THE DREAM TOUR
MECHANICS MISSION

MODULE VI
CAREERS IN MECHANICS

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.

MISSION: MECHANICS

MODULE VI TITLE: STEM CAREERS IN MECHANICS

INTRODUCTION

A career can be defined as a chosen pursuit, a profession or occupation. With the aid of technology and the increased acceptance of people having multiple kinds of work, the definition of career is shifting to being defined as an individual's work and life roles over their lifetime. It is important that you provide your students opportunities to explore various career options in science, technology, engineering and mathematics-related fields. As middle school students, they may be unaware of all of the job possibilities. This module provides suggested activities that will help students to learn about a variety of mechanics careers.

Mechanics is an important branch of physics concerned with the behavior of physical bodies when subjected to forces. Developed by Sir Isaac Newton, the laws of mechanics and the law of gravity successfully explained the orbits of the moon around the earth and the planets around the sun. Newton's laws are used to design cars, clocks, airplanes, earth satellites, bridges, buildings—just about everything, except electronics.

Note to the Teacher: This module can be used to help students develop an understanding of (1) science as a human endeavor, (2) nature of science and (3) history of science. (NSES Content Standard G: History and Nature of Science)

STUDENT LEARNING OUTCOMES

Categorize careers in areas of classical mechanics.

Summarize the diversity of contributors and contributions to mechanics.

EVIDENCE OF LEARNING (PRODUCTS)

Research paper on one career in an area of classical mechanics.

Write up of an interview of someone who works in a classical mechanics profession.

Make a model of a product, invention, or design by a scientist or engineer working in a mechanics area to include a biography of the inventor or designer.

MODULE PREPARATION

In order for students to have the abilities necessary to do scientific inquiry (NSES Content Standard A), they must be able to access, gather, sort, retrieve and organize data for scientific investigations and knowledge. If you begin with this module, be sure that you provide students with research strategies that they will need to complete the tasks listed in the instructional suggestions.

The same approach that is used when they are organized to design an investigation, conduct a debate, design a project, or solve a problem may be used.

MISSION: MECHANICS

MODULE VI TOPIC: STEM CAREERS IN MECHANICS

SUGGESTIONS FOR TEACHERS	SUGGESTED STUDENT ACTIVITIES
Form collaborative student teams (3-5 students/team). Be sure to provide each team with a list of the Evidence of Learning. Unless labeled "Individual" the Suggested Student Activities should be done in student teams. Let each team of students select one of the following headings to research careers. Provide the teams with due dates. Newtonian mechanics Fluid mechanics Hydraulics Celestial mechanics Astrodynamics Acoustics Universal gravitation Biomechanics Biophysics. If you prefer, have students brainstorm to determine what classical mechanics careers or areas they will research. Introduce and facilitate the book circles. Allow time for teams to share their reaction to the biography or you can provide questions for them to answer. For outstanding trade books, go to www.nsta.org/publications/ostb. Have students keep a resource file (3"x5") on careers, scientists, inventors, engineers, and technicians. Provide students with the information that you want them to include on the cards. Individual students or student teams could do this. At the end of each semester, have students plan and present an Exhibit Fair for students in their school or for elementary students or to present to parents. The exhibit fair should be based on the contributions of the scientists they researched.	Research and report on careers in classical mechanics. Include the education required, job description, and the salary range. Present a plan to your teacher for approval for presenting your research to the class. Be Creative. Compile a list of people past and present who worked in or made a contribution to the careers you researched. Select a book that is a biography for one person on your list. Create a career portfolio for one classical mechanics career. (Individual) Write a job advertisement for a STEM career in classical mechanics including job benefits and starting salary. Create and maintain a wiki to post summary statements about the careers that you research. Answer the following questions: If you could invent a tool that would be used in space exploration, what would it be? Explain. (Individual) If you never study mathematics or science, how could that change your life? (Individual)