National Center
for Earth and Space Science Education

Universities Space Research Association

Introduction to the *Journey through the Universe* Program, the MESSENGER Education and Public Outreach Program, and the MESSENGER Education Module *Staying Cool* Grade pre-K–4 Lessons

1. The Programs

Journey through the Universe (http://journeythroughtheuniverse.org) is a national science education initiative that engages *entire* communities—students, teachers, families, and the public—using education programs in space exploration and the space sciences to inspire and captivate. The initiative embraces the notion that—*it takes a community to educate a child.*

Journey through the Universe programming is tailored to a community's strategic needs in science, technology, engineering, and mathematics (STEM) education, and is a framework for partnership between school districts, museums and science centers, colleges and universities, civic and business organizations, and the public. The cornerstone philosophy for all programming is—*inspire… then educate.*

NASA's MESSENGER Spacecraft Mission to Mercury (http://messenger.jhuapl.edu} includes education programs delivered by organizations nationally. The National Center for Earth and Space Science Education oversees a number of these programs, including: 1) the development of middle and high school components for grade pre-K-12 MESSENGER Education Modules—each a theme-based compendium of inquiry-based lessons on Solar System science and exploration (the Carnegie Institution of Washington is responsible for the grades pre-K-4 component); 2) delivery of Solar System content through community initiatives such as *Journey through the Universe*, and 3) the creation, training, and support of a cadre of master science educators—the MESSENGER Educator Fellows—which in turn train 3,000 teachers a year on the Modules, corresponding to 27,000 teachers trained over the mission lifetime (through 2012), and translating into experiences for over 1 million students.

2. The Grade pre-K-12 MESSENGER Education Module *Staying Cool*

The MESSENGER Education Module *Staying Cool* focuses on the process of scientific inquiry as applied to engineering problems in planetary exploration. The lessons specifically address the extreme conditions of the space environment, the problems these conditions pose for spacecraft, and the engineering solutions to these problems. Lessons explore how MESSENGER—or any other spacecraft—can use sunlight and other forms of radiation to meet the scientific goals of the mission, while still protecting the instruments and other sensitive parts of the spacecraft from too much sunlight and radiation.

The MESSENGER Education Module *Staying Cool* includes grade level components at three grade levels: elementary (pre-K–4); middle (5–8); and high school (9–12). Each component contains lessons comprised of content overviews, inquiry-based hands-on activities, assessment rubrics, resource listings, student worksheet masters, and answer keys.

The lessons were developed from the ground up from national science education standards and benchmarks. Lessons target core standards and benchmarks through inquiry-based, hands-on activities whose objective is deep conceptual understanding of both content and process.

3. The *Staying Cool* Grade preK-4 Lessons

This document provides a description of each lesson and the embedded inquiry-based activities for the *Staying Cool* **elementary school (grade pre-K–4)** component. Also provided are connections to grades pre-K–4 National Science Education Standards and AAAS Benchmarks for Science Literacy.

Staying Cool: The Pre-K–1 Grade Level Component Progression		
Lesson Title	Lesson Description	Activities
Lesson 1: Cooler in the Shadows	Students will make inferences about the cause of shadows, by observing and making their own shadows in the sun. Many properties of shadows (such as heat and brightness of light) will also be identified firsthand as the students conduct simple experiments to observe changes that are comparable to those experienced by the MESSENGER spacecraft in its voyage to and around Mercury.	*Activity 1: Shadows* In this activity, students will explore making and tracking the shadows of different objects over the course of the day to discover patterns in the behavior of sunlight, temperature and shadows. *Activity 2: Bear Shadow* Students demonstrate their understanding of shadows through a reading of the book Bear Shadow by Frank Asch. *Activity 3: Shadows of the Neighborhood* In this activity, students will construct a model neighborhood to demonstrate their understanding of shadows. Many questions and suggestions for variants to the activities are presented to allow the teacher to tailor this lesson to particular needs. *Activity 4: Creating Shadows of Model Earth* Students experiment with making shadows of a three-dimensional object including a globe to see how they can alter the size, shape and position of their shadows.
Design Challenge: What Will Keep My Lunchbox Cool?	Students often have creative ideas for solving common problems. Their solutions are often limited to ideas rather than to reality and a product. The goal of this activity is to develop the young learner from a creative thinker to a problem solver. In this activity, students will take an everyday problem and design a practical solution. Youngsters will consider how to keep a lunchbox cool during a trip to the beach.	*Activity:* Students use the scientific method to design a way to keep their lunchbox cool in a hot environment.

Staying Cool: The 2-4 Grade Level Component Progression		
Lesson Title	Lesson Description	Activities
Lesson 1: Sensing Energy	Students detect the unseen energy in UV light coming from the Sun, discuss why such light is harmful, and experimentally determine how we might protect ourselves.	*Activity:* Using 'UV beads', which sense ultraviolet light by changing color, students detect UV light coming from the Sun. Students first test a number of light sources, such as fluorescent and incandescent bulbs, but find that it is the Sun that produces an obvious color change. A class discussion explores key concepts, including: forms of light that cannot be seen, that all light contains energy, and that the energy in ultraviolet light from the Sun poses a danger to us. Students then use the UV beads to develop methods to block UV light, and afford us protection.
Design Challenge: How Do You Keep Things from Getting Too Hot?	This challenge provides a motivating experience for children to use a scientific approach, problem solving and cooperative teamwork. They are challenged to work as a team to design and build an effective sunshade for a model of the MESSENGER spacecraft.	*Activity:* Students will work as a team to draw and build a model of the MESSENGER spacecraft with design elements as specified. Students will then design and test a sunshade to protect sensitive on board tools and instruments from excessive heat of the Sun. The sunshade must keep the instrument deck at least 10 degrees Celcius cooler than the temperature of the craft without the sunshade.

Connection to Standards

This Education Unit has been mapped to the National Science Education Standards (National Research Council, National Academy Press, Washington, DC, 1996) and to the Benchmarks for Science Literacy, (American Association for the Advancement of Science, Project 2061, Oxford University Press, New York, 1993). A complete explanation of the Standards can be found at: http://www.nap.edu/html/nses/html/. A complete explanation of the Benchmarks can be found at: http://www.project2061.org/tools/benchol/bolintro.htm. Core standards for each lesson are indicated by a "√"; related standards are indicated by an "x."

	Education Standards In Staying Cool Pre-K–4 Grade Level Component									
	National Science Education Standards							AAAS Benchmarks for Science Literacy		
	Standard A: Science as Inquiry		Standard B: Physical Science	Standard D: Earth and Space Science	Standard E: Science and Technology		Standard F: Science in Personal and Social Perspectives	Benchmark 3: The Nature of Technology	Benchmark 4: The Physical Setting	Benchmark 11: Common Themes
	Abilities necessary to do scientific inquiry	Understanding about scientific inquiry	Light, heat, electricity, and magnetism	Objects in the sky	Understanding about science and technology	Abilities to distinguish between natural objects and objects made by humans	Science and technology in local challenges	Design and systems	Energy transformations	Models
Pre-K–1 Lesson 1: Cooler in the Shadows	x	x	√	√					√	
Pre-K–1 Design Challenge: How Can I Keep My Lunchbox Cool?				√	√		x			
2-4 Lesson 1: Sensing Energy	x	√	√	√						
2-4 Design Challenge: How Do You Keep Things from Getting Too Hot?	x	x			√	√		√		√