Microscopic Life & The Cell
Units

Introduction: In these two units, *Microscopic Life* and *The Cells*, students are introduced to the big picture of life on Earth. Students discover that all living things, despite their complexity, share the same basic characteristics. Students learn that all organisms (bacteria, protists, fungi, plants, and animals) are composed of cells, and that a single cell is the fundamental unit of life. Students explore the relationship of organisms to their environment. In their efforts to answer the question "What is life?", it is hoped that students develop an appreciation for the awesome diversity of life on Earth and a personal interest in life in all its forms.

Overview: *Microscopic Life Unit:* Life cannot be fully defined without including the cell as the basic unit of life. Individual cells have the same needs and perform the same functions as more complex organisms. However, some living cells are organisms while some living cells are not organisms, depending on their ability to live freely and independently, not dependent on being part of a larger organism for their survival. Three of the five kingdoms of living things (Monera, Protista, and Fungi) all include single-celled organisms. Prior to this unit students developed an operational definition of life that is used throughout the course. Students were also introduced to the microscope to observe and study microorganisms.

The Cell Unit: Life happens in cells. No matter how simple or how complex an organism, it is made of cells and the cells are alive. Cells have defining structures, such as a membrane, cell wall, nucleus, chloroplasts, and cytoplasm. A major subdivision in cells is whether or not they have a nucleus (eukaryote) or not (prokaryote). The diversity of cells helps us understand the diversity of Life on Earth. In the next unit, The Seeds of Life, students investigate organisms in a dormant state, it's germination and development, and investigate cell differentiation.

These hands-on investigations support the kind of explorations where students and teachers are finding things out together. Students work cooperatively for the most part in buddy teams or groups of four, although individual work is also used. In addition, when questions come up, the class -- as a community of learners -- digs out the answers together. Investigations vary teaching strategies and pace of instruction as well as provide opportunities for middle-schoolers to move about and be social.

Nationally Validated Curriculum: *Diversity of Life Course, Teacher's Guide,* F.O.S.S. Life Science Curriculum (Delta Scientific, 2003).

Brief Description of Target Students: This unit is designed for students in a grade seven biology class. The grade seven biology curriculum spirals from the grade five curriculum which emphasized characteristics of plants and animals, as well as adaptations of living things.

Unit Length: 9 X 45 minute sessions for *Microscopic Life* unit
2 X 45 minute sessions for *The Cell* unit

Microscopic Life

Activity 1: Microworlds (2 sessions)

Activity 2: Discovering Cells (2 sessions)
Activity 3: Paramecia (3 sessions)
The Cells
Activity 4: Human Cells (1 session)
Activity 5: Ribbon of Life (1 session)

English Objectives:
Standard 2 – Questioning, listening and contributing.
Standard 19 – Writing.
Standard 21 – Organizing ideas in writing.
Standard 26 – Analysis of media.

Driving Question: How do we know something is alive?

Microscopic Life: Microworlds
Activity 1

Relationship of this Lesson to the Unit: Life cannot be fully defined without including the cell as the basic unit of life. In this lesson, students go on a mini-pond safari where they search for simplest life-form: the unicellular protista. Students are introduced to protists such as amoebae, euglena, flagellates, and paramecia. (This follows the unit *What is Life?* in which students observe what all life has in common and *Introduction to the Microscope* in which students develop skills in using a microscope to observe and study microorganisms.)

Massachusetts Frameworks Strand and Learning Standard:
Science and Technology/Engineering Framework
Strand 2: Life Science (Biology), Grades 6-8.
Learning Standards: Structure and Function of Cells
2. Recognize that all organisms are composed of cells, and that many organisms are single-celled (unicellular), e.g., bacteria, yeast. In these single-celled organisms, one cell must carry out all of the basic functions of life.

Science Concept: The cell is the basic unit of life. Is it possible that living microorganisms can be found in miniponds made from clean, drinkable water?

Process Skills: Observing.

Science Habits of Mind: Be curious. Be careful and accurate in observations**.**

Activity 1 Materials for Class:
Minipond from previous unit
Blank paper
1 Dropper

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Activity 1 Materials for each Group:

2 Microscopes
1 Microscope kit
1 Minipond
1 Dropper bottle of Congo red-dyed yeast
Colored pencils
Microorganism Guide
Lab Notebooks

Session Length: Three 45 minute sessions.

Microscopic Life **Activity 1: Microworlds** **DAY 1**	
TIME	PROCEDURE
Prep	During the previous unit *Introduction to the Microscope*, students were supplied with a container of water. Students wrote up a lab including title, materials, background, experimental design and procedures to answer the question "What will happen if I we observe the container for several days.") and a place for observations. Materials available included hay, soil and rocks. Students observe what their container look like, smell like and view a slide on the first day. Now it is a week later.
5 min	**Activator.** To engage students in observing at the micro level, class begins with Microscope Mania where students solve the identity of photos (taken at the micro level) of common items.
5 min	**Introduction.** Remind students of the aquatic habitats – miniponds -- they set up. *What changes did you observe so far in your jar? What may have been creating the smell in the jar? How do your observations compare to your hypothesis?* Propose looking to see if anything is living in the ponds. *What evidence of life do you think you'll find in a pond?* Ask students how they would explore their ponds for life. They should at this point suggest the microscopes. **Discuss Strategies for Exploration.** *Just like any pond, your miniponds can be divided into different regions. Different regions of the pond might be used by different kinds of organisms. What regions might you sample?* As students suggest regions of the pond, write them on the chart. They might mention the surface, mid-water region, bottom, and surfaces of structures like leaves, grass, soil, or rocks. **Propose the Minipond Safari.** Propose going on a safari. *What is a safari? How*

	could we mount a safari in our miniponds? Inform students that they are going on a safari to look at several different types of microorganisms. They will observe what their ponds look like, smell like and view slides under the microscope.
30 min	**Start the Safari.** Getters pick up their miniponds and return to their team to begin exploration. Demonstrate how to make a wet mount using cotton filaments on the overhead. Adding a few filaments of cotton helps to slow down speedy organisms and create barriers or corrals that contain the organisms to some degree. Emphasize that only a few wisps of cotton are needed. Point out that it is important to transport their minipond smoothly to the tables, jiggling the contents as little as possible. Suggest that students let the miniponds stand undisturbed at their desks for a couple of minutes while they place a few filaments of cotton on a slide. They should then, without moving the minipond, draw a drop of culture liquid from it. Suggest that each member of a team make a slide from a different region of the pond and compare the discoveries. Caution students to avoid getting mud and dirt on the slide. It will prevent the coverslip from lying flat on the sample. Students observe their specimens at 40X and 100X. Organisms are drawn to scale and behaviors described in their lab notebooks. Remind students that a few cells drawn accurately with internal details are more valuable than a page full of empty squares. Circulate around the room while students are on safari. *How are these organisms different? What organism that we have looked at more closely resembles some of these organisms?* [Brine shrimp.] Let student interest determine how long to let the inquiry proceed. It may continue for an extra day or two.
5 min	**Clean up.** After students have had time to observe their microorganisms, share their discoveries with other students, and record their discoveries in their lab notebooks, ask them to NOT empty their minipond jars but return them to the materials station along with cleanly blotted slides.
	Homework. Under the title of "Microscopic Life," record your thoughts about life at the microscopic level. Include two observations about organisms that were similar and two observations about organisms that were different. Why? You may 1) write a paragraph or 2) draw the organisms you are comparing – label and explain which are different and which are similar.

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Microscopic Life Activity 1: Microworlds *continued* DAY 2	
TIME	PROCEDURE
10 min	**Activator.** Go to Favorites on your team's computer and click on "Pond Life Identification Kit" [SciLinks website]. See if you can find any of the organisms that you saw under the microscope. If you can, go to your notebook and label your drawings with the names of the organisms. Compare your drawings and your observations. Take notes about any interesting information.
15 min	**Continue the Safari.** Let students continue to make several slides, taking water from different parts of the minipond.
15 min	**Discussion.** Class reconvenes and each team reports observations to the scientific community. Add each team findings to the chart as questions as answered: *How many organisms did you find?* *What was the most common organism that you found?* *What similarities did you find? Differences?* Introduce the term "cell" and add to the class chart for Operational Definitions. Include **Historical Information:** How the name *cell* originated. (Hooke, tiny rooms in monastery, etc). *Which organisms are single celled? Which organisms are multicellular? What makes you think that these are multicellular when some are smaller than the single-celled organisms* ? *How could you tell the difference between single celled and multicellular organisms?*
5 min	**Clean up.** Ask students to NOT empty their minipond jars but return them to the materials station along with cleanly blotted slides.
	Homework. In your lab notebook, record how your observations compare with your original hypothesis? Provide evidence for your answer.

Microscopic Life Activity 1: Microworlds *continued* Day 3	
TIME	PROCEDURE
Prep	For the following brain teaser, make hand-outs with a drawing of a 3 L and 5 L jug. Provide 1 L increments of " pond water" (blue paper rectangles). Put materials on each desk or team table.
10 min	**Activator.** **Virtual Pond Dip.** http://www.microscopy-uk.org.uk/index_body.html

Field Code Changed

	Students go on a "Virtual Pond Dip" to discover additional pond organisms not found in the miniponds. By moving the mouse over the images in the jar, the names appear. Click the mouse further information about the organism. Call students attention to review minipond findings. Tell students they will go back to their "Virtual Pond" at the end of class.
20 min	**Review Minipond Findings.** *Did you see anything alive in there when you first put your pond together? What changes did you observe in the jar?* *Where do you think all those organisms came from? How did they get in your ponds?* *What happened to the number and kind of cells you saw from day one to now? Why?* *What may have been creating the smell in the jar? Was your hypothesis accurate?* **Team Meeting.** Provide worksheet with the questions and give students a few minutes to discuss these questions in their groups. Have one person from each group give an explanation for the abundance and diversity of life found in the ponds. Teams may suggest that the organisms were in the water. Remind them that they started with pure water, either treated tap water or bottled water. Some students usually suggest that the organisms were in hibernation or something like that. Explain that some microorganisms can lapse into a state of diapause, which is sort of like hibernation. During diapause the organism is sealed tightly against the outside environment. In this state it can blow around in the wind or lay on the dry ground, awaiting proper conditions to resume its aquatic existence. *Now where do you think the organisms in your ponds came from? What do you think might happen to these organisms if the water evaporates? When we are through investigating our ponds, how should we dispose of them?*
15 min	Students complete "Virtual Pond Dip". Students choose one organism – either a new one or one you saw in your minipond sample and take notes to 1) describe the appearance, 2) method of movement, 3) the part of the pond your organism lives in, and 4) any other info about your organism.
	Homework. Organize your notes from your Virtual Pond Dip. From your organism's point of view, use your notes to write a paragraph titled: 'Let me introduce my CELLF!". Be sure to include 1) a description of your appearance, and 2) your method of movement, 3) the part of the pond your organism lives in, and 4) any other interesting info about your organism. Include a drawing if you wish.

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RUBRIC

	Novice	**Competent**	**Expert**
Process Skill	Does not observe or connect to lesson	Observes but does not connect to lesson.	Observes and connects to lesson.
Habit of Mind	Does not raise questions. Observations incomplete and accurate.	Questions some of the time. Observations complete but not accurate.	Questions outcomes. Observations complete and accurate.
Concept	Understands that the cell is the basic unit of life…	AND gives evidence…	AND can explain why living organisms can be found from miniponds made from clean drinkable water.

Microscopic Life
Activity 2: Discovering Cells

Relationship of this Lesson to the Unit: Students are introduced to some living cells which are not organisms. Students observe the three-dimensional rectangles –cells – of the Elodea leaf. They view chloroplasts moving, evidence of an active process called cytoplasmic streaming. Students begin to make the distinction between "alive" and "organism".

Massachusetts Frameworks Strand and Learning Standard:
Science and Technology/Engineering Framework
Strand 2: Life Science (Biology), Grades 6-8.
Learning Standards: Structure and Function of Cells
2. Recognize that all organisms are composed of cells, and that many organisms are single-celled (unicellular), e.g., bacteria, yeast. In these single-celled organisms, one cell must carry out all of the basic functions of life.

Science Concept: Differences between living cells and organisms. When looking at an Elodea leaf under a microscope, what evidence of life can be observed? What characteristic appears to be common in all the leaf samples?

Process Skills: Experimenting.

Science Habits of Mind: Know why it is important in science to keep honest, clear, and accurate records.

Activity 1 Materials for Class:

3 Droppers
1 Basin, clear, 6 L
8 Sprigs of Elodea
Treated or bottled water

Activity 1 Materials for Each Group:

2 Microscopes
1 Microscope kit
1 Plastic cup with lid
Colored pencils
4 Lab notebooks

Session Length: One 45 minute session.

Microscopic Life **Activity 2: Discovering Cells** **Day 4**	
TIME	PROCEDURE
Prep	Set-up an Elodea wet-mount center with the basin of Elodea and a few droppers.
5 min	**Activator:** *A brain-teaser:* Your mother asks you to bring 4 litres of water from the nearest pond , but you have only a 3 litre jug and a 5 litre. How do you bring 4 litres of water from the pond? *Solution.* Fill the 5 litre jug.Then fill the 3 litre jug to the top with water from the 5 litre jug. Now you have 2 litres of water in the 5 litre jug. Dump out the 3 litre jug back to the pond and pour what's in the 5 litre jug into the 3 litre jug. Then refill the 5 litre jug, and fill up the 3 litre jug to the top. Since there were already 2 litres of water in the 3 litre jug, 1 litre is removed from the 5 litre jug, leaving 4 litres of water in the 5 litre jug.
5 min	**Introduction:** Lift a sample of Elodea from the culture and ask students if they recognize it. Some should know it as a popular aquarium plant. *Today we will use the microscopes to look at living material to see what we can learn. We will start by looking at the leaves of this aquatic plant called Elodea.* Preview together the Lab Sheet which describes the Elodea wet-mount prep.
10 min	**Students prepare wet mounts.** Students look at Elodea under the microscope at 100X (remind them to focus up and down). Move about the classroom and ask: *What do you see when you look at the Elodea?*

	When you focus up and down through the leaf sample, what did you notice? *Are the rectangles flat, as if the design is drawn on the surface of the leaf?* *Are the boxes empty?* *How many layers of these boxes or bricks do you see?* *Is the Elodea leaf a cell?*
15 min	**Estimate the size of cells and draw them.** Students set their microscopes to 400X (Students learned to estimate the size of cells in a previous lab "Field of View and Magnification", they can refer back to that lab in their notebooks) and draw what they see in the field of view. (Remind students that a few cells drawn accurately with internal details are more valuable than a page full of empty squares). **Discuss cell size**: *Are all of the cells in an Elodea leaf the same size?* *How many layers of cells are there in an Elodea leaf?* *Are the large cells on the top of the leaf or the bottom?* *How big are Elodea cells? How does this compare to the size of cells in your miniponds***?**
5 min	**Discussion:** *Did you notice anything moving inside any of the cells*? Let them look for another minute. Some students may remark on the moving fluid in the cell. *Cells are filled with a fluid called cytoplasm. Cytoplasm can sometimes be seen moving inside the cells of living plants. The green balls moving in the cytoplasm are chloroplasts – the structures that give plants their green color.* The terms "cytoplasm" and "chloroplast" can be added to Operational Definitions as they will encounter these terms in the next unit on cell structure.
5 min	**Clean-up**: students wash elodea samples from their slides back into the Elodea container, clean and dry slides.
	Homework: Draw a cell from the elodea and compare it to the cell you chose for the 'Let me introduce my CELLF!" assignment". What's different? What's the same?

Microscopic Life **Activity 2: Discovering Cells** **DAY 5**	
TIME	PROCEDURE
5 min	**Activator**. Students guess the order, from largest to smallest, of the following: bacteria, human hair, dust mite, the head of a pin, virus, red blood cell.
30 min	**Cells Alive!** Students compare sizes of organisms as well as compare animal cells, plant cells, and bacterial cells. Students view computer models of cells, learn the functions and the descriptions of the cells and their components.

	Part A. Students access the link: "How Big is a.." to discover how their answers to the Activator compare to the real thing and complete their worksheet. **Part B.**. Students go back to the computers to explore "Cell Models": the animal cell model, the plant cell model, and the bacterial cell model and complete the e-sheet. [SciLinks. URL http://www.cellsalive.com/toc.htm]
10 min	Class comes together to discuss the commonalities and differences. Does each cell have something unique about it?

RUBRIC

	Novice	**Competent**	**Expert**
Process Skill	Follows method but unable to offer hypotheses or evidence.	Follows method and is able to offer hypotheses OR evidence.	Follows method, offers hypotheses, and evidence.
Habit of Mind	Does not keep clear and accurate records.	Keeps clear and accurate records but unable to note differences between team observations and data	Keeps clear and accurate records. Notes differences between team observations and data.
Concept	Not able to determine differences between living cells and organisms.	Able to show three differences between living cells and organisms and able to either offer common characteristics of Elodea cells or give evidence of life observed in lab.	Clearly delineates differences between living cells and organisms, offer common characteristics of Elodea cells and give evidence of life observed in lab.

Microscopic Life
Activity 3: Paramicium

Relationship of this Lesson to the Unit: In Activity 3 students compare Elodea and paramecium and distinguish between multicellular and single-celled organisms. Students begin to make the distinction between "alive" and "organism" and are introduced to the term protist. Students feed the the paramecia observe as the yeast is digested.

Massachusetts Frameworks Strand and Learning Standard:
Science and Technology/Engineering Framework
Strand 2: Life Science (Biology), Grades 6-8.
Learning Standard: *Classification of Organisms*
1. Classify organisms into the currently recognized kingdoms according to characteristics that they share. Be familiar with organisms from each kingdom.

Learning Standard: *Structure and Function of Cells*
2. Recognize that all organisms are composed of cells, and that many organisms are single-celled (unicellular), e.g., bacteria, yeast. In these single-celled organ- isms, one cell must carry out all of the basic functions of life.
3. Compare and contrast plant and animal cells, including major organelles (cell membrane, cell wall, nucleus, cytoplasm, chloroplasts, mitochondria, vacuoles).
4. Recognize that within cells, many of the basic functions of organisms (e.g., extracting energy from food and getting rid of waste) are carried out. The way in which cells function is similar in all living organisms.

Science Concepts: Paramecia have structures that have certain functions. Cells have the same needs and perform the same functions as more complex organisms. What evidence can be observed to support the idea that single-celled paramecia are organisms?

Process Skills: Interpreting data.

Science Habits of Mind: Keep records of investigations and do not change the findings later.

Materials for each group
- 2 Microscopes
- 1 Microscope kit
- Cotton filaments
- 1 Dropper bottle of Congo red-dyed yeast
- 1 Plastic cup
- Colored pencils
- 4 Packets: The Lowly Paramecium
- 4 Lab Notebooks

Materials for the Class
- 1 Petri dish
- Vinegar (or other weak acid)
- Paramecium culture
- Water
- Congo red stain
- 1 Dropper

Session Length: Three 45 minute sessions.

Microscopic Life **Activity 3: Paramicium** **Day 6**	
TIME	PROCEDURE
Prep	Sample paramecia culture and view a slide to ensure that culture is viable.
5 min	**Activator.** Brain-teaser: Consider this, "What is the largest living organism?" (Solution: The largest living organism is the giant sequoia tree. The wood in one of these trees is enough to make 50 average-sized houses.)
10 min	**Review Living and Nonliving.** Review with students what they saw when they looked at the *Elodea* leaves. Discuss whether the *leaves* were alive or not. Students may not be clear on how their definition of life applies to the *Elodea* leaf. Emphasize that each cell of the elodea leaf is dependent on the whole organism (plant) to survive (eat, drink, breathe, grow, etc.) Refer to the class chart on Evidence of Life). **Recall the Paramecia.** *Today we will have an opportunity to look more closely at the paramecia you saw dashing around in the slide from your minipond.* Ask students to anticipate problems they might encounter trying to observe the paramecia. They will probably remember that they are really small and move around too fast.
20 min	**Lab/Observations.** Students should start searching for paramecia at 40X and increase to 100X and 400X. Once a couple of students have located paramecia, have them work through the *Paramecia* sheet, estimating the length. *Is the paramecium alive? What is your evidence?* Circulate to make sure that everyone is looking at the same thing. As with the Elodea cell drawings, a detailed illustration of a single organism is much more useful than a lot of plain oval outlines. Circulate to make sure students are seeing and recording the internal structures and not just drawing cigar-shaped blobs. Listen-in: has anyone found the thread-like cilia around the outside of the paramecium or the circular vacuoles inside?
10 min	**Discussion.** After students have drawn and recorded their observations, teams discuss and record the following questions: *What movements did you observe? What did you see on the inside of the paramecium? What did you see on the outside of the paramecium?*
	Homework. Read "The Lowly Paramecium" and respond to questions.

Microscopic Life
Activity 3: Paramicium
DAY 7

TIME	PROCEDURE
20 min	

Discussion. Distinguish between "alive" and "organism".
Make a T table to compare charactistics of Elodea vs. Paramecia. Take out a piece of paper and fold in half length-wise. In the top 1//4 of the page draw an elodea cell on the left and a paramecium on the right. Allow 4 minutes for discussion *What did the microscopic structure of the Elodea leaf look like ? What did the microscopic structure of the paramecium look like? Do the things inside of the paramecium look like the things inside the Elodea cells?*

Together, build a concept map of a "cell". Ask the Observer in each group to report the discussion results for their group and begin mapping (discussion should reveal information such as the chart below. Teacher guides students to determine whether each type of cell is categorized as **Living Cell and/or Organism** and writes conclusions at top**:**

Elodea cells Living Cell --YES Organism - NO	**Paramecia Living cell – YES Organism - YES**
stay in one place	move around
Each cell is stuck to another cell	each cell is alone
cannot live alone – needs other parts of the plant to survive	Lives alone or free-living
Each cell is part of a bigger organism	Each cell is not part of a bigger organism –but is itself an organism .
Elodea leaf is made of many cells	Made of one cell
multicellular organism	single-celled organism.
Alive	Alive

Refer to the class's concept map as well as Operational Definitions chart and discuss:

Can a single living cell be a living organism?

Can a single living cell not be a living organism?

Is an Elodea leaf cell a living organism?

Is a paramecium cell a living organism?

Reinforce. Reinforce concept map finding: Elodea plant is an organism --made of many cells – a multicellular organism. The individual Elodea cell, although it is alive, is not an organism. The paramecium is an organism. The paramecium is,

	however, just one cell. Paramecia are single-celled organisms.
	Homework. Reflect in in your journal about the paramecium. Was it doing all of the things you have listed in your definition of a living organism? Did you see it eat or use energy? Give off waste? Reproduce? What could we do in class to see some of these activities in paramecia?

Microscopic Life **Activity 3: Paramicium** **DAY 8**	
TIME	PROCEDURE
10 min	**Activator:** Classification of "Creepy Critters" – looking at common characteristics. Students group "critters" according to similar characteristics and classify them.
10 min	**Introduce "Protist".** Paramecia are single-celled organisms in a kingdom of life called Protista. In Greek, "proto" means early, and "protist" means the very first. So single-celled organisms like paramecia are members of a kingdom of life that includes organisms that are similar to some of the very first life-forms on Earth. Bear in mind, protists are not true plants or animals (although they may have characteristics similar to plants and animals). Plants and animals are always multicellular. Protista is a separate kingdom whose members are mostly single-celled.
25 min	**Discussion.** Direct attention to the classroom chart on the Operational Definition of a living thing. Ask for volunteers to share their journal entries for *What could we do in class to see some of these activities in paramecia?* Record suggestions on the CHART PAPER. For example, one part of the operational definition of living is requires food. Some students should have seen the water-releasing vesicles (bubbles) and may have seen a paramecium ingest something, such as a smaller organism in the sample. Student suggestions may include: watching to see if paramecia eat anything; providing the yeast suspension-it worked for the brine shrimp. Students may suggest other common characteristics of living things from the class's Evidence of Life list (grow, consume nutrients, exchange gases, respond to stimuli, reproduce, need water, eliminate waste, and are composed of cells) compiled in the first unit, *What is Life*, in the Diversity of Life course. Acknowledge all suggestions. Some may be added to the Parking Lot. Guide the suggestions to FEEDING. Students will have an opportunity to feed the paramecia to confirm.

	Homework: **Classification:** Hand a "bag of various fasteners" (photo on worksheet.) As renowned taxonimists, you are to develop a classification system. Look at similarities and differences to categorize each fastener. Each item can belong only to one group. Consider form (the way it looks) and function (the way it works). What criteria did you use to differentiate among categories?

	Microscopic Life **Activity 3: Paramicium** **DAY 9**
TIME	PROCEDURE
10 min	**Activator:** Handout another "bag of fasteners" – worksheet photo from yesterday- have students separate each fastener by cutting with scissors and then group into classifications
10 min	**Revisit the Characteristics of Life Display.** Have students recall that they have been developing a definition of "living" by describing the characteristics of life that are common to all things that we consider living. *Do cells have life? Do the characteristics of cells have the characteristics of life?* Reinforce that cells are alive. Life happens in cells and only in cells. Cells are the fundamental units of life. Turn students' attention to the list of characteristics of life. Review the needs and behaviors that define life. *Is there anything else that we should add to the list that is true of all living things* ? Students should be ready to add the fact that all living things are made of cells. Some are individual cells, and others are complex collections of cells, but life is always cellular. Add "is made of cells" to the list of characteristics of life.

30 min	**Feeding Paramecia.** Remind students that one of the characteristics of living organisms is the need for food. Today they will look for evidence that paramecia take in food. Preview the procedure for preparing, feeding, and observing paramecia. Before starting the feeding investigation, discuss the use of dyed yeast: **Demonstration: Congo-red color change.** Demonstrate the acid response by putting a petri dish on the overhead projector. Add a few milliliters of water and a few drops of Congo red-dyed yeast. The liquid looks pink. Add a few drops of vinegar or other dilute acid. *What happened when acid was added to the Congo red-dyed yeast?* *When congo red dyed yeast turn blue, what is present?* **Lab.** After the paramecia have ingested some yeast, digestion will begin. In about 15 to 20 minutes the yeast will begin to turn blue in the vacuoles inside the paramecia. Circulate while students are observing the paramecia feeding and ask a few questions to focus their observations. *The paramecia do not have legs or fins. How do you think they move around?* *How do the paramecia get the yeast inside their bodies* ? Do *paramecia have mouths?* *How do paramecia get rid of waste products* ? *What keeps the paramecium's insides from spilling out?* *What does the yeast inside a paramecium look like?*
5 min	**Clean up** When students have completed their observations, have them clean their slides and stow them in the kits. Have students carefully return the paramecium culture cups and other materials to the materials station.
	Homework. Have students respond to the worksheet Feeding Time. Students read the text and work alone to respond to the ideas presented.

RUBRIC

	Novice	Competent	Expert
Process Skill	Unable to provide accurate data.	Provides some accurate data.	Interprets data accurately.
Habit of Mind	Does not keep records of investigations.	Keeps records of investigations but incomplete.	Keeps records of investigations and does not change the findings later.
Concept	Unable to provide evidence to support the idea that single-	Provides some evidence to support the idea that single-	Provides clear evidence to support the idea that single-

celled paramecia are organisms?	celled paramecia are organisms?	celled paramecia are organisms?

The Cell
Activity 4: Human Cells

Relationship of this Lesson to the Unit:

Science and Technology/Engineering Framework
- Strand 2: Life Science (Biology), Grades 6-8.
  - Learning Standard: *Classification of Organisms*
    1. Classify organisms into the currently recognized kingdoms according to characteristics that they share. Be familiar with organisms from each kingdom.
  - Learning Standard: *Structure and Function of Cells*
    2. Recognize that all organisms are composed of cells, and that many organisms are single-celled (unicellular), e.g., bacteria, yeast. In these single-celled organ- isms, one cell must carry out all of the basic functions of life.
    3. Compare and contrast plant and animal cells, including major organelles (cell membrane, cell wall, nucleus, cytoplasm, chloroplasts, mitochondria, vacuoles).
    4. Recognize that within cells, many of the basic functions of organisms (e.g., extracting energy from food and getting rid of waste) are carried out. The way in which cells function is similar in all living organisms.

Science Concept: What are humans made of? What evidence do we have that humans not only have cells, but *are* cells?

Process Skills: Modeling.

Science Habits of Mind: Go to reliable sources for evidence. Challenge sources to make sure they are reliable.

Materials for Class:
- Rubbing alcohol
- Methylene blue
- Multimedia setup
- Diversity of Life CD

Materials for each Group:
- 2 Microscopes
- 1 Microscope kit
- Lab Notebooks

Session Length: One 45 minute session.

The Cell **Activity 4: Human Cells** **DAY 10**	
TIME	PROCEDURE
Prep	**Add Stain to Kits.** Fill the empty dropper bottle in each microscope kit with methylene blue. **Consider Local Restrictions.** Your school or district may impose a restriction on examining human cells. If you find yourself in this situation, look into acquiring prepared slides of human cheek tissue from a commercial biological supply house.
10 min	**Activator.** *SciLINKS* URL http://www.cellsalive.com/toc.htm Students view computer models of cells, learn the functions and the descriptions of the cells and their components. Students access the links: "How Big is a..", and "Cell Models the animal cell model, the plant cell model, and the bacterial cell model**.**
5 min	**Review cell.** Have students recall their observations of microorganisms in the previous investigation: ▪ Cells are the most elementary, basic units of life. ▪ Organisms are free-living life-forms ▪ Organisms can be as simple as single cells, or as complex as plants and animals. *What are humans made of?*
30 min	**Describe the cheek tissue investigation.** Tell students that there is one easy way to investigate a sample of human tissue: cheek scraping. Describe and demonstrate the process of preparing a stained wet mount of a cheek sample. NOTE: Don't tell students they are searching for cells-just that they are checking cheek tissue to see what it is made of. **Introduce the cheek investigation sheet.** Ask students use the worksheet *Cheek Investigation*, follow the instructions, gather the data, and discuss the observations in their groups. After discussing the results, students should answer the questions on the sheet. **Observe Cheek Cells.** Let students get microscopes and microscope kits. Allow about 30 minutes for students to make the observations and complete the sheet. Circulate to help identify cheek cells in their slides. *NOTE: For health and safety reasons, have each student wash off their own slide and coverslip, and properly dispose of their own toothpick.*
10 min	**Discuss Results.** Once students observe cheek cell under magnification, guide discussion so that they realize that humans are made of cells. *What does this investigation suggest about the construction of the human body?* *Do you think all the cells in the human body are the same? Why or why not?*

	If all the millions of different cells in the human body are alive, how do they get the resources, like food and water, that they need to stay alive? It has been suggested that all life is aquatic. How do you think that applies to humans?
5 min	**Clean up.** Ask students to wash their own slides and coverslips and dispose of their toothpicks. They should return the microscopes and microscope kits to their storage locations. If the blue stain on the slides and coverslips persists, have students use alcohol to clean them.
	Homework. Relationship between cells and human beings.

RUBRIC

	Novice	**Competent**	**Expert**
Process Skill	Does not understand that cell models in the SciLINKS activity are scientific models.	Understand that cell models in the SciLINKS activity are scientific models.	Understands that cell models in the SciLINKS activity are scientific models AND does an enrichment activity of making a 3-D cell model.
Habit of Mind	Go to reliable sources for evidence. Challenge sources to make sure they are reliable.	. Go to reliable sources for evidence. Challenge sources to make sure they are reliable.	. Go to reliable sources for evidence. Challenge sources to make sure they are reliable.
Concept	Does not know humans are made of cells and does not connect that humans not only have cells, but *are* cells.	Knows humans are made of cells but does not make the connection that humans not only have cells, but *are* cells.	Knows humans are made of cellsand provides that humans not only have cells, but *are* cells.

The Cell
Activity 5: Ribbon of Life

Relationship of this Lesson to the Unit: Students integrate cell theory into their developing concept of life through the use of the Ribbon of Life CD-ROM. The ribbon starts with atoms, advance to molecules, and goes on to cells. It highlights cellular structures and more advanced levels of organization: tissue, organ, organ system, and complex multi-sensory organism. All along, students reflect on the need for water, nutrients, gas exchange, and waste removal.

Science and Technology/Engineering Framework
- Strand 2: Life Science (Biology), Grades 6-8.
  - Learning Standard: *Classification of Organisms*
    1. Classify organisms into the currently recognized kingdoms according to characteristics that they share. Be familiar with organisms from each kingdom.
  - Learning Standard: *Structure and Function of Cells*

2. Recognize that all organisms are composed of cells, and that many organisms are single-celled (unicellular), e.g., bacteria, yeast. In these single-celled organ- isms, one cell must carry out all of the basic functions of life.
3. Compare and contrast plant and animal cells, including major organelles (cell membrane, cell wall, nucleus, cytoplasm, chloroplasts, mitochondria, vacuoles).
4. Recognize that within cells, many of the basic functions of organisms (e.g., extracting energy from food and getting rid of waste) are carried out. The way in which cells function is similar in all living organisms.

Science Concept: What are the cellular structures that define cells? How are cells organized into more advanced levels or organization?

Process Skills: Inferring.

Science Habits of Mind: Look at matter from amny different sides before drawing a conclusion.

Materials for Class:
Multimedia setup
Diversity of Life CD

Materials for each Group:
Lab Notebooks
Diversity of Life Resource books

Session Length: One 45 minute session.

The Cell **Activity 5: Ribbon of Life** **DAY 11**	
TIME	PROCEDURE
Prep	Each team will use the computer at their lab bench. Preview Ribbon of Life CD.
5 min	**Activator.** Keep this question in the back of your mind as you read *Cell: The Basic Unit of Life*: "Humans and many other organisms don't live in water. But, why would a person make the statement that all life is aquatic?"
15 min	**Introduce the Ribbon of Life.** Tell students that in this activity they will study the lives of cells more closely. They will use the *FOSS Diversity of Life* CD-ROM to get information. Describe the access students will have to computers. **Set up computer use**. Encourage teams to pass the role of navigator around so all group members have an opportunity to drive.

	Exploration of the Ribbon of Life. From the main interface of the CD-ROM (garden and patio), direct students to the Lab. Click on the computer screen. This launches Cells and the Ribbon of Life. Allow 15 minutes for students to explore the ribbon without guidance.
10 min	**Use the Ribbon of Life sheet .** After 15 minutes, call for attention and ask to use the Ribbon of Life worksheet as a guide to focus their attention on the details of cell structure and function. Help them think about the big ideas of cell survival and interaction that are embedded in the Ribbon of Life activities. Let students continue to work with the Ribbon of Life while they fill in the sheets. **Discuss the sheet**. If students were working at multiple computers, call them back to their seats. Use your demonstration computer while you discuss the *Ribbon of Life* sheet. Start by reviewing questions 1-3 to lay a foundation for the other discussions. Click through Cells and the Ribbon of Life, pausing at each stop to read the rollover statement. Reinforce the idea that each new stop represents a more complex level of organization of matter than the previous one. Follow the *Where Are the Organisms*? thread of organisms. Reinforce that the three stops along the way are bacteria (prokaryotic cells), single eukaryotic cells (protists and fungi), and complex multicellular organisms (plants and animals). Discuss the difference between being alive and being an organism. Refer to chart Operational Definitions.
15 min	**Continue the review.** Continue to review the ideas on the *Ribbon of Life* sheet, making sure to elaborate on these topics and add to Operational Definitions chart as needed. Make two T charts to write the details of the comparisons of 1.) prokaryotes and eukaryotes, and 2) sheep cells to paramecia. 1.) **prokaryotes and eukaryotes** ▪ Organelles are the structures inside cells. ▪ Prokaryotic cells have few organelles; eukaryotic cells have many. ▪ The only organelles common to all cells are ribosomes. ▪ All cells also have a cell membrane and cytoplasm, the fluid that fills the cell. ▪ Eukaryotic cells have a nucleus; prokaryotic cells do not have a nucleus. ▪ Bacteria are prokaryotes; all other organisms are eukaryotes. ▪ Bacteria are the only kinds of organisms that do not have nuclei in their cells. 2) **sheep cells and paramecia**

	▪ Paramecia and sheep cells are both eukaryotic cells. Paramecia cells can live alone because these single cells are organisms. Sheep cells depend on the complex systems in the sheep to keep them alive, so sheep cells are not organisms. Paramecium cells generalize-they are able to do everything for the organism. Sheep cells specialize-they do only one thing for the organism. Cells in complex organisms often work with other similar cells to perform specific functions. Masses of cells working together are tissues. Examples of tissues include bone, muscle, nerves, and endosperm (cotyledon). **Aquatic nature of cells.** ▪ Cells are mostly water, and the environments in which all cells live is wet. Organisms that have moved onto dry land have to maintain systems that keep all their cells surrounded by fluid. Plants and animals transport water through vascular systems and circulatory systems to ensure that the aquatic environment is provided. ▪ These water-delivery systems also transport other essential resources to and from the cells, including gases, energy; and waste.
	Homework. Everything is made of atoms, even organisms. Show the steps of increasing organization from atom to organism. Write, create a small poster or a 1-2 slide Powerpoint. Indicate in your paper or poster: Which level begins what scientists would consider *living or alive?*

RUBRIC

	Novice	**Competent**	**Expert**
Process Skill	Does not derive conclusion that cells are one level of the of many levels organization.	Understands that there are steps of increasing organization from atom to organism but is unable delineate them.	Understands, knows and make the connections between the steps of increasing organization from atom to organism.
Habit of Mind	Unable to look at matter from many different sides before drawing a conclusion.	Able look at matter from many different sides but does not draw conclusion.	Able look at matter from many different sides and draw conclusion.
Concept	Does not know the cellular structures that define cells.	Knows some of the cellular structures that define cells.	Knows all of the cellular structures that define cells.

Microscopic Life & The Cell
Units

CONCEPT MAP

Where we've BEEN (last unit):	*Where we ARE (current unit):*	*Where we're GOING (next unit):*
Introduction to the Microscope	Microscopic Life and The Cell	Seeds of Life

All organisms (bacteria, protists, fungi, plants, and animals) are composed of cells, and that a single cell is the fundamental unit of life.

The cell is the basic unit of life.

Some living cells are organisms while some living cells are not

No matter how simple or complex an organism is, it is made of cells, and the cells are alive.

Cells have defining structures.

When looking at an Elodea leaf under magnification, what evidence of life can be observed? What characteristic appears to be common to all leaf samples?

What evidence can be observed to support the idea that single-celled paramecia are organisms?

What are humans made of? What evidence do we have that humans not only *have* cells but *are* cells?

What are the cellular cstructures that define cells? How are cells organized into more advanced levels of organization?

What's the bigger picture?	*What's a connection to today's world*?
Living organisms have structure and function and have a relationship to their environment.	The more different life forms we can keep with us on this planet, the better the chances that we, our children and their children will not only survive, but live in a balanced and beautiful world.

Lynne Sheridan
Lesley University