

## Parachute Recovery, Inquiry into Energy Systems

<b>LEARNING AREA:</b>	Scientific Concepts and Applications
<b>EDUCATIONAL LEVEL:</b>	High School
<b>CONTENT STANDARD:</b>	Earth and Space Systems

### A student shall:

**A.** Demonstrate understanding of an energy system as represented by a parachute recovery system. Students will design, test, and evaluate such a system and write a lab report of their design.

**B.** Demonstrate understanding:

1. of how historical and current scientific concepts and knowledge guide scientific inquiries;
2. that scientific inquiries are performed to test ideas and predictions and to learn about the natural world;
3. of how the use of various technologies influence the quality of data and the investigation;
4. of the essential role of mathematical tools and models and how they are essential to scientific inquiry;
5. of how explanations based on evidence adhere to established criteria including empirical standards, logic, openness to criticism, and reporting of methods and procedures;
6. of how traditions govern the conduct of science, including ethics, peer review, and consensus.

**C.** Design and conduct an experiment to investigate a question and test a hypothesis by:

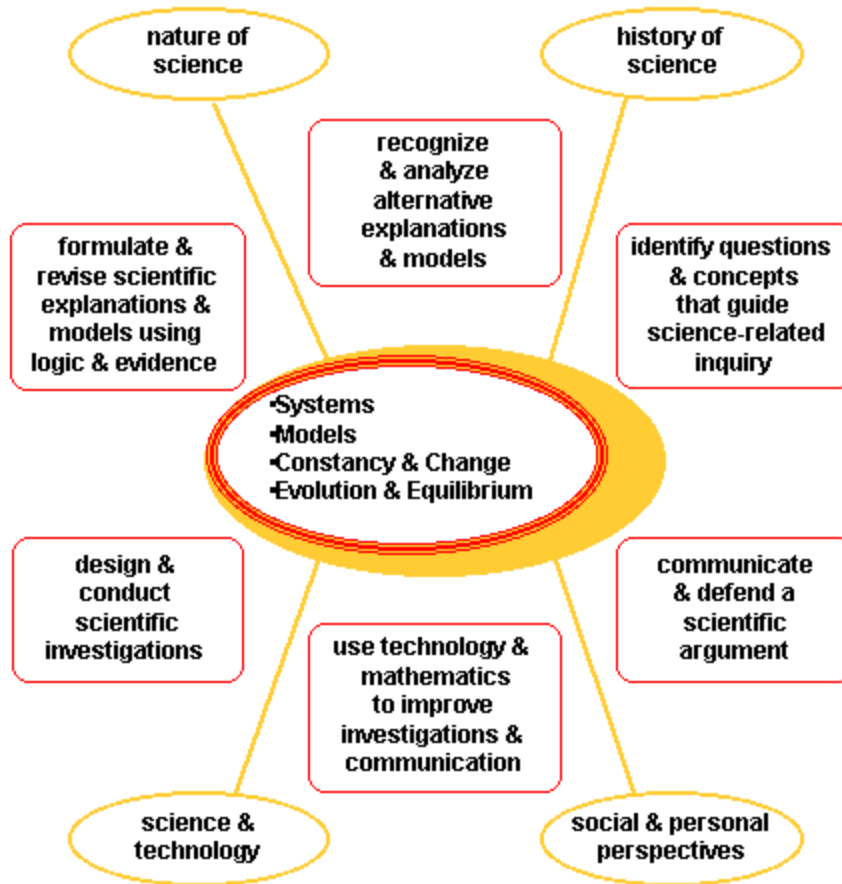
1. formulating a question and hypothesis;
2. designing and conducting an investigation;
3. recording relevant data;
4. analyzing data using mathematical methods;
5. contracting reasonable explanations to answer the question and supporting or refuting the hypothesis;
6. identifying and considering alternative interpretations of results, and
7. specifying implications for further investigations

**D.** Design and conduct one experiment to measure one of the forces by identifying scientific issues based on observation and the corresponding scientific concepts; analyzing data to clarify scientific issues or define scientific question, and comparing results to current recovery systems.

**NEXT STEP: Large Process/Concepts**

## Parachute Recovery, Inquiry into Energy Systems

### Large Process/Concept-----



### NEXT STEP: Assessment Task

## Parachute Recovery, Inquiry into Energy Systems

### Assessment Task-----

#### Description:

After an introduction on energy concepts, students will research parachute recovery systems employed by government and civilian agencies (such as the Cirrus Corporation) to recover air or space vehicles. Students will then perform an experiment and model a system using this technique and experimental data.

#### Products/Evidence of Learning:

1. A summary of media center research performed
2. An experiment proposal with data interpretation
3. A written report

#### Overview:

The objective of this activity is to design and build a parachute recovery system that will allow an egg dropped from some specified height to safely land without damage (typically two stories). It is unique in that the system must be viewed as an energy system. The type of parachute system used will be based upon their initial media center research. Once a design is selected, modeling must be used to avoid trial and error methodology using eggs; i.e. the recovery system will be tested only once with an egg. Success will depend largely in part on how well the students have utilized the data presented and modeled systems prior to a drop. The system is to consist of a small container that just encloses a standard egg (such as a paper tube from an aluminum foil dispenser). The base of the container must be a hard material, at least a 1/4 inch thick, such as plywood or hardboard. Only 2 mm of any padding may be used at the base. No padding may be used above or on the sides to protect the egg. The teacher will "sacrifice" one egg in front of class by dropping it. This will be done from an initial height of 1 cm, continually adding 1 cm to this height until the egg cracks. From this information the student will calculate the maximum energy the egg can handle. The students will construct a parachute system and test it by putting in a dummy load. It is up to the students to determine its power dissipation based on drops from heights no greater than 3 meters. Only when a reasonable model based upon tests and data comparison has been submitted will the students be allowed to test their system with an egg. A formal report will be written at the end of this exercise explaining how their system worked, how much energy it dissipated and the power output, how well it performed, as well as offering a comparison of its performance to other systems used.

### NEXT STEP: Checklist

# 2001 Transportation Education Academy Activities

High School Activities: Air, Land, Water, Multi-Modal

## Parachute Recovery, Inquiry into Energy Systems

### Checklist-----

STUDENT	TEACHER	
_____	_____	Student correctly utilizes energy and power concepts in their investigation.
_____	_____	Student relates and utilizes media research in their project.
_____	_____	Student relates the importance of modeling to the actual physical system.
_____	_____	Student evaluates final test results including a critique and comparison of other systems.
_____	_____	Student produces a formal lab report which clearly communicates his/her results.