What will students be able to do?

- Analyze the 4 forces of flight
- Identify challenges and iterate on solutions
- Apply knowledge to aircraft design
- Build and test prototypes

Activities - How will we teach the content and skills?

- Flight notes and Class discussion
- Bill Nye Flight video and notes
- Flight Kahoot and/or Baamboozle game
- Design a paper airplane
- Research and presentations

Evidence/Assessments - How will we know what students have learned?

- Question and answer worksheet accompanying google slides Pre/post quiz
- Final Builds for paper airplane and throwing contest
- Formative Assessments

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
Forces of flight	Engineering design principles from Unit 1	Apply the principles of flight to analyze the aerodynamics of the complex systems designed in Unit

		1, considering how design decisions could affect flight performance.

Key Resources

- www.teachengineering.org
- https://www.schooltube.com/watch/bill-nye-flight_lk8h5s26xvd5gi.html
- Paper and pen
- Chromebooks

21st Century Life and Careers

9.2.8.CAP.12	Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential.

Career Readiness, Life Literacies, & Key Skills

9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
9.4.8.CT.2	Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).
9.4.8.CT.3	Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.

Interdisciplinary Connections/Companion Standards

NJSLS ELA

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)

RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS2-2)

WHST.6-8.1 Write arguments focused on discipline-specific content. (MS-PS2-4)

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-PS2-2)

NJSLS Mathematics

MP.2 Reason abstractly and quantitatively. (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3), (MS-ETS1-4), (MS-PS2-2)

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), (MS-PS2-2)

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)

6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-PS2-2)

6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers. (MS-PS2-2)

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. (MS-PS2-2)