### TABLE 3.1 Key Features of Driving Questions

#### Feasibility
- Students can design an investigation to answer the question.
- Students can perform an investigation to answer the question.
- Materials for the investigations are readily available.
- The question is developmentally appropriate for the students.

#### Worth
- The question is related to what scientists really do.
- The question is rich in science content/concepts.
- The question helps students link science concepts.
- The question is complex enough to be broken down into smaller questions.
- The question leads to further questions.
- The question meets district, state, or national curriculum standards.

#### Contextualization
- The question is anchored in real world issues.
- The question has real world consequences.

#### Meaning
- The question is interesting and important to learners.
- The question intersects with learners’ lives, reality, and culture.
- The phenomena covered by the question are of interest to students.

#### Sustainability
- The question allows students to pursue solutions over time.
- Students can pursue answers to the question in great detail.
Examples of Driving Questions

In this section, we will use the key features of driving questions to explore three examples. The summary of the features of driving questions presented in Table 3.1 will structure the examples.

Example 1: What Kind of Insects Live on Our Playground? Imagine that the district you are working in has a curriculum objective related to students learning about insects. Rather than covering insects as a topic, you decide to ask the driving question “What kinds of insects live on our playground?” Does this question meet the features of a good driving question? Let’s explore.

The question is feasible because it gives children opportunities to investigate and ask new questions of their own. They might ask, “When do the various insects first appear on the playground?” “When do the insects disappear?” “What kind of food do they eat?” “Where do they live?” “What type of environment do the insects live in?” and “How do they eat?” Students can design and perform investigations to answer these questions. For example, they can keep journals about when insects appear and disappear. They can collect insects and investigate what they eat or how they react to light. They can take nature walks to investigate where insects live and how they move. Also, there isn’t much sophisticated equipment—besides a hand lens, jars, and maybe a net—that is needed for this project.

Second, the question is worthwhile because it enables students to explore rich science content, including insect classification, life cycles, and behaviors. Also, the question enables students to relate to what scientists really do (ask lots of questions and pursue solutions to these questions). This question matches up with a number of benchmarks for elementary students cited in *Benchmarks for Science Literacy* (AAAS, 1993). For instance, one of the benchmarks for grades 3–5 is that, “Insects and various other organisms depend on dead plant and animal material for food.” By exploring the subquestion “What do insects eat?” students can attain this benchmark. The question also helps meet a number of other benchmarks (AAAS, 1993) and standards (National Research Council, 1996) for inquiry and the nature of science. For example, as students observe insect behavior and take notes, they are observing and recording information, two important benchmarks.

Third, the question is contextualized and meaningful. The type of insects found can give an indication of the quality of soil and the local environment. By observing the insects, finding
out information about them, asking subquestions, and conducting investigations to answer the subquestions, students can come to understand how this is a real world question with meaning for them: They are not just reading about insects or exploring them through classroom activities; they are exploring and learning about insects in their environment, in the backyard, on the playground, and/or in a local nature area.

Fourth, this question is sustainable: It can take students an entire year to study all the insects in their environment, given that insects appear and disappear in different seasons. Moreover, the question might propel students to learn more about insects.

Example 2: What Kind of Land Features Are in My Environment? Often, school districts have curriculum objectives related to earth science. Imagine that your class is studying the question “What kind of land features are in my environment?”

The question is feasible, because it allows students to ask a number of subquestions such as, “What type of soil do we have?” “What kind of rocks do we have?” “How was the shape of the river formed?” and “How were the hills and valleys formed?” However, it is likely that these questions will not come easily to upper elementary students. Taking walks to help focus students’ observations on various geological features would help. Some of these questions allow students to perform investigations. For instance, students can collect a variety of rocks from around the school or at home and then try to identify what they are. Although students can’t explore how a river was formed, they can do various explorations on a stream table (a long tray set up with sand and water to simulate erosion) to duplicate the formation of streams and rivers. They can also search the library or the World Wide Web for historical pictures of the river to see if the shape of the river has changed. Other questions like, “How were the hills and valleys formed?” cannot be explored easily through investigations. However, students can read and discuss how such phenomena occur, and they can manipulate modeling clay to simulate how a hill is formed as pressure below the earth presses up upon it.

Next let’s explore whether the question is worthwhile. The driving question and subquestions provide learners with opportunities to learn a number of important earth science concepts. For instance, the students can explore classifications of rocks and soil, compositions of rock and various soils, types of land formations, and reasons for various land features. Hence, by pursuing an answer to the driving question, students have the opportunity to explore important science content that meets a number of benchmarks cited in Benchmarks for Science Literacy (AAAS, 1993). For instance, one of the benchmarks for grades 3–5 is as follows:

Rock is composed of different combinations of minerals. Smaller rocks come from the breaking and weathering of bedrock and larger rocks. Soil is made partly from weathered rock, partly from plant remains—and also contains many living organisms (AAAS, 1993, p. 72).

Taking students on walks to explore various local phenomena helps show that the driving question and subquestions are tied to the real world. Although some children will not see the question as meaningful to them, allowing them to bring in different soil samples and various rocks from their backyards will help them gain ownership of the question. For instance, students can bring in various sample cores (drillings into the soil with a tube to show the soil from different layers) from their backyards and compare them. They can explore questions like “How are the samples different?” and “If they are different, why are they different?”

Finally, as students begin to see the value of the driving question, the question becomes sustainable because there is much rich content associated with it. Many of the subquestions take time to explore and investigate. For example, “What type of soil do we have?” is a question that can be explored over time as students investigate what plants can grow in the soil type, whether it can be used for making things (such as bricks), and if it drains well (such as sand) or holds water (such as clay).

Example 3: How Can I Care for the Various Animals in Our Classroom? Let’s look at a third example that focuses on biological objectives. Many children will be interested in the
animals that are in the classroom. Most students, as well as adults, love to watch various animals eat and play. The driving question "How can I care for the various animals in our classroom?" appears to have much potential to engage students in learning about animals.

The question appears to be very feasible. Students can ask a number of related questions and pursue answers to many of these questions through investigations. For instance, students could ask, "How do the eating habits of our animals differ?" "How do the various behaviors of the animals differ?" and "What kind of habitat do the various animals prefer?" All of these questions can be explored through investigations. Students can observe the eating habits of the different animals and find different feeding patterns. Some subquestions like, "What should I do if one of our animals gets sick?" should not be explored via hands-on investigations. Students can explore such questions by finding literature on the topic or talking to experts, such as veterinarians. As mentioned earlier, the care of animals should always be left to the expert.

In pursuing an answer to the driving question and the various subquestions, students will need to explore a variety of different science content areas. For instance, they will study content such as nutrition and environmental needs, habitat, body systems, body function and structure, and behavior. These content areas match Benchmarks for Science Literacy (AAAS, 1993) and National Science Education Standards (NRC, 1996). Hence, with respect to students exploring important content, the driving question appears to be worthwhile. The question is also worthwhile in that students can perform a number of investigations related to it.

The question also appears to be very motivating. Observing and caring for classroom animals is meaningful. Teachers can enhance interest and ownership by assigning students to care for particular pets. Because the pets are in the classroom and the learners must care for them, the question is contextualized for the learners.

Finally, the scope and the nature of the driving question and subquestions appear to hold students’ attention for a long period of time. Caring for and learning about the animals can be done throughout the entire school year.

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**HOW DOES THE DRIVING QUESTION DIFFER FROM OTHER QUESTIONS?**

When you open up a traditional elementary or middle school science textbook, you are likely to see that the book is organized in terms of topics: the solar system, phases of the moon, weather, nutrition, plants, the human body, force, and so on. Often, a chapter will also mention reasons for learning the topic. For instance, the study of genetics has led to the development of different hybrids of corn and other vegetables and is worth study. Although knowing such reasons might increase interest, the reasons are not the driving forces behind learning, and teachers frequently find it difficult to hold students' attention when focusing on topics that a textbook suggests are important.

Traditional science classes, like textbooks, are also organized by topic, rather than by a driving question. Nonproject-based science classes might cover the same science content as project-based science classes, but the material is not connected in the same way. By using driving questions, students can see that everything they learn has a purpose, and when they learn a new skill or concept, they can immediately apply it to help answer their questions.

Contrast the three driving questions just examined with questions like, "What are the six simple machines?" "What are the nine planets of the solar system?" and "What is light?" These questions focus on topics. Although some students might be interested in the structure of the solar system, most children don't have a reason to be. Although these topics might encompass worthwhile content, they are not likely to engage learners. These questions are not directly related to children's lives. These questions lack the ability to help students develop connections between their studies and their own lives.

In addition, traditional science instruction and textbook activities lead to the development of isolated skills and understandings, without context and meaning. Typical activities that students pursue in school science are designed to demonstrate or verify concepts. For example, a traditional science textbook chapter on plants
ACTIVITY 3.3

Evaluating Various Questions

MATERIALS NEEDED:
- paper and pencil or computer

A. Listed here are several questions. Evaluate whether the questions can serve as driving questions. Are the questions feasible, worthwhile, meaningful, contextualized, and sustainable? Be sure to state your reasons.

<table>
<thead>
<tr>
<th>Question</th>
<th>Can It Serve as a Driving Question?</th>
<th>Reason</th>
</tr>
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<tbody>
<tr>
<td>What is gravity?</td>
<td></td>
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<tr>
<td>Why do I need to wear a bicycle helmet?</td>
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<td>Why does my water taste bad?</td>
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<tr>
<td>What is matter?</td>
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<td>What foods are good for me to eat?</td>
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<td>Do all apples have the same number of seeds?</td>
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<tr>
<td>How can I run faster?</td>
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<tr>
<td>How good is the soil in my playground or yard for growing plants?</td>
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<tr>
<td>Why do only the weeds grow in the cracks of the sidewalk?</td>
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<tr>
<td>What kind of leaves are these?</td>
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<tr>
<td>Why is too much junk food bad for me?</td>
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<td></td>
</tr>
<tr>
<td>Why is it colder in the winter and warmer in the summer?</td>
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</table>

B. Contrast your answers with those of another person in your class. Try to come to a consensus.

C. Keep this list in your portfolio.

HOW IS A DRIVING QUESTION DEVELOPED?

Coming up with driving questions with the features discussed earlier in this chapter is challenging work. Teachers might make a number of failed attempts before settling on a question for a project. Slowly, however, teachers can develop a repertoire of driving questions and projects.

will tell students that plants need sunlight to grow. Then, the textbook activity will likely verify this information by having students grow one plant in the sun and another in a dark closet. (This kind of teaching is similar to that presented in Scenario 2.) Because such activities are tied to topics rather than to driving questions, students fail to make connections between the skills and concepts they learn. Take time now to complete Activity 3.3.