Rationale:
According to the California Science Standards, erosion and its effects on the environment are important science concepts introduced in the 4th grade and covered in more depth in the 6th grade. While the new science standards have not yet been implemented in most schools, these modules were designed to complement these standards. Specific science standards addressed in this Earth Science lesson plan are:

4th grade:
- Some changes in the Earth are due to slow processes, such as erosion.
- Moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).
- Students can differentiate observation from inference (interpretation) and know that scientists' explanations come partly from what they observe and partly from how they interpret their observations.
- Students are asked to measure the weight and volume of objects.
- Students can formulate and justify predictions based on cause-and-effect relationships.
- Students are asked to follow a set of written instructions for a scientific investigation.
- Students are asked to construct and interpret graphs from measurements.

5th grade:
- Students are asked to record data by using appropriate graphic representations and make inferences based on those data.

6th grade:
- Water running downhill is the dominant process in shaping the landscape, including California's landscape.
- Rivers and streams are dynamic systems that erode, transport sediment, change course, and flood their banks in natural and recurring patterns.
- Earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats.
- Students are asked to develop a hypothesis.
- Students are asked to select and use appropriate tools and technology (including balances and graduated cylinders, etc.) to perform tests, collect data, and display data.
- Students are expected to recognize whether evidence is consistent with a proposed explanation.

Disclaimer: These activities were adapted from the website: http://btc.montana.edu/nten/trc/eslab_text.html. Other activities can be found on this site as well.
Part 1: Erosion

Objectives:
After participating in the program *Earth Science, Part 1*, students will be able to:

- measure and record a volume (of water)
- measure and record the mass (of soil)
- explain how contouring, cover crops, strip cropping, reforestation, and interseeding are used to control erosion
- make graphs comparing different soil treatments and draw conclusions based on experimental data
- recognize that erosion is a continuous natural process
- report how human activities contribute to (accelerate) erosion processes
- list some impacts of erosion on the environment

Vocabulary:
- **erosion** - the process by which the earth's surfaces (e.g., rocks and soil) are loosened, dissolved or worn away and transported to another place
- **runoff** - water that flows over the earth's surface
- **contouring** - an erosion control measure that consists of planting of row crops (like corn, soybeans, and tobacco) across the slope as much as possible
- **sod cover** - the planting of grass plants to control erosion
- **terracing** - used in areas with long slopes - the slopes are shortened by installing some sort of ridges across the contours of the field
- **strip cropping** - a variation of contour farming which involves growing crops in long narrow strips along the contour - row crops such as corn are grown side by side with strips of canopy crops such as soybeans or alfalfa
- **conservation tillage** - any tillage system which leaves a minimum of 30% of the previous residue on the soil surface
- **reforestation** - when farm land is planted with trees to return it to its original forested condition to control erosion
- **cover cropping** - when a non-cash crop is planted without the intention of harvesting to cover land for a growing season instead of leaving it fallow (when a field or land has been plowed but not sown with seed) – this is usually done during the season that a cash crop is not being grown
- **interseeding** - an erosion control measure which entails sowing a cover crop into a standing vegetable crop

Lesson Notes:
1. Can you name some natural processes that contribute to erosion? This list could include landslides, avalanches, rain, rivers, tides, glaciers, wind, and floods.
   Can you think of any human activities that would make erosion go faster than it normally would in nature? Students may suggest things such as: uncontrolled burning, agricultural practices, logging, recreational activities, mining, and urban development (e.g., highway and home site construction).
2. What outcomes do the students anticipate from the erosion experiment? Which soil conditions will erode the most and which will erode the least? Students could also predict which soil treatments are likely to erode most quickly or most slowly, and which will encourage the most water retention in the soil.

What soil conditions did each of the erosion tray represent?

- Tray 1: no treatment
- Tray 2: sod cover
- Tray 3: contouring across the slope
- Tray 4: contouring in the direction of the slope
- Tray 5: terracing

The answers to the following questions will depend on the actual results of the class’ experiments (These results can be different than the “ideal” results due to variations in preparation, materials, etc.). It is important that the students be able to discuss the results and reach logical conclusions based on them.

Which erosion tray lost the most soil?
Which had the greatest amount of runoff?
Does the amount of runoff water relate to the amount of soil eroded?
In which tray did the erosion first appear?
In which tray did the erosion last the longest?
Which land management methods were most effective in controlling erosion in this experiment? Why?
Why did we use the same amount of water and rate of sprinkling for each erosion tray?

3. The following subjects could be introduced and discussed at this point, or could be used as assignments for the students to independently research and report to the class: strip cropping, conservation tillage, reforestation, cover cropping, and interseeding.

Answers to the worksheet are located in the file: earthsci_1_wksht_key.

References and Extension Ideas:

These activities were adapted from the website: http://btc.montana.edu/nten/trc/eslab_text.html. Extension activities can be found on this site as well as on the sites listed below:

1. http://btc.montana.edu/nten/trc/