# *River Cutters*
# Candidate Benchmarks

This list is provided to help workshop leaders anticipate which benchmarks participants might select as candidates. The list should not be distributed to participants. Because the unit is recommended for grades 6-9, mostly 6-8 benchmarks are listed as candidates.

**1B *Scientific Inquiry* (6-8)#2**

If more than one variable changes at the same time in an experiment, the outcome of the experiment may not be clearly attributable to any one of the variables. It may not always be possible to prevent outside variables from influencing the outcome of an investigation (or even to identify all of the variables), but collaboration among investigators can often lead to research designs that are able to deal with such situations.

**3B *Design and Systems* (6-8)#2**

All technologies have effects other than those intended by the design, some of which may have been predictable and some not. In either case, these side effects may turn out to be unacceptable to some of the population and therefore lead to conflict between groups.

**3C *Issues in Technology* (6-8)#5**

New technologies increase some risks and decrease others. Some of the same technologies that have improved the length and quality of life for many people have also brought new risks.

**3C *Issues in Technology* (6-8)#6**

Rarely are technology issues simple and one-sided. Relevant facts alone, even when known and available, usually do not settle matters entirely in favor of one side or another. That is because the contending groups may have different values and priorities. They may stand to gain or lose in different degrees, or may make very different predictions about what the future consequences of the proposed action.

**4C *Processes that Shape the Earth* (3-5)#1**

Waves, wind, water, and ice shape and reshape the earth's land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers.

**4C *Processes that Shape the Earth* (6-8)#2**

Some changes in the earth's surface are abrupt (such as earthquakes and volcanic eruptions) while other changes happen very slowly (such as uplift and wearing down of mountains). The earth's surface is shaped in part by the motion of water and wind over very long times, which act to level mountain ranges.

**4C *Processes that Shape the Earth* (6-8)#3**

Sediments of sand and smaller particles (sometimes containing the remains of organisms) are gradually buried and are cemented together by dissolved minerals to form solid rock again.

**4C *Processes that Shape the Earth* (6-8)#4**

Sedimentary rock buried deep enough may be reformed by pressure and heat, perhaps melting and recrystallizing into different kinds of rock. These re-formed rock layers may be forced up again to become land surface and even mountains. Subsequently, this new rock too will erode. Rock bears evidence of the minerals, temperatures, and forces that created it.

**4C *Processes that Shape the Earth* (6-8)#5**

Although weathered rock is the basic component of soil, the composition and texture of soil and its fertility and resistance to erosion are greatly influenced by plant roots and debris, bacteria, fungi, worms, insects, rodents, and other organisms.

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**4C *Processes that Shape the Earth* (6-8)#7**

Human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, have changed the earth's land, oceans, and atmosphere. Some of these changes have decreased the capacity of the environment to support some life forms.

**5F *Evolution of Life* (6-8)#3**

Many thousands of layers of sedimentary rock provide evidence for the long history of the earth and for the long history of changing life forms whose remains are found in the rocks. More recently deposited rock layers are more likely to contain fossils resembling existing species.

**8C *Energy Sources and Use* (6-8)#5**

Energy from the sun (and the wind and water energy derived from it) is available indefinitely. Because the flow of energy is weak and variable, very large collection systems are needed. Other sources don't renew or renew only slowly.

**11B *Models* (6-8)#1**

Models are often used to think about processes that happen too slowly, too quickly, or on too small a scale to observe directly, or that are too vast to be changed deliberately, or that are potentially dangerous.

**11B *Models* (6-8)#3**

Different models can be used to represent the same thing. What kind of a model to use and how complex it should be depends on its purpose. The usefulness of a model may be limited if it is too simple or if it is needlessly complicated. Choosing a useful model is one of the instances in which intuition and creativity come into play in science, mathematics, and engineering.

**12A *Values and Attitudes* (6-8)#1**

Know why it is important in science to keep honest, clear, and accurate records.

**12A *Values and Attitudes* (6-8)#3**

Know that often different explanations can be given for the same evidence, and it is not always possible to tell which one is correct.

**12B *Computation and Estimation* (6-8)#5**

Estimate distances and travel times from maps and the actual size of objects from scale drawings.

**12C *Manipulation and Observation* (6-8)#5**

Inspect, disassemble, and reassemble simple mechanical devices and describe what the various parts are for; estimate what the effect that making a change in one part of a system is likely to have on the system as a whole.

**12D *Communication Skills* (6-8)#5**

Find and describe locations on maps with rectangular and polar coordinates.

**12E *Critical-Response Skills* (6-8)#3**

Be skeptical of arguments based on very small samples of data, biased samples, or samples for which there was no control sample.

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| Session | Pages | Evidence for Content Match |
|---|---|---|
| 1 | 11-16 | On p. 12, students are told that they will be creating and observing the events in a simulated river model but that time is speeded up thousands of times in their models so geological events that would take many human lifetimes in a real river may only take seconds or minutes in their models. They are also told that the diatomaceous earth in the model represents the soil or dirt on the earth and that the water that drips from their dripper systems represents the rain that falls on the Earth. At the end of the session, p. 15, they are asked to make a "practice river." |
| 2 | 17-22 | Students make a model river cutter and observe features of the river and land forms created. On p. 18, they are asked to imagine that their model earth represents a real continent sloping to the seashore. |
| 3 | 23-30 | On p. 24-25, students are reminded that they have created models of a river system, and that models do not always work exactly like a particular river. On p. 27, the teacher is directed to explain that larger streams and rivers cut through the earth in much the same manner as the water in their tubs moved the diatomaceous earth. On p. 28, students are asked for their ideas on other experiments they could do with their river models. |
| 4 | 31-38 | Students model a new and an old river by allowing their river cutters to operate for 5 and 10 minutes, respectively. In the discussion, p. 36, students are asked to compare features of the "young" vs. "old" rivers (but they are not asked to consider whether or why 5 and 10 minute runs adequately model young and old rivers). |
| 6 and 7 | 45-52 | In sessions 6 and 7 students model constructing dams (in order to create a recreational reservoir) and finding locations for toxic waste dumps (in order to determine the best location to place a toxic dump waste site). |

Based on the content match, we see that *River Cutters* addresses the following part of the benchmark: **Models are often used to think about processes that happen too slowly or that are too vast to be changed deliberately.**