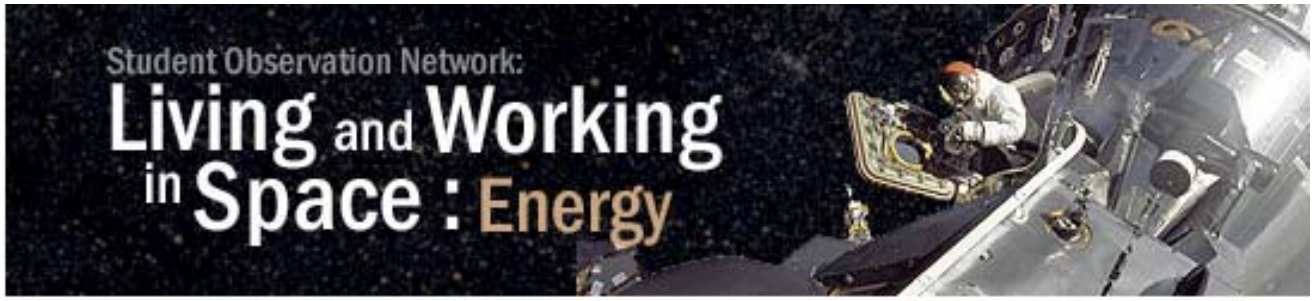
National Aeronautics and Space Administration

Solar Energy for Space Exploration
Teacher Resources



Standards

National Science Education Standards

Grades 5-8

1. Science as Inquiry (Std [Standard] A)
    a. Abilities necessary to do scientific inquiry
    b. Understanding about scientific inquiry
2. Physical Science (Std B)
    a. Transfer of Energy
3. Earth and Space Science (Std D)
    a. Earth in the Solar System
4. Science and Technology (Std E)
    a. Abilities of Technological Design
    b. Understanding about Science and Technology

Grades 9–12

5. Science as Inquiry (Std A)
    a. Abilities necessary to do scientific inquiry
    b. Understanding about scientific inquiry

Physical Science (Std B)

c. Structure of atoms

d. Structure and properties of matter

e. Chemical reactions

f. Motions and forces

g. Conservation of energy and increase in disorder

h. Interactions of energy and matter

6. Science and Technology (Std E)

a. Abilities of Technological Design

b. Understanding about Science and Technology

Five Es

	Suggested Activity	What the Teacher Does	What the Student Does
Engage	• Demonstrate • Read • Write freely • Analyze a graphic organizer • Brainstorm	• Creates interest. • Generates curiosity. • Raises questions. • Elicits responses that uncover what the students know or think about the concept/topic.	• Asks questions such as, Why did this happen? What do I already know about this? What can I find out about this? • Shows interest in the topic.
Explore	• Perform an investigation • Read authentic resources to collect information • Solve a problem. • Construct a model.	• Encourages students to work together without direct instruction from the teacher. • Observes and listens to the students as they interact. • Asks probing questions to redirect the students' investigations when necessary. • Provides time for the students to puzzle through problems.	• Thinks freely but within the limits of the activity. • Tests predictions and hypotheses. • Forms new predictions and hypotheses. • Tries alternatives and discusses them with others. • Records observations and ideas. • Suspends judgment
Explain	• Analyze and explain • Support ideas with evidence • Formulate structured questions • Read and discuss • Provide teacher explanation • Conduct thinking-skill activities: compare, classify, and analyze errors	• Encourages the students to explain concepts and definitions in their own words. • Asks for justification (evidence) and clarification from students. • Formally provides definitions, explanations, and new labels. • Uses students' previous experience as basis for explaining concepts.	• Explains possible solutions or answers to others. • Listens officially to others' explanations. • Questions others' explanations. • Listens to and tries to comprehend explanations the teacher offers. • Refers to previous activities. • Uses recorded observations in explanations.
Extend	• Solve problems • Make decisions • Conduct experimental inquiry • Conduct thinking-skill activities: compare, classify, and apply	• Expects the students to use formal labels, definitions, and explanations provided previously. • Encourages the students to apply or extend the concepts and skills in new situations. • Reminds students of alternative explanations. • Refers the students to existing data and evidence and asks, "What do you already know?" Why do you think?" • Strategies for explore apply here also.	• Applies new labels, definitions, explanations, and skills in new but similar situations. • Uses previous information to ask questions, propose solutions, make decisions, and design experiments. • Draws reasonable conclusions from evidence. • Records observations and explanations. • Checks for understanding among peers.
Evaluate	• Do any of the above • Develop a scoring tool or rubric • Test • Assess performance • Produce a product • Make a journal entry • Create a portfolio	• Observes the students as they apply new concepts and skills. • Assesses students' knowledge and/or skills • Looks for evidence that students have changed their thinking or behaviors • Allow students to assess their own learning and group-process skills. • Asks open-ended questions, such as: Why do you think? What evidence do you have? What do you know about x? How would you explain x?	• Answers open-ended questions by using observations, evidence, and previously accepted explanations. • Demonstrates an understanding or knowledge of the concept or skill. • Evaluates his or her own progress and knowledge. • Asks related questions that would encourage future investigations.