Unit 4 Overview
In unit 4, Continuity: Reproduction and Inheritance in Living Systems, the students will focus on continuity in biological systems. In chapter 10, Reproduction in Humans and Other Organisms, they will develop a conceptual view of reproduction. They are introduced to both asexual and sexual reproduction, with human reproduction as a major example. In chapter 11, Gene Action, the students will explore the dynamics of gene expression and replication at a molecular level. This exploration provides them with a basis for examining some of the fundamental techniques that underlie genetic engineering. In chapter 12, Continuity of Information through Inheritance, the students will begin their study of genetics and explore the transmission of information, genetic variation, inheritance patterns, and the role of genetics in evolution and behavior.

Prior Conceptions
Reproduction and inheritance are areas many students find fascinating. Nevertheless, high school students continue to have several misconceptions about both reproduction and the inheritance of characteristics. As with incorrect conceptions in other areas of biology, prior conceptions about reproduction and inheritance may be difficult to modify, but the BSCS 5E instructional model offers multiple opportunities to confront these prior conceptions and compare them with biologically correct understandings.

The authors of Making Sense of Secondary Science (Driver, Squires, Rushworth, and Wood-Robinson, 1994) summarize several incorrect ideas about reproduction that are common among middle school and high school students. Students often equate sexual reproduction with copulation. For example, many students consider in vitro fertilization an example of asexual reproduction. They do not understand that sexual reproduction is the fusion of specialized cells from two parents that does not necessarily require physical contact between the parents. Students also often assume that males of all species are larger and stronger than females, and that the offspring produced by asexual reproduction are weaker than those produced by sexual reproduction.

What do the things in these pictures have in common? Consider how each can store or transfer information, or do both. The storage and transfer of information allows continuity of that information: it is available and then passed on. Though each picture shows something that stores or transfers information, how the transfer is accomplished varies a great deal.

In unit 4, Continuity: Reproduction and Inheritance in Living Systems, you will explore the idea of continuity. You will examine the processes that contribute to the continuation of life on Earth, including the continuity of a species. These processes include reproduction as well as the storage and transfer of genetic information in living organisms.

By the end of unit 4, you should be able to:

- Illustrate how sexual reproduction has on our lives.
- Compare and contrast the potential impact that technology has on our lives.
- Explain that the continuity of a species, and the evolution of a species, depends on the continuity of genetic information.
- Describe the structure of genetic material.
- Illustrate how sexual reproduction is important for the evolution of a species, and why this is important for the evolution of a species.
- Appreciate the current and potential impact that technology has on our lives.

The Project 2061 Atlas of Science Literacy (2001) identifies several incorrect ideas that middle school students and some high school students often have about inheritance. Terminology is often a source of confusion for students when studying genetics (Pearson, 1988). Students often believe that “mutation” and “recessive” have negative connotations. Furthermore, the phrase “have the gene” is often associated with genetic disorders. For example, in talking about a genetic disorder, people often say that if a person “has the cystic fibrosis gene,” he or she will be affected by cystic fibrosis. It is important to make it clear to students that everyone has the gene within their genetic makeup, but when that gene is mutated there sometimes may be problems such
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By the end of unit 4, you should be able to

- compare and contrast the strategies that different organisms use for reproduction,
- explain that the continuity of a species depends on the transfer of genetic information,
- describe the structure of genetic material,
- explain how genetic information is expressed,
- illustrate how sexual reproduction and mutation increase genetic variation and why this is important for the evolution of a species, and
- appreciate the current and potential impact that technology has on our lives.

As cystic fibrosis. Students should also realize that even if a person has a mutated gene, he or she will not necessarily develop a disorder, depending on the particular disease. To help address these problems, teachers should carefully define the terms they use related to genetics and continue to use them in a very precise manner.

Research studies have found that upper-middle school and high school students have some understanding that genes carry translatable information (American Association for the Advancement of Science [AAAS], 2001). This general understanding is reinforced and made more concrete in two activities in chapter 11: Expression of Genetic Information, the Explain activity, and Genetic Technology, the Elaborate activity.

Some students believe that the characteristics of each parent are “blended” in their offspring. Other common, incorrect prior conceptions about heredity are that offspring inherit characteristics from just one parent, either the mother or the same-sex parent, or that certain characteristics are inherited solely from the mother, and others are inherited solely from the father (AAAS, 2001). The activities in Patterns of Inheritance, the second Explain activity of chapter 12, and the first Elaborate activity, Predicting Inheritance by Using Pedigrees, address all of these incorrect prior conceptions. They will help students recognize that genes are discrete entities inherited from both parents. The genes from each parent combine to form particular characteristics.

Predicting Inheritance by Using Pedigrees, the first Elaborate activity of chapter 12, also helps students work through the challenging case of X-linked traits, which often appear to be inherited only by males from their mothers. Completing this activity will help students see that females
also inherit genes associated with X-linked traits, from their mothers or their fathers (or from both). The incorrect idea that some characteristics produced by the environment can be inherited over several generations persists among high school students (AAAS, 2001). *The Genetic Basis of Human Variation*, the second Elaborate activity of chapter 12, helps reinforce the correct notion that populations have *preexisting* variations, some of which may be favored by changing environmental conditions. Over many generations, the favored variations become more prevalent in a population.

**Advance Preparation for the Unit**

You will need to order materials for the lab activities in chapters 11 and 12 (optional). The *Advance Preparation* section of each chapter will direct you to the specific activities that require materials and planning in advance.

We recommend that you set up a question box in the classroom in which students can leave questions that they may feel are tangential to the concepts in this unit but that they are embarrassed to ask aloud. Let students know the purpose of the box ahead of time and indicate that you will review and answer questions as time permits.

Another method for collecting questions is to have each student write his or her questions on a piece of paper. Then pass around a large envelope. Explain to students that all students should turn in a piece of paper, and that it may be blank if they do not have any questions. This way, students can feel more comfortable that they will not be singled out as they put a question into the box. The envelope might be passed around several times over the course of the chapter.