# Session 1

# What Is Life?

What is life? This question at first seems deceptively simple—we all know how to recognize what is living and what is not. Or do we? What are the characteristics of all living things, and how do we know if an object really possesses those characteristics? This session explores how the concept "life" can be defined.

## The Video

We open with a look at environments where you wouldn't expect to find life and pose the question: If you are looking for life, what do you look for? Dr. Herbert Thier, representing the Science Curriculum Improvement Study (SCIS 3+), emphasizes the importance of building understandings of the concept "life" in the early elementary grades as a foundation for the development of ideas in life science throughout the elementary school years and beyond.

The program continues as children in grades 2 and 3 are presented with a challenge: group objects as living, dead, or nonliving. In what is called the "Science Studio," the children are observed and interviewed in a clinical setting to uncover their ideas about these three concepts.

In Brooklyn, New York, we visit LauraJo Kelly and her second-grade students as they generate their own definitions of living, dead, and nonliving and proceed to design experiments to test whether a "mysterious" object is alive. An interview with Dr. Gary Ruvkun, who is leading a team of researchers to determine whether life exists on Mars, tells us what he considers to be the best sign of life.

Finally, Dr. Paul Williams introduces us to an ongoing Web site-based activity—Bottle Biology—that is meant to provide you with an opportunity to apply ideas addressed during the session as well as act as a resource for K–6 classroom activities.

## Learning Goals

During this session, you will have an opportunity to build understandings to help you:

- Distinguish between living, dead, and nonliving
- Define the characteristics of life

# On-Site Activities

## Getting Ready (60 minutes)

### Activity One—Track Your Understanding (40 minutes)

One way to assess your own learning at the end of this course is to start by documenting what you know now. Below are questions related to the life science topics being addressed during this course. Answer them as best you can—this is not a test! At the final session, you'll be able to track how your understandings have changed.

1. What distinguishes living things from dead and nonliving things?
2. How do scientists classify living things?
3. A new type of life form has been discovered. How could you tell whether it should be classified as an animal, plant, or something else?
4. There is a saying that like begets like. In the living world, we observe this as offspring that resemble parents and types of organisms that produce the same types. What ensures this continuity of life?
5. Describe the life cycle of a typical animal.
6. Describe the life cycle of a typical plant.
7. Distinguish between DNA, chromosomes, and genes.
8. What causes individuals of a species to vary from one another?
9. Explain the process of natural selection.
10. Describe the ideas underlying the theory of evolution.
11. What defines a species?
12. How does evolution result in new species?
13. Distinguish between producers, consumers, and decomposers.
14. How does energy travel through the living world?
15. How does matter travel though an ecosystem?

**Facilitators:** Please collect participants' answers and bring them to Session 8.

**Facilitators:** Distribute the items described in the Individual Session Materials on page 10.

### Activity Two—Living, Dead, or Nonliving? (20 minutes)

1. Working alone, write a definition for each of the following terms: living, dead, and nonliving.
2. With a partner, examine objects introduced by the facilitator and categorize them as living, dead, or nonliving. Record the distinguishing characteristics of each object, and highlight those that are most important in the classification process. Then, create a general list of the characteristics of living organisms.
3. As a whole group, compare how you classified the objects and discuss the characteristics that are most important when classifying objects into the categories of living, dead, or nonliving.

# On-Site Activities, cont'd.

## Watch the Video (60 minutes)

As you view the video, think about the following focus questions:

1. What are the five characteristics of life presented in this video?
2. As you watch the Science Studio, listen to the children reason aloud as they classify objects as living, dead, or nonliving. Which ideas raise uncertainties for you?
3. In the featured classroom, LauraJo Kelly's second-grade students are asked to classify "green stuff" as living, dead, or nonliving. During the video, listen for facts about the "green stuff." How does this information change your approach to determining whether it's alive or not?

## Going Further (60 minutes)

1. After viewing the video, join your partner to revisit your definitions of living, dead, and nonliving. Together, revise your ideas and write new definitions. Talk about how, if at all, your thinking about the question "What is life?" has changed.
2. As a whole group, discuss whether the five characteristics of life presented in the video are adequate for defining life. Are there any others? Which, if any, seem more important than the others?
3. With the group, compare some of the ideas that your students have about the concepts of living, dead, and nonliving. Which seem to be the most challenging to address? Why?
4. What makes the "green stuff" (a dead animal that has been dyed green and now looks like a plant) a useful object for classifying living, dead, or nonliving? What, if anything, is problematic about using the "green stuff" for this task?

# Between Sessions

## Homework

**Note:** All participants should complete assignments marked by *.

### About the Reading Assignments

The reading assignments for this course are meant to expose you to research on children's ideas about life science as well to encourage you to compare your ideas to those of your students.

Each week, you will be assigned a reading from the Leeds National Curriculum Science Support Project, a seminal resource that reviews children's ideas in the life sciences. The assigned excerpts from this resource are provided in the Appendix.

As you read, you will probably identify ideas that are particularly prevalent among your students, but you should also be thinking about your own understanding of this content. Do you hold some of the same ideas as the students? Are there ideas expressed that you understand to be scientifically inaccurate, but you aren't sure why? Asking these questions as you read can help you to assess your own level of content knowledge.

Your approach to the reading assignment for each session will be the same. The first step will be to identify several children's ideas that compare to your own, represent some uncertainty to you, or are particularly prevalent among your students. The second step will be to form a question about the content involved in each idea and to try to answer it. The third step is to note what evidence you are using to support your answers.

For example, one idea that children often have is that seeds, eggs, and pupae are not alive, but they believe that seedlings, chicks, and butterflies can come from them. A question you could ask from that observation is: Can living things arise from things that aren't themselves alive? Once you have asked a question, answer it and consider what evidence you are using to develop your answer. The session videos and activities provide opportunities to build and support the answers to your questions.

At the start of each session, working in a small group, you will be asked to share the ideas that you identified, along with the corresponding questions and ideas about supporting evidence. The group's questions will then be pooled as a set of focus questions for subsequent activities.

In this way, you will build answers to your questions. Questions that remain unanswered represent excellent opportunities for consulting other resources—a college-level textbook, knowledgeable peer, science specialist, or even a life science expert.

### Reading Assignment*

Driver, R., et al. (1992). *Life and Living Processes.* Leeds National Curriculum Support Project, Part 2. Leeds City Council and the University of Leeds, UK.

Research Summary: Children's Ideas About Living Things (pp. 1–14: The concept of "living"; the concept of "animal"; the concept of "plant"; the process of classification; cell theory)

As you read:

1. Identify several children's ideas that compare to your own, represent some uncertainty to you, or are particularly prevalent among your students.
2. For each idea, form a question about the content involved and try to answer it.
3. Note what evidence you are using to support your answers.

# Between Sessions, cont'd.

### About the Life Science Problem Sets

Each session will be accompanied by a problem set that will reinforce content learning by asking questions that apply or extend life science concepts addressed in the video. Possible answers for the problem sets are provided in the Appendix.

It should be emphasized that many questions have a variety of answers—answers will vary depending on the understandings of the person answering the question. The intent is not to give you "right answers," but to allow you to compare yours with more advanced learners in life science. At the beginning of each session, group members will review an answer for each question to address any remaining content issues.

## Life Science Problem Set*

(Suggested answers are listed in the Appendix.)

1. Pick two objects: a living thing and its nonliving model (e.g., a bear and a stuffed teddy bear, a rose and a silk rose). How could you use scientific criteria to convince someone that one object is living and the other isn't?
2. Of the characteristics of life explored in the video, which do you think are *most* distinctive of living things? Explain your reasoning.
3. How would you know if something you observed under a microscope was a cell?
4. Suppose you took a walk in the woods one day and found a strange object that you couldn't identify. What would you do to try to find out if it was a living thing? Would it make a difference if it were a plant or an animal? Why?

See the following page for information about the **Ongoing Concept Mapping** activity.

## Ongoing Concept Mapping*

Develop a concept map for the question "What is life?" that includes the characteristics of life, including any that you believe are important but that may not have been described in the video.

### About the Guided Journal Entries

As you proceed through this course, one way of building and connecting understandings is to reflect upon your learning as you go. In each session, a question will be suggested to guide a journal entry. At the end of the course, these entries should help you see how your ideas have progressed.

## Guided Journal Entry

Most people are impressed by the remarkable diversity in the living world. Yet, some are more amazed at the unity within the living world. What are the characteristics of life that unify all living things? How can the characteristics of life be used to appreciate both unity and diversity in the living world?

# Between Sessions, cont'd.

## About the Ongoing Concept Mapping Activity

Within each session, several fundamental concepts are explored. Creating a set of concept maps will provide you with an opportunity to reflect on your understandings of these concepts and their connections to one another as well as to see how the content in each session relates to that of other sessions.

An explanation of concept mapping is listed below. Please also read Dr. Joseph Novak's article, "The Theory Underlying Concept Maps and How To Construct Them," available free online at http://cmap.coginst.uwf.edu/info/printer.html.

## About Concept Maps

Concept maps are graphic ways of organizing and representing knowledge. They are built around concepts to which labels can be applied. Each concept is linked with words to one or several other concepts to form a proposition—a meaningful statement about some object or event in the universe.

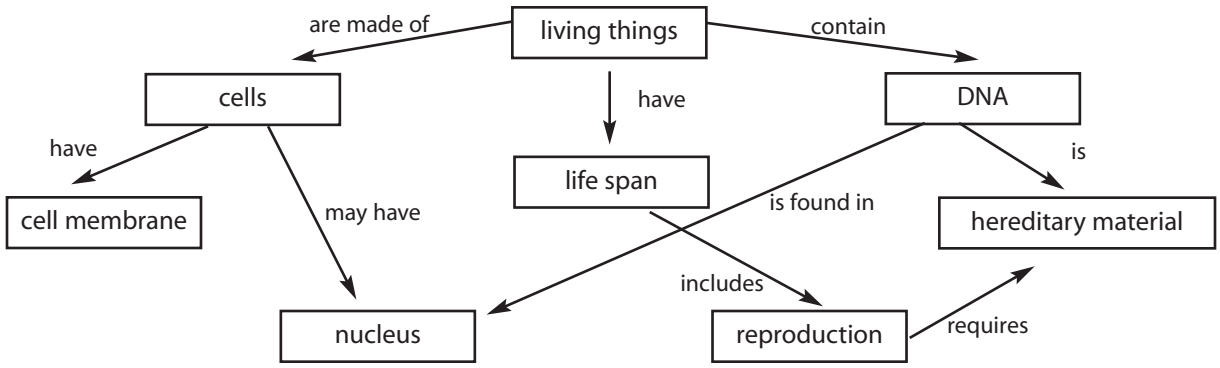
Concept maps are hierarchically organized around a "domain" of knowledge. The domain of knowledge is the most general concept for which the map is being built (e.g., life). Once the domain has been selected, key concepts that apply to this domain are identified that range from general (e.g., cells, life span, DNA, etc.) to specific (e.g., details about or examples of the more general key concepts—for example, different cell parts or stages in a life span). This "ranking" is meant mainly to assist in building a hierarchical concept map.

It is a good practice to first build a preliminary concept map (sticky notes can be very useful here) to allow for changes that occur as a result of thinking through the concepts and their relationships the first time. The next draft can reflect these changes. The "domain" is placed at the top of the map, with the most general key concepts in one or more levels below, depending on the number of key concepts identified and how they "rank" in relationship to the domain and to each other. The most specific concepts are placed toward the bottom of the map, underneath the concepts to which they apply.

Once the concepts have been laid out, one or a few connecting words are chosen to link them in such a way that a meaningful (although abbreviated) statement results. Connecting words tend to be verbs (is, have, include), but can also be conjugations (and, or) or prepositions (with, between). Connecting words should be chosen carefully, as they reflect how two concepts are understood to be related. The finished proposition represents a unit of meaning. This unit of meaning can then be built upon, revised, or assessed for understanding.

Another key feature of a concept map involves cross-links. Cross-links are connections between concepts that are made after the map is constructed by searching for relationships between different map segments. Cross-links help reveal the extent to which concepts are understood to be connected to one another. One can also cross-link different maps in this way.

Below is an example of a map for the concept "living things."



# Between Sessions, cont'd.

### About the Guided Channel-TalkLife Postings

Although this is a course designed to help enhance your understandings of life science concepts, the intention is for you to use this knowledge to inform your teaching. Often, a community of learners who are also teachers can collaborate to support one another in transforming content knowledge into successful classroom action. In each session, a question will be suggested to guide a discussion on Channel-TalkLife, to facilitate this type of collaboration among participants.

To subscribe to Channel-TalkLife, visit http://www.learner.org/mailman/listinfo/channel-talklife.

## Guided Channel-Talk Posting

The answer to the question "What is life?" has applications at many grade levels. How does the question "What is life?" apply to the science curriculum in your classroom? Are some characteristics of life more appropriate than others for the students you teach? In this Channel-Talk posting, share your experiences, opinions, and ideas for teaching about this topic with your colleagues.

## Textbook Reading Suggestions

The following are suggestions for several reading topics that may provide additional background and enrichment information. These topics are likely to be addressed in any college-level biology textbook, and can usually be located in the table of contents or index:

- biology as a science
- cells
- life cycles
- organic molecules
- matter
- DNA
- characteristics of living things
- cell theory
- reproduction
- energy
- photosynthesis

## Preparing for the Next Session*

**For "Getting Ready"**

Defining living, dead, and nonliving involves developing a classification scheme. The next session will introduce a system of biological classification as practiced by life scientists. To prepare for the next session, locate at least 10 specimens that represent a diverse array of living things (they can be living, dead, or nonliving models or pictures). Bring your collection with you.

**Materials Needed for Next Time**

- At least 10 specimens as described above

# Between Sessions, cont'd.

## Ongoing Activities

### About Bottle Biology

There are four Bottle Biology systems to choose from. Each has been designed to provide application and extension activities for the topics being addressed in the sequential pairs of sessions that compose the course.

The "TerrAqua Column" has been designed as a companion to Sessions 1 and 2—reinforcing concepts related to defining life and classifying living things. Sessions 3 and 4 focus upon animal and plant life cycles. The "*Brassica* and Butterfly System" allows first-hand experience with plant and animal life cycles that are intertwined. The basics of biological evolution are addressed in Sessions 5 and 6. Using the "Field Population System," you can do an experiment that demonstrates how evolution works. Sessions 7 and 8 explore interdependence in the living world. The "EcoColumn" offers a way of exploring large-scale concepts at a "bottle-sized" scale.

During the first two weeks of your course, you should choose one of the systems, assemble necessary bottle materials, construct the system involved, gather the living and habitat materials you'll need, and stock your system. By the end of the second week, your system should be stocked and ready to go.

After that, you should select from the activities suggested for each system on the Web site. At the Web site, you can share your experiences with your colleagues as you explore with your own Bottle Biology system.

*Life Science* has also set up these same systems and done some of the suggested activities. You can track our progress and compare it to your own. Check out the "Bottle Biology Spotlights" that are relevant to each session.

### Bottle Biology

**Bottle Biology Spotlights: Session 1**

| System | Activity |
|---|---|
| TerrAqua Column | Is It Alive? |

**Note:** Bottle Biology activities have been designed to occur over a six-week study period, once a system has been stocked. This allows two weeks over an eight-week period for start-up activities. Be aware that your *Life Science* course may occur over a different period of time—Bottle Biology can be modified to fit your course. Visit the Web site to find detailed information about Bottle Biology:

http://www.learner.org/channel/courses/essential/life/bottlebio/

## Graduate Credit Activities

Begin your work on the annotated bibliography and action research project. (See the Graduate Course Requirements section at the front of this guide for more information on the graduate credit assignments.)