THE DREAM TOUR
AERONAUTICS MISSION

MODULE I
THE SCIENCE OF FLIGHT

Introduction

The traditional model of students passively learning facts and reciting them back out of context is no longer sufficient to prepare them to survive in today's world. In order to be successful in today's world and in the future they must possess the fundamental skills or reading, writing, computing, in additional to digital-age skills such as conducting research, working in teams, gathering, synthesizing, and reporting information, and using high tech tools in order to solve complex problems. Fundamental and digital-age skills are necessary for students to become active participants in the learning process, which is facilitated by a skilled teacher.

The Dream Tour, one of two outreach projects of The Harris Foundation (www.theharrisfoundation.org), is a motivational program that encourages America's middle school students (grades 6-8) to both find and achieve their potential by encouraging them to go to college and study science, technology, engineering, and mathematics (STEM) as a way to fulfill their dreams. Dr. Bernard Harris, the founder and CEO of the Foundation, travels to cities throughout the United States to encourage students to achieve their potential.

Missions and Modules

The Dream Tour Instructional Component consists of three missions – Aeronautics, Mechanics, and Geosciences. Each mission currently has three modules designed to expose middle school youth to STEM concepts, processes and content.

The modules do not form a middle school curriculum. The modules are not teaching plans. The modules are instructional resources that contain activities, suggestions, and projects related to six STEM concepts taught in grades 6-8 that can be incorporated into any curriculum or teaching plan. It will be necessary for the teacher to provide engaging content, experiments, investigations, and assessments that will result, when combined with module suggestions, in greater student commitment to learning and achievement. The missions and the modules are linked; therefore they may be taught in any order. The order in which the missions are taught is a teacher decision. Although the modules can be used in grades 6, 7, and 8, the target grade level is 8.

In each module, students will be involved in exploring STEM– related concepts simultaneously developing cross-curriculum skills while working in small collaborative teams. Each module will contain Student Learning Outcomes selected to challenge students and peak their interest in STEM. Students will be required to think critically and analytically, and to find and use appropriate learning resources. Each module is focused on experiential learning that foster active learning, support knowledge construction, concept development that integrate school learning and real life. Students will demonstrate their understanding of the Student Learning Outcomes by completing one or more of the Evidence of Learning suggestions.

The missions are described below.

The Aeronautics Mission
Aeronautics is the study of the science of flight. To design an airplane or other flying machine, aeronautical engineers must understand four basic areas - aerodynamics, propulsion, materials and structures, and stability and control. The three Aeronautics Modules are:

- The Science of Flight
- Space Travel
- STEM Careers in Aeronautics

The Mechanics Mission
Mechanics is the study of the way matter and forces interact with each other in the macroscopic world (bodies that you can easily see, in the solid state). Fields within mechanics are statics, dynamics, and kinematics. The three Mechanics Modules are:

- Physical Forces
- Machines and Inventions
- STEM Careers in Mechanics

The Geosciences Mission
The geosciences address all issues relating to Earth Systems, including the earth, oceans, and atmosphere. The major applications of the geosciences include exploration and development of natural resources (oil, gas, coal, minerals, water, soil), preservation of the natural environment, restoration from environmental damage, and exploratory research. The three Geosciences Modules are:

- Earth Materials
- Weather and Climate
- STEM Careers in Geosciences

All of the modules, except the Career modules, will contain the following components. The Career modules will not include the underlined components.

- Introduction – This component begins with a statement about middle school science. Followed by a definition for the six concepts with the primary concept for the module underlined.
- Student Learning Outcomes – Statements of what students should be able to do upon completion of the module are listed in this component.
- Evidence of Learning – This component contains ways that students can demonstrate their understanding of the Student Learning Outcomes.
- Module Preparation –This component contains advance planning, other information and the academic vocabulary for the module. The academic vocabulary will contain a core list of words that will appear in all of the modules except the career modules. Several other vocabulary words will also be included.
- Suggestions – This component contains Suggestions for Teachers and Suggested Student Activities. Teachers may add to or change the suggestions as long as students are provided opportunities to be actively involved in activities that will assist them in answering the Student Learning Outcomes.

- For Further Study – This component includes other activities that students can do. The activities could be used as homework assignments, make-up work, extra credit points, special assignments, or used in place of or in addition to the Suggested Student Activities. A suggested research topics and suggested research questions are also included.
- Resources – This component will contain one or more websites that can be used to develop teaching plans and/or with the suggested activities.
- Note to the Teacher – Though not a separate component, a Note to the Teacher may appear in module components.

Modules and the National Science Education Standards

According to the National Science Education Standards (NSES), "students should develop an understanding of what science is, what science is not, what science can and cannot do, and how science contributes to culture." (National Research Council, 1996, p. 21)

The NSES presents broad unifying concepts and processes that provide linkages within and among different fields of biological, physical and earth sciences. Unifying concepts help students to construct a holistic understanding of and organize their thinking about science. The NSES also include content standards. Selected unifying concepts and content standards for 5-8 are reflected in the modules.

Below is a brief description of several unifying concepts identified in the NSES. The concepts in **boldface type and underlined** are the concepts that will be developed in the modules.

- **Systems, order and organization** To understand and interpret the world students need the ability to think about the whole in terms of its parts and about parts as they relate to one another and to the whole. "A system is an organized group or related objects or components that form a whole." (NRC 1996) The amount of **matter, energy**, information and the rate at which they are transferred through systems varies. Science shows that there is order and predictability in nature in which certain events or conditions seem to be repeated at regular intervals or periods. Understanding the basic laws and theories that explain the world can be accomplished by connecting order and organization to **systems.**

- **Evidence, models and explanation** Students must have varied and numerous science experiences in a learning environment, which encourage the search for evidence. Models including physical objects, mathematical representations, and computer simulation are used to represent real objects and events, which may or may not be directly observable.

- **Constancy, change, and measurement** The concepts of constancy and change underlie most understandings of the natural and technological world. Through observations, students learn that some characteristics of living things, materials, and systems remain constant (constancy) over time, whereas others change. Through formal and informal studies, students develop an understanding of the processes and conditions in which constancy, change, and measurement take place.

- **Evolution and equilibrium** Evolution is a series of changes in systems. Systems may be biological, physical, or technological. Geological systems include chemical, physical and biological processes. As systems react to **forces** and change, a physical state called equilibrium may develop where forces and changes occur in opposite and offsetting directions.

The science process skills such as observing, classifying and predicting are integrated into NSES Content Standard A, Science as Inquiry. According to the Standards "Inquiry is a step beyond 'science as a process,' in which students learn skills… The new vision includes the 'processes of science' and requires that students combine processes and scientific knowledge as they use scientific reasoning and critical thinking to develop their understanding of science." (National Research Council, 1996, p. 105)

It is important to remember that the Standards do not imply that inquiry should be used for every lesson. The Standards emphasize that a variety of teaching strategies (approaches) are necessary to serve the goal of learning science. It is also important to remember what scientific inquiry is, "a multifaceted activity that involve s making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results." (National Research Council, `1996. P. 23) Therefore inquiry should be taught throughout the school year.

Duration of a Module

The amount of instructional time devoted to each module will depend upon several factors including how the information will be used, class schedule, length of class periods, required curriculum, student interest, and depth of student preparation and prior knowledge.

How to use the Modules

First look at the primary concept in **boldface type and underlined** for each of the modules. Begin with the concept or topic most appropriate for your teaching plans. You do not have to teach all of the modules or begin with Module I and end with Module IX. The modules were developed so teachers could pick and choose the topics and/or activities needed for his/her teaching needs. The modules are equally adaptable to your required curriculum.

Then, review the Student Learning Outcomes for the module you have selected to find out what the students should be able to do upon the completion of the module.

Next, select the Evidence of Learning that you want your students to complete, then write the objectives and decide what knowledge (content) must be taught.

Finally, look at the Suggested Student Activities and select the activity or activities that you want you students to complete. Be sure to select the activities that will help students to complete the Evidence of Learning you have selected.

What, how, and when students' knowledge is assessed is a teacher decision.

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MODULE I TOPIC: THE SCIENCE OF FLIGHT

INTRODUCTION

Middle school science is frequently taught as separate disciplines – life science, earth science, and physical science. When concepts such as matter, energy, change, force and system are taught, the science disciplines come together. However, frequently students are taught these and other concepts individually increasing the chance that students will fail to understand how these concepts are connected. This module will focus on these concepts, which are essential to the teaching of life, earth, and physical sciences with emphasis on the concept of matter-energy.

Energy-Matter – Are interchangeable manifestations of substance and that which enables something to be moved or changed.

Change – Everything is in the process of becoming different or something else. The rate at which change happens varies from very fast to very slow so that it may not noticed in extreme cases.

Force – Any influence that produces motion or that prevents motion; it is a push or pull upon an object.

System – A system is a whole that is composed of parts arranged in an orderly manner according to some scheme or plan. A change in one part tends to affect other parts in the system.

Anything that has the ability to do work has **energy.** A machine has energy. A muscle has energy. Air has energy. There are several forms of energy and two basic kinds of energy, kinetic and potential. Everything in the world is made up of **matter**. Matter is anything that has mass and takes up space. Matter can exist in four phases or states, have physical and chemical properties and can be changed.

The History and Nature of Science (NSES Content Standard G) should be an integral part of your teaching plans to reinforce the students' content knowledge.

STUDENT LEARNING OUTCOMES

Compare potential energy and kinetic energy and describe how potential energy may be changed to kinetic energy.

Explain the flight of an airplane through the concepts of energy, change, and force.

Explain how each of Newton's laws of motion applies to the flight of a rocket.

Describe the general properties of matter.

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EVIDENCE OF LEARNING

Collage or storybook on energy.
A graphic representation of the states and properties of matter.
A working model of an airplane or a spacecraft (rocket, etc.).
In words and pictures, explain how a satellite can have both kinetic energy and potential energy while in orbit.

MODULE PREPARATION

Before you begin this module, introduce the academic vocabulary. If you are a "Dream Tour" school, this should be done before the main event to ensure that the students will be ready to actively participate in the event.

Check for students' understanding of the academic vocabulary words below in **boldface type.** A strategy such as "Think Pair Share" or "Pair Read" could be used.

The first three steps to effective vocabulary instruction (Marzano) could be used to introduce the academic vocabulary. The nonlinguistic representation of the terms (graphic organizers or pictures) that the students produced can be displayed during the main event. The other three steps to effective vocabulary instruction could be used to reinforce the "new" vocabulary words.

If you have not already done so, introduce your students to journal writing. Discuss the purpose and importance of journals and explain that journals are a means of recording ideas, opinions, and dreams. Therefore, there are no right and wrong answers. Journals are different from science notebooks. Science notebook entries could include vocabulary words, questions for discussion, class notes, and assignments. Students should keep both throughout the block of time devoted to this module.

Decide on the directions, task cards, charts and/or criteria for the student activities you have selected.

Along with the content you have identified that must be taught, select appropriate experiments and investigations related to the Evidence of Learning projects. Include at least one experiment that will require students to form a hypothesis, identify variables and construct charts and data tables to record observations.

Academic Vocabulary

Acceleration	Bernoulli's Principle	Drag
Energy	**Force**	**Gravity**
Lift	Mass	Matter
Motion	Newton's Laws	Pressure
Speed	Thrust	**Velocity**
Weight		

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MODULE I TOPIC: THE SCIENCE OF FLIGHT

SUGGESTIONS FOR TEACHERS	SUGGESTED STUDENT ACTIVITIES
Form collaborative teams of 3-5 students/team Be sure to provide each team with a list of the Evidence of Learning suggestions. Unless labeled "Individual" the suggested student activities should be done in student teams. Ask what, how and why questions or conduct an activity that will require students to retrieve information about the academic vocabulary words and the Student Learning Outcomes from prior grades and or life experiences. If you have not done so, provide time to teach students how to do a WebQuest and a storyboard. Have student teams present one of their airplanes to the class. The PowerPoint presentation should include a description of the airplanes, an explanation of how if flies, and a visual. After the presentation, ask the class to identify the variables. As a class discuss the results. Select one of the storyboards to turn into a movie clip. Have students keep a 3"x5" resource file on scientists, engineers, inventors, and technicians. Provide them with the information you want them to record. As students complete activities, have them add words, with operational definitions, to the academic vocabulary list. Provide students with a method for taking notes such as Cornell notes strategy. Their notes will be useful for other modules.	Record entries into your journal; record experimental and investigative results and notes in your science notebook. (Individual) Use all of the academic vocabulary words and in writing a summary of flight. (Individual) Design a WebQuest to study flight. Research and report on the Wright Brothers and other scientists and inventors in the early development of flight. (Individual) Create a story pyramid for one of the scientists you researched. (Individual) Create a storyboard for flight. Include energy. Investigate the states and properties of matter. Make different models of paper airplanes. Design your own experiment to test your airplanes. Submit your design to your teacher for approval. Perform the test. Answer the following question: What are the four forces acting on an airplane? Explain each force. (Individual) If you could design a flying machine of the future, what would it look like? How would you power it? (Individual) Produce a nonlinguistic representation to illustrate the effects of gravity, pressure, and velocity on the movement of objects. Complete a concept web for matter. Demonstrate the lift effect of an airplane that can be explained by Newton's third law of motion and by Bernoulli effect.

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MODULE I TOPIC: THE SCIENCE OF FLIGHT

FOR FURTHER STUDY

Students can research the flight of insects, birds and bats.

Have students make and test kites instead of making a model of an airplane or a spacecraft.

Have students conduct an Internet Scavenger Hunt on Energy.

Have students describe how/where simple machines are found in an airplane. (This can be done in Module V: Machines and Inventions.)

Have students demonstrate their understanding of the concept energy-matter by stating examples of energy-matter in one of the earth sciences.

Suggested Research Topic
Supersonic flights

Suggested Research Questions
How do propeller aircraft work?
How does a helicopter fly?
How do gliders stay up?
How does a jet engine work?
How are aircraft pressurized?

RESOURCES

Visit the Teacher Lounge and the Student Zone on the Dream Tour website (www.daring2dream.org) for STEM information and other resources. Visit the HUNSTEM link.

For information on beginning a Web Quest on flight, refer to the following website: http://cte.jhu.edu/techacademy/fellows/Hammond/WebQuest/khindex.html. (If you use this resource, you ca focus on "how things fly."

For a storyboard, try Windows Movie Maker or other movie making software.

For patent information: www.uspo.gov

For information on engineers, visit the following websites:
www.discoverengineering.org
www.eweek.org/site/engineers/zoom (This site contains student information and activities.)