Anglophone School District - North

Grade 6 Science - Unit Lesson Guide

Diversity of Life

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The Aim of Science Education - Scientific Literacy

The aim of science education in the Atlantic Provinces is to develop scientific literacy.

Scientific Literacy is an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problem-solving, and decision-making abilities; to become lifelong learners; and to maintain a sense of wonder about the world around them. To develop scientific literacy, students require diverse learning experiences that provide opportunities to explore, analyze, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment.

The Three Processes of Scientific Literacy

An individual can be considered Scientifically Literate when he/she is familiar with, and able to engage in, three processes: Inquiry, problem solving, and decision making.

Inquiry

Scientific inquiry involves posing questions and developing explanation for phenomena. While there is a general agreement that there is no such sing as the scientific method, students require certain skills to participate in the activities of science. Skills such as questioning, observing, inferring, predicting, measuring, hypothesizing, classifying, designing experiments, collecting data, analysing data, and interpreting data are fundamental to engaging science. These activities provide students with opportunities to understand and practise the process of theory development in science and the nature of science.

Problem Solving

The process of problem solving involves seeking solutions to human problems. It consists of proposing, creating, and testing prototypes, products, and techniques to determine the best solution to a given problem.

Decision Making

The process of decision making involves determining what we, as citizens, should do in a particular context or in response to a given situation. Decision-making situations are important to their own right, and they also provide a relevant context for engaging in scientific inquiry and/or problem solving.

Science Assessment Overview

Science is a hybrid term that houses different disciplines such as: Physics, Chemistry, Biology, Environmental Studies, Engineering, Math, etc. Given this broad spectrum, it is not realistic that we can paint science assessment with a single brush in terms of probes that work for every science activity. However, regardless of school subject, let alone science, the frequency of assessment should be unbalanced with formative assessment occupying 80% of practise and summative with the remaining 20%.

80% Formative - 20% Summative

Formative Assessment
Formative assessment is a range of formal and informal assessment procedures employed by teachers during their learning process in order to modify teaching and learning activities to improve student attainment. It typically involves qualitative feedback (rather than scores) for both students and teacher that focuses on the detail of content and performance. Feedback is the central function of formative assessment. It typically involves a focus on the detailed content of what is being learnt.

Science Formative Assessment falls into 2 distinct categories, and they are divided about how feedback is given. Please be aware that an activity could be informal or formal, it is the purpose of the task that determines purpose.

Informal Formative
Informal Formative Science Assessment acts as a monitoring probe and is distinct because it is not graded.

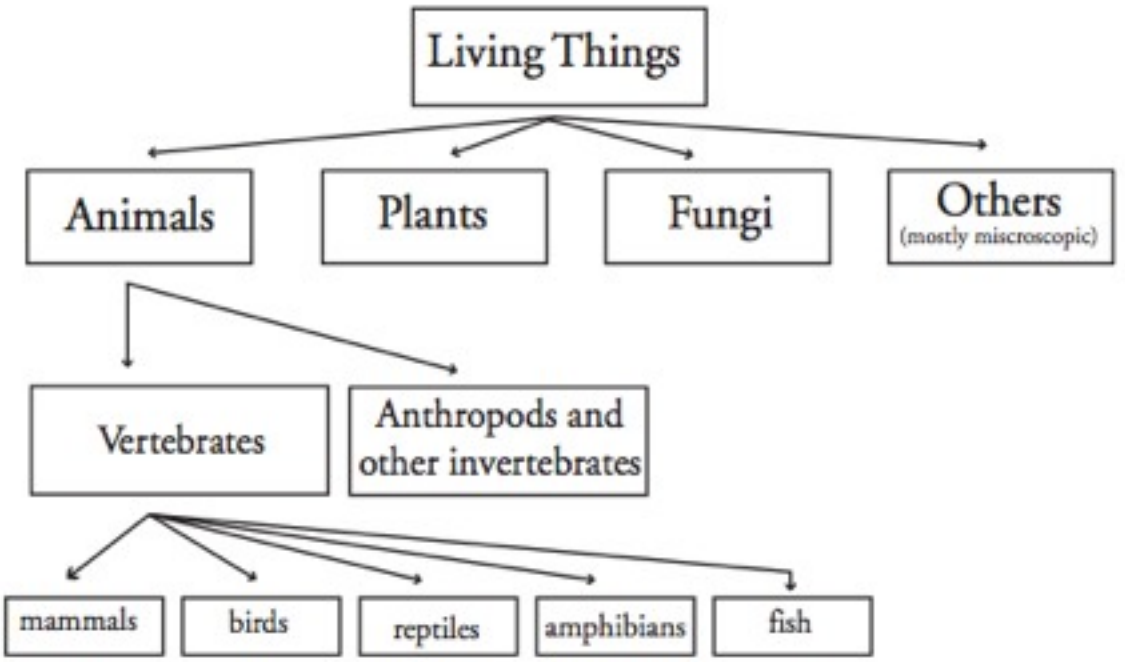
Formal Formative
Formal Formative Science Assessment provides specific feedback to students, the teachers corresponds via anecdotal feedback, rubrics, and written responses to offer progress to student attainment.

Summative Assessment
Summative assessment seeks to monitor educational outcomes, often for the purposes of external accountability. Usually occurring at the end of a learning unit and determines if the content being taught was retained.

Diversity of Life

Focus and Context

Inquiry is the focus in this unit, with an emphasis on observation and classification. Students should be involved in closely observing living things (plants, animals and microorganisms), noting their features, and constructing classification schemes that group organisms with like features. They should also be introduced to formal classification schemes through classification within the animal kingdom. Students will gain an appreciation for the diversity of life in their local habitat, in their province, in the world, and, through fossil studies, over time.



Unit Instructional Overview

The Role of a Common Classification Scheme for Living Things	The Animal Kingdom: Vertebrates and Invertebrates	Microorganisms*	Adaptations and Natural Selection
Activity: Working With Classification	Activity - Classifying the Animal Kingdom	Access Prior Knowledge - Activity	Activity - Asking Questions about Adaptations of local species
Activity: Classifying local habitat	Activity - Classifying Vertebrates	1st Cycle - Activity - Exploring Microorganisms	Activity -Comparing Adaptations
	Activity - Classifying Arthropods	2nd Cycle - Activity - Microorganisms Basic Needs	Activity -Studying Endangered Species
		3rd Cycle - Activity Research	Activity - Fossils...Natural Selection

* - EECD Grade 6 Inquiry package - available at https://portal.nbed.nb.ca/tr/lr/k-8Science/Pages/default.aspx

Diversity of Life - Curriculum Outcomes

The Role of a Common Classification Scheme for Living Things	204-6 identify different ways to classify living things in their local habitat, and select one	206-1 classify living things in the local habitat and create a chart or diagram that shows the method of classifying	207-2 present a selected classification scheme to others
	104-5 describe how classifications may vary and suggest possible explanations for variations	206-9, 300-15 identify communication problems that arise from the differences in classification schemes for living things, and describe the role of a common classification system	
The Animal Kingdom: Vertebrates and Invertebrates	104-8, 300-16 classify animals as vertebrates or invertebrates	300-17 compare the characteristics of mammals, birds, reptiles, amphibians, and fish	205-7 record observations while investigating common arthropods
	300-18 compare characteristics of common arthropods	206-1 classify invertebrates as arthropods or “other invertebrates”	
Microorganisms*	204-8, 300-19 identify and use correctly appropriate tools to examine and describe some living things that cannot be seen with the naked eye	302-12 describe how microorganisms meet their basic needs, including obtaining food, water, and air, and moving around	
	107-6 provide examples of how science and technology have been involved in identifying and controlling the growth of microorganisms	107-1 describe products and techniques that can be used at home to protect agains unwanted microorganism growth	
Adaptations and Natural Selection	204-1, 205-8 propose questions about the relationship between the structural features of organisms and their environment, and use a variety of sources to gather information about this relationship	301-15 compare the adaptations of closely related animals living in different parts of the world and discuss reasons for any differences	105-1,107-6 describe reasons why various animals are endangered, and describe efforts to study their population size and ensure their continued existence
	301-16 identify changes in animals over time, using fossils	105-5 identify the theory of natural selection as one that has been developed based on the gradual accumulation of evidence	106-3, 107-11 identify paleontologists as people who study fossils, and describe examples of improvements to some of their techniques and tools that have resulted in a better understanding of fossil discoveries

Diversity of Life

Strand - The Role of a Common Classification Scheme for Living Things

General Curriculum Outcomes	Specific Curriculum Outcomes
204-6 identify various methods for finding answers to given questions and solutions to given problems, and select one that is appropriate	204-6 identify different ways to classify living things in their local habitat, and select one
206-1 classify according to several attributes and create a chart or diagram that shows the method of classifying	206-1 classify living things in the local habitat and create a chart or diagram that shows the method of classifying
207-2 communicate procedures and results, using lists, notes in point form, sentences, charts, graphs, drawings, and oral language	207-2 present a selected classification scheme to others
104-5 describe how results of similar and repeated investigations may vary and suggest possible explanations for variations	104-5 describe how classifications may vary and suggest possible explanations for variations
206-9 identify new question or problems that arise from what was learned	206-9, 300-15 identify communication problems that arise from the differences in classification schemes for living things, and describe the role of a common classification system
300-15 describe the role of a common classification system for living things	

Working With Classification

Outcomes:
204-6 identify various methods for finding answers to given questions and solutions to given problems, and select one that is appropriate
206-1 classify according to several attributes and create a chart or diagram that shows the method of classifying
104-5 describe how classifications may vary and suggest possible explanations for variations

Lesson Activity Overview:
This lesson should focus on having the students work with various materials to classify them. Probably the best way to do this is to fill a ziplock bag with random household item such as macaroni, paper clips, marbles, etc...(be careful to avoid items that students could be allergic to). Every bag should have relatively the same objects in it.

1. In groups have students create a classification chart based on the materials that are in the ziplock bag. Students should have no scaffolding with the intent being that the groups will classify the objects based on their own choosing.

2. Next, have groups identify the attributes in which they categorized their objects. Record these attributes on the board.

3. Student groups should take time to discuss their choice of attribute. Then students should reorganize their classification chart based on the feedback of their group discussions.

4. Groups will share their new classification scheme.

5. Have students discuss how classification may vary and suggest possible explanations for variations.

Assessment: Informal Formative
1. Ensure that student groups have created a classification chart based on established criteria. (206-1)

Classifying A Local Habitat

Outcomes:
207-2 present a selected classification scheme to others
104-5 describe how classifications may vary and suggest possible explanations for variations
206-9 identify new question or problems that arise from what was learned (from the differences in classification schemes for living things)
300-15 describe the role of a common classification system for living things

Lesson Activity Overview:
This lesson should focus on having the students work with local organisms to classify them. Since local habitats vary, there is not a list that can be given. Keep in mind, that in New Brunswick we have similar species throughout the province.

1. Begin the lesson by brainstorming the different species that live in your local area. Remember to keep in mind the many different species of living creatures, not just deer and moose.
2. In groups have students create a classification chart based on the species that were brainstormed. Students should have no scaffolding with the intent being that the groups will classify the species based on their own choosing.
3. Next, have groups identify the attributes in which they categorized their species. Record these attributes on the board.
4. Student groups should take time to discuss their choice of attribute vs the classification of others. Then students should reorganize their classification chart based on the feedback of their group discussions.
5. Groups will present their new classification scheme to the class.
6. Have students discuss how classification may vary and suggest possible explanations for variations.
7. Have a Volleyball discussion around problems that could arise from having different classification schemes for the same thing.
8. Introduce the role of a common classification scheme for all living things
    a. Students should be exposed to the biological classification scheme (image 1). Having said that, it is not essential that they understand every part of this system as it is highly advanced. 2 part of interest:
        i. The kingdom - this will be starting point for the Animal Kingdom that will be studied in later sections
        ii. Genus and Species - this is the taxonomy in which we use latin words to characterize - a Domestic Dog is Canis lupus familiaris
    b. Students should see image 2 so they understand the specific Kingdom that will be studied in this unit.

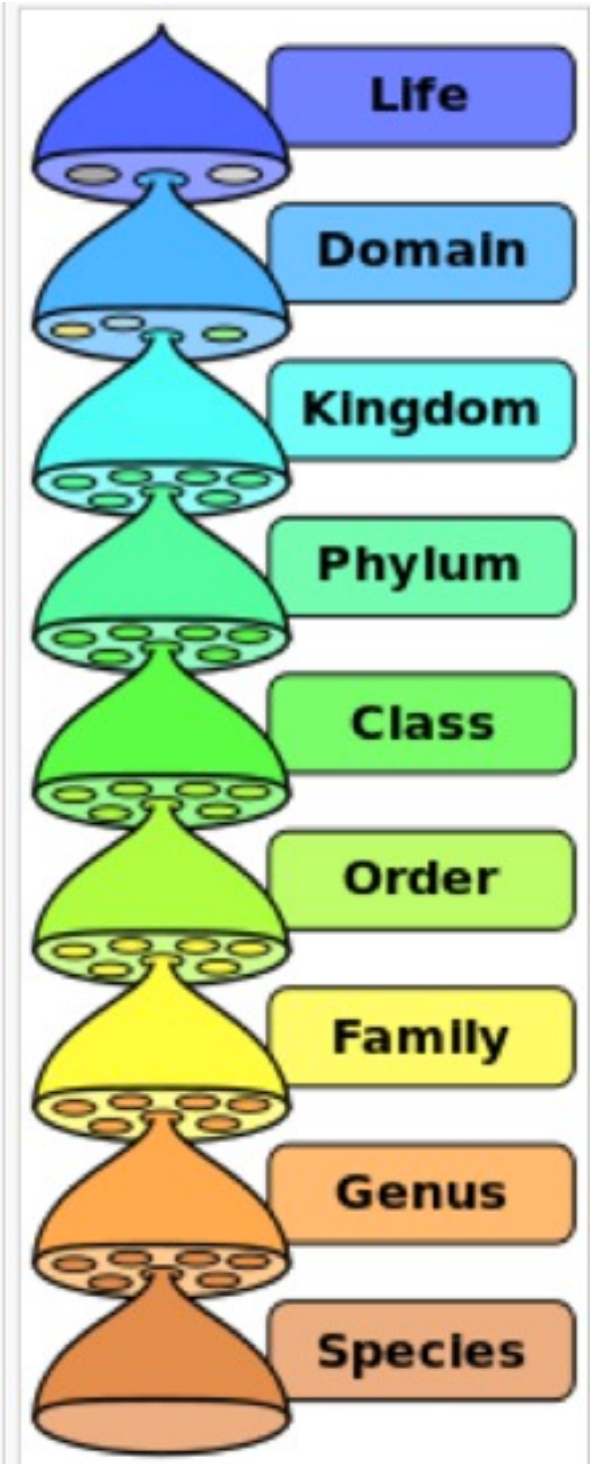
Assessment: Informal Formative
1. Ensure that student groups have created a classification chart based on established criteria.

2. Students should create a journal entry surrounding their discussion of classification schemes varying.

Assessment: Formal Formative

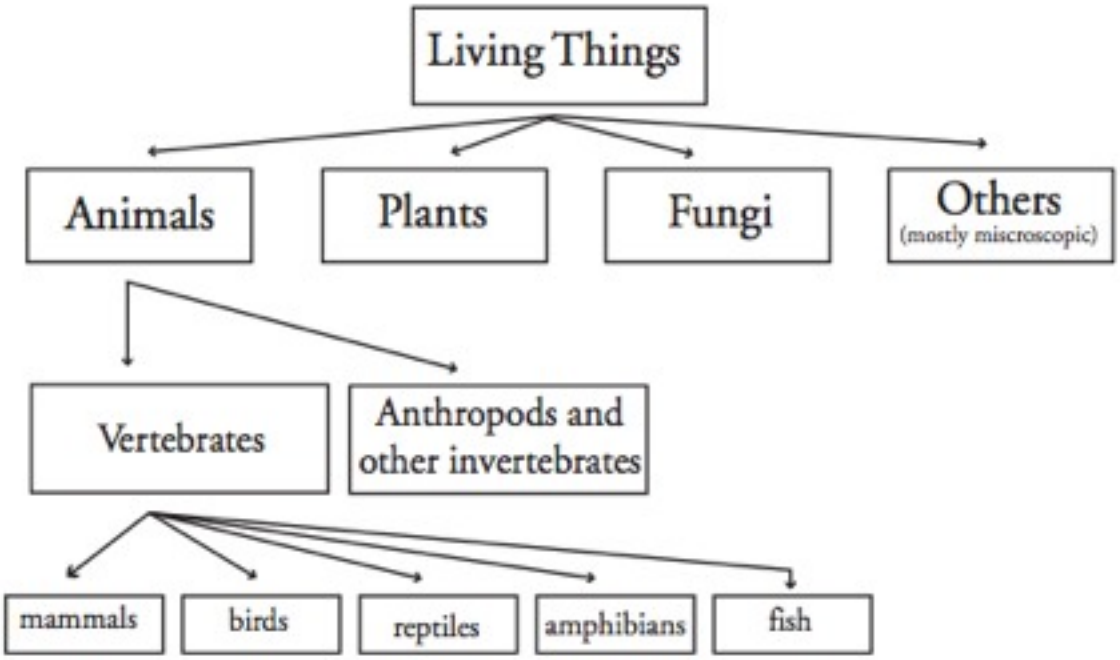
1. Students should create a journal entry surrounding their discussions on the problems that different classification schemes can create and the role of a common classification scheme.

Image 1



http://en.wikipedia.org/wiki/Biological_classification

Image 2


Living Things
Animals
Plants
Fungi
Others
(mostly miscroscopic)
Vertebrates
Anthropods and other invertebrates
mammals
birds
reptiles
amphibians
fish

Diversity of Life

Strand - The Animal Kingdom: Vertebrates and Invertebrates

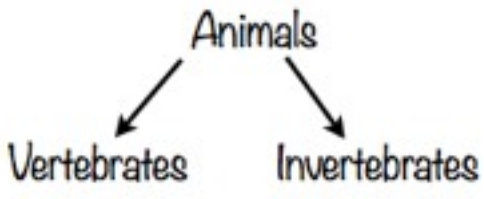
General Curriculum Outcomes	Specific Curriculum Outcomes
104-8 demonstrate the importance of using the languages of science and technology to compare and communicate ideas, processes, and results	104-8, 300-16 classify animals as vertebrates or invertebrates
300-16 distinguish between vertebrates and invertebrates	
300-17 compare the characteristics of mammals, birds, reptiles, amphibians, and fish	300-17 compare the characteristics of mammals, birds, reptiles, amphibians, and fish
205-7 record observations using a single work, notes in point form, sentences and simple diagrams and charts	205-7 record observations while investigating common arthropods
300-18 compare characteristics of common arthropods	300-18 compare characteristics of common arthropods
206-1 classify according to several attributes and create a chart or diagram that shows the method of classifying	206-1 classify invertebrates as arthropods or “other invertebrates”

Classifying the Animal Kingdom

Outcomes:
104-8 - demonstrate the importance of using languages of sciences (vertebrates or invertebrates)
300-16 distinguish between vertebrates and invertebrates

Lesson Activity Overview:
This lesson will continue the work of understanding classification. The difference in this lesson is that the attributes to classify have been established. Working with the Animal Kingdom, we are classifying animals as either vertebrates or invertebrates.

1. Ask students to identify as many animals as possible, record this brainstorm on the board.
2. Ask students if they have ever heard of the term “Vertebrates” - Record students responses of their opinion on the board. it is key to not give the answer so that students can work their ideas through.
3. Ask students if they have ever head of the term “Invertebrates” - Record students responses of their opinion on the board. - it is key to not give the answer and allow students to come to the answer on their own



4. Allow for volleyball discussions after showing this graphic. Students should be trying to formulate their own working understanding of the terms vertebrates and invertebrates. - In keeping with the inquiry approach, it is key to not give the actual definitions of these terms and allow the students to work through them via discussion.
5. Once students have agreed on their working understanding of the terms vertebrates and invertebrates show them a comparison chart:
http://www.diffen.com/difference/Invertebrate_vs_Vertebrate
   Make any alterations to the working definition based on the evidence provided from the web site and any further discussion that take place.
6. Revisit the animals from the brainstorm earlier in the lesson and have the students classify them as vertebrates and invertebrates.

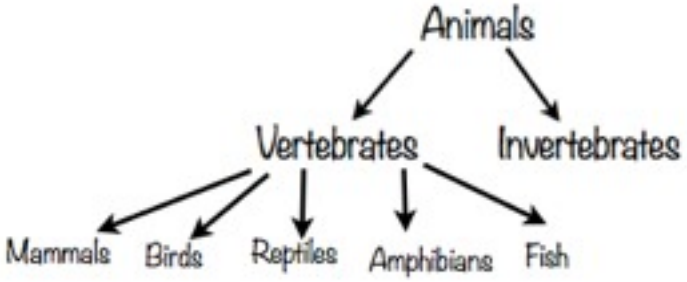
Assessment: Formal Formative
Have students create a journal entry based on their understanding of the terms vertebrates and invertebrates and give actual examples as evidence.

Classifying Vertebrates

Outcomes:
104-8 - demonstrate the importance of using languages of sciences (vertebrates as mammals, birds, reptiles, amphibians, and fish)
300-17 compare the characteristics of mammals, birds, reptiles, amphibians, and fish
207-2 present a selected classification scheme to others

Lesson Activity Overview:
This lesson will continue the work of understanding classification and will work further to classify vertebrates in the animal kingdom.
Previously, students have classified animals in the vertebrate section. The focus now is to reclassify those vertebrates as either mammals, birds, reptiles, amphibians, or fish.

1. Either you can use the previous brainstorm or you can choose to start fresh, but the intent is to list as many different vertebrates as possible, based on the classification of the previous lesson.
2. Next, ask students to LIST the different categories of vertebrates - try not to lead them to the answers and see if they can come up with them on their own. Allow for students to debate each other.



3. After students have had adequate time to discuss, show them the graphic above.
4. In cooperative groups, create a working understanding of each of the 5 categories of vertebrates. With the focus on creating the following dichotomous key:

"what makes a _____ different from the other vertebrates?"
*some may need to research to differentiate between the 5 categories.
Students should have 5 questions that they have to answer and thus should have created a rudimentary dichotomous key for identifying the categories of vertebrates.

5. Students should present their identification keys to the class and allow the each group to comment once the presentations have finished.
6. Next, as a class, create a dichotomous key based on the presentations of the class.

Assessment: Informal Formative
Ensure that students worth in groups to create their dichotomous key for the classification of vertebrates.

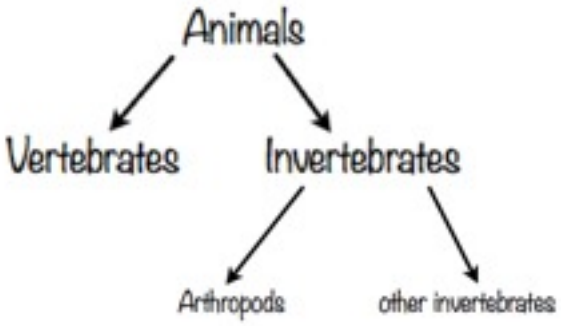
Assessment: Formal Formative:
Ensure that students can differentiate between the 5 categories of vertebrates

Classifying Arthropods

Outcomes:
205-7 record observations while investigating common arthropods
300-18 compare characteristics of common arthropods
206-1 classify invertebrates as arthropods or “other invertebrates”

Lesson Activity Overview:
This lesson will continue the work of understanding classification. However, the focus of the curriculum for these outcomes targets Arthropods specifically.

The best way to make this lesson as investigative as possible is to have students observe common arthropods. If possible, have actual examples of arthropods for students to explore. The focus is not to dissect these animals but rather observe and identify they common characteristics. If a physical investigation is not possible, be creative to find a web or print resource that makes the experience as investigative as possible. Rather then just giving the common characteristics the focus should be on the students determining the characteristics themselves.



Characteristics of all Arthropods: https://www.dsb1.edu.on.ca/ecocampbickell/Golden%20Avenue%20Grade%206/website/characteristics.htm
• A hard outer body covering called an Exoskeleton
• Specialized mouth parts
• Jointed legs
• Compound Eyes
• Segmented body

If an invertebrate does not meet all of these characteristics we would have to classify them as “other invertebrates”

Common Arthropods:
Because a large majority of arthropods belong to the three main groups this table classifies each type with most common species of each:

Insects	Arachnids	Crustaceans
Ants	Spiders	Crabs
Beetles	Scorpions	Shrimp
Butterflies	Ticks	Lobsters
Grasshoppers	Mites	Barnacles
Flies		
Dragonflies		

http://examples.yourdictionary.com/examples/examples-of-arthropods.html

Assessment: Informal Formative
Ensure that students have recorded their observations of arthropods during the investigation.

Assessment: Formal Formative
Students will be able to classify invertebrates as arthropods or other invertebrates based on the 5 characteristics of arthropods.

Diversity of Life

Strand - Microorganisms

General Curriculum Outcomes	Specific Curriculum Outcomes
204-8 identify appropriate tools, instruments, and materials to complete their investigations	204-8, 300-19 identify and use correctly appropriate tools to examine and describe some living things that cannot be seen with the naked eye
300-19 examine and describe some living things that cannot be seen with the naked eye	
302-12 describe how microorganisms meet their basic needs, including obtaining food, water, and air, and moving around	302-12 describe how microorganisms meet their basic needs, including obtaining food, water, and air, and moving around
107-6 provide examples of how science and technology have been used to solve problems around the world	107-6 provide examples of how science and technology have been involved in identifying and controlling the growth of microorganisms
107-1 describe examples, in the home and at school, of tools, techniques, and materials that can be used to respond to their needs	107-1 describe products and techniques that can be used at home to protect agains unwanted microorganism growth

New Nouveau Brunswick
Be...in this place • Être...ici on le peut

Science Resource Package: Grade 6

Diversity of Life: Microorganisms

Numbered List

New Brunswick Department of Education

September 2009

Access Prior Knowledge

Activity

To determine the level of knowledge and any misconceptions:

Part 1 Have students do a "Think, Pair, Share" where students first think/write about the answer individually; then discuss with a partner; then share with the larger group. The class discussion tips on pages 17-18 may be helpful. Record their answers on chart paper (or in another way) so that these "facts" can be revisited in later lessons.

Ask students:

- *What are microorganisms?*
- *Where do they live?*
- *Where do they not live?*
- *What do microorganisms do?*
- *Name as many as you can.*

Part 2 Have students draw a picture of what they think a microorganism looks like. Have students share their drawings and ask if the drawing is life-sized. Students should begin to communicate that microorganisms are too small to see without the aid of technology.

Part 3 Ask students how we can learn about microorganisms if they are small. (Anticipate students will talk about magnifying them, using a microscope, etc.) Have students consider other problems associated with studying microorganisms.

The following websites can be used to make microorganisms come alive for students and to emphasise their microscopic size.

www.cellsalive.com/howbig.htm This animation allows the magnification to be increased to look at items on the head of a pin – a dust mite, a grain of pollen, blood cells, bacteria, viruses.

http://learning.aliant.net/school/index.asp "The Protists" Put the title into the search box and this 20 minute video comes up. When you click on the picture, the video will start with a table of contents to the right of it. Note that you can click on any part of the contents list to go to that portion. There is no need to view the entire video. (You need to register to use the videos on the Aliant site. Registration is free. If you try to watch the video without logging in, you are prompted to do so.) This video has clips of a variety of microorganisms.

✓ **Assessment:**
Note the concepts and misconceptions students are expressing. You will need to know these to plan effective questions for subsequent activities and discussions so that students will examine and adjust their alternate conceptions.

Post student versions of curricular outcomes on chart paper (see page 20). Inform students that these outcomes will be addressed over the next portion of the unit. Point out to students which outcomes are being addressed in each activity.

1st Cycle

✪ Curriculum Outcomes

204-8 Identify appropriate tools, instruments and materials to complete investigations.
300-19 Examine and describe some living things that cannot be seen with the naked eye.

Exploring Microorganisms Activity

This activity is to make students aware of the variety of microorganisms and their small size. A video may be used to introduce the activity.

Some suggestions:

- You tube slide show MicroscopicWorld1 (3 minutes) at http://www.youtube.com/watch?v=98Ra2q1ZqUU or search title in "you tube" search box. This video clip shows microorganisms that live in a pond.
- BrainPop.com videos: "Protozoa"," Protists", "Bacteria" http://www.brainpop.com/science
  The BrainPop site requires a paid subscription though it is possible to sign up for a five day free trial.

The following tasks should be done in stations:

1. Looking at prepared slides using a microscope

   Your school has been given two prepared slides of microorganisms. Depending on the size of your class and number of working microscopes, each slide could be located at a different station.

   Have students successfully use a microscope to view the microorganism(s). Have them draw and label their microorganism, including the magnification used for viewing.

2. If your school has them, have students view microorganisms in the prepared images with slide viewers (see photo). Have students draw and label the microorganisms, including the viewing magnification (stated on the card).

3. Giant microbes – getting smaller

   Using coloured grid paper with squares of 1 cm, have students cut a 10 cm by 10 cm square. They should glue it to the student sheet (see page 21) with the blank side up. Have them cut pieces the required size from the grid paper and glue each onto the sheet in the appropriate space.

Have students trace the giant microbe onto grid paper. They should cut it out and glue it onto the next student sheet (see page 22). Students should try to cut a microbe shape that is ten times smaller and glue it in the appropriate spot. They should continue the progression as small as they can. How much larger is this smallest piece than the actual microbe. (Note that the magnification is given for the giant microbe)
(Note that additional giant microbes are available in specialty stores or see giantmicrobes.com)

4. Giant microbes and you

   Have students measure the length of the giant microbe.
   Knowing the magnification of the giant microbe, have students figure out what their height would be (proportionally) if the microbe was actually this size.

5. Observe living microorganisms

   Have student observe living microorganisms from a hay infusion. Let students choose how they might do this. Have hand lenses, slides, droppers and microscopes available.

   What sorts of movement can be seen?

Safety note: The hay infusion has a high bacterial count and while most bacteria are not harmful, be sure to wash with soap and hot water if your skin comes into contact with the infusion.

A demonstration of how to do a wet mount slide can be found at http://teachertube.com/viewVideo.php?video_id=104994&title=Slips_and_Slides&vpkey=1976f47400 or go to http://teachertube.com and search “How to make a wet mount slide in the style of "In Plain English" series”.

ⓘ Teacher note: A hay infusion needs to be made 4 to 7 days ahead to allow the microorganisms time to grow and reproduce to a reasonable concentration.

To make a hay infusion, add cut up hay to water in an open jar or container. The hay should be free of herbicides and pesticides. The water should be untreated - from a stream, pond or puddle. The container should be kept at room temperature. Initially bacteria will grow (and perhaps create an odor). The bacteria are food for the protozoa, whose populations will then increase. The protozoa populations peak in about a week.

More information can be found at http://www.bioedonline.org/resources/microbesIndex.cfm . Choose *Observing Microbes*.

Tips:
The hay infusion jar could be covered with cheese cloth and set outside if temperatures permit.

It is easier to observe microorganisms under low to medium powers in the microscope as the protozoa move very quickly and are easier to observe with a wide field of view. The field of view narrows under higher magnification.

If coverslips are not available they may be made by cutting up a blank overhead transparency.

Depending on the size of your class and the equipment your school has, some additional stations may be required. Some possibilities:

6. Do research

   Using online sites to find images or resource books from your classroom (*The Variety of Life* text for example) or school library, find 3 different microorganisms. Draw and label each, including their habitat and magnification, if possible.

7. Create a script for video, cassette, podcast or reader's theatre showing the parts of a microscope and explaining what each does. Record if possible.

8. Watch a video on microorganisms – one of the videos options for introducing this activity (see page 6) could be used. Make note of at least 3 facts that would be interesting to share.

✓ **Assessment:**
During the student activity, make notes on outcomes (or parts of outcomes) you observe being addressed. Process skill outcomes are part of the curriculum and should be assessed. Using the observation chart or the checklist (see pages 24 to 26) on a clipboard may be helpful to you. Develop your own code for quick notes.

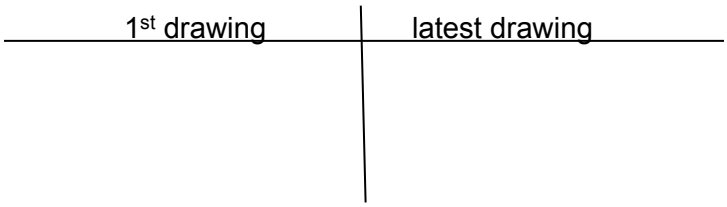
A suggested code:
√ for observed and appropriate,
WD - with difficulty,
RTT - refused to try,
A -absent.

This chart may be used on multiple days, using a different coloured pen or pencil each day and putting the date in the corner. You may not have a symbol or note for every child every day. Some teachers like to focus on a group or two each time. However you choose to make note of your observations, you will always have a sense of who you need to take more notice of and who might need extra support. The information will also help you when it is reporting time.

Reflection: Class Discussion

- Repeat the sketching of a microorganism from the Accessing Prior Knowledge activity (see page 4). With a partner, have students do a compare/contrast with their first image. Ask students to share the kinds of things they noticed.

- Have each student make a chart comparing their first and current drawings. This could be done as a T-chart. Students might comment on characteristics like: the amount of detail, accuracy, generic versus a specific microorganism, use of labels, scale.



- Revisit the “what we think we know” chart created in the Accessing Prior Knowledge activity (page)4. Ask: *Are there any items that should be added to or revised. Is there other information we could add?* Remind your class about respectful discussion. The discussion tips on pages 17-18 may be helpful.

✓ **Assessment:**
Look at microorganism sketch and comparison chart with earlier drawing. What do these indicate about student understanding? Notice characteristics like: amount of detail, accuracy, generic versus a specific microorganism, use of labels, and scale
How has student knowledge about microorganisms changed?

Getting Smaller

Original size square of paper (10 cm by 10 cm)

10 times smaller

An additional 10 times smaller

An additional 10 times smaller

An additional 10 times smaller

About how many times smaller is this smallest piece than the original piece?

_____

Shrinking the Giant Microbe

Original size of giant microbe

About 10 times smaller

An additional 10 times smaller

An additional 10 times smaller

An additional 10 times smaller

About how many times smaller is the actual microbe than your smallest version of it? (Hint: The giant microbe has its magnification on the tag.)

2nd Cycle

✪ Curriculum Outcomes

204-1 Propose questions to investigate and practical problems to solve.
204-6 Identify various methods for finding answers to given questions and solutions to given problems, and select one that is appropriate.
204-8 Identify appropriate tools, instruments, and materials to complete their investigations.
205-7 Record observations using a single work, notes in point form, sentences and simple diagrams and charts.
302-12 Describe how microorganisms meet their basic needs, including obtaining food, water, and air, and moving around.

Have a class discussion about what needs microorganisms have. How do their needs compare to ours? Use the "I think, we think, we all think" strategy for getting ideas. This strategy has individual students record what they think. Students then share their thoughts with a partner or small group. A list is made of ideas to share with the whole class. All ideas shared with the class are discussed and recorded in some way (for example: chart paper, Smart board, cards tacked to bulletin board)

Microorganisms' Basic Needs Activity

Note that if the rubric is to be used for assessing student work, it should be given to students and discussed **before** the investigation. Examples of previous experimental write ups should be displayed. If this is new to students, the process should be modeled by the teacher several times before expecting students to complete one independently.

- Are food, water, and air needed by yeast? Have students ask a testable question with respect to the needs of yeast. Have students design an experiment to obtain evidence to answer the question. Have them do their experiment. Ensure students understand that the experiment needs to be fair, with variables controlled.
- Students should write up their question, materials and procedure to hand in. Remind them the procedure has to be detailed enough for another researcher to follow successfully.

The resource *Variety of Life Teacher's Guide – Atlantic Edition* has a lesson "How Do Micro-organisms Meet Their Needs?" beginning on page 74 that has background information about yeast and controlling variables.

Try to have different student groups deprive yeast of different things. Do students realize the value of having a control?

✓ **Assessment:**
On observation chart (or other record), note how students are performing on the skill outcomes.

Have students self-assess their write up before handing it in to you. Give students the guidelines (see “got it” column) and ask them to comment on how well their work meets each criteria. The third column will be for you to give feedback (see sheet on page 23).

✓ **Assessment:**
Note if students are able to write up a lab report or if mini-lessons on specific parts of the report are needed. The following rubric may be helpful.

Got it	Nearly there	Not yet
Question is **stated clearly** and in a **testable** form	Question is **clear** but not in a testable form.	Question is **unclear**.
Materials list includes **all necessary** and **appropriate** items.	Materials list **incomplete**.	Materials list **incomplete** and contains **unnecessary** items.
Written steps **are detailed** and in **sequential order**. Steps are detailed enough that **variables are controlled**. Procedure **could be replicated.**	Some steps **are unclear or missing** and/or steps are **out of order**. **Missing** some **details** that would **control one or more variables** during the replication.	Steps are **not accurate** or there is **not enough detail** to replicate procedure.
Spelling and grammar **errors are absent or rare**.	**Some** spelling and grammar **errors**.	Spelling and grammar **errors common**.

Reflection: Class Discussion

Ask they class to share their observations from the experiment. Ask them what conclusions can be made about the basic needs of yeast. Why are these conclusions valid?

Revisit the “what we think we know” chart created in the Accessing Prior Knowledge activity (page 4). Ask: *Are there any items that should be added to or revised. Is there other information we could add?* Remind your class about respectful discussion. The discussion tips on pages 17-18 may be helpful.

Reflection: Journaling

- Was your yeast experiment “fair”? Why or why not? What improvements might you have made?

✓ **Assessment:**
Journal entries should not receive a score or mark. A positive comment followed by a question to refocus attention or suggest the next step in learning is very effective.

Note whether students can identify a fair experiment (variables controlled).

3rd Cycle

✪ Curriculum Outcomes

205-8 Identify and use a variety of sources and technologies to gather pertinent information.
207-2 Communicate procedures and results, using lists, notes in point form, sentences, charts, graphs, drawing, and oral language.
302-12 Describe how microorganisms meet their basic needs, including obtaining food, water, and air, and moving around.

Research Activity

- Decide if students are to work with partners or individually.
- Have students choose a micro-organism (such as paramecium, amoeba, euglena, E. coli, yeast, stentor, rotifers, slime moulds, lactobacillus, acidophilus, bifida, thermophile, botulism, see sites below) and research how it meets its needs (food, water, air, locomotion).
- Have students present to the whole class, or do as a carousel. A carousel has half the class showing and explaining, while other half goes around viewing and learning. The groups then switch roles. It is a great way for all students to present that does not take a lot of class time. An alternate way to have students present is by taking pictures and/or clips and post electronically (such as at voicethread.com).

These sites may be helpful for students to use in their research.
www.Bacteriamuseum.org

http://www.biology4kids.com/files/micro_main.html

http://www.childrensuniversity.manchester.ac.uk/interactives/science/microorganisms/

Reflection: Class Discussion

After students have seen/heard about other students' information, make a class chart of the range of strategies the microscopic world has of obtaining food, water, air, and locomotion.

Students may find it interesting and helpful to stand in a circle holding hands and try to simulate microorganism movement. This would work nicely for the movement of amoeba.

The Aliant Learning Center has some videos that may be used to reinforce student learning. http://learning.aliant.net/school/index.asp Some possible are "Protozoans and Algae Food for All" or "The Protists".

Revisit the “what we think we know” chart created in the Accessing Prior Knowledge activity (page 4). Ask: *Are there any items that should be added to or revised. Is there other information we could add?* Remind your class about respectful discussion. The discussion tips on pages 17-18 may be helpful.

Reflection: Journaling

How might microorganisms meet their needs?

✓ **Assessment:**
Journal entries should not receive a score or mark. A positive comment followed by a question to refocus attention or suggest the next step in learning is very effective.

Note whether students can identify some needs of microorganisms and how they might meet those needs.

Think like a scientist

Asking good questions is an important skill in science. Initially students will need support. Model the skill with the whole class and students will begin to have the confidence to contribute. After some practice, students will be able to generate questions successfully individually.

Present students with a situation and ask them to generate questions that could be investigated scientifically. (These situations and questions do not have to be limited to those that can be done in a classroom.)

Situation:

> Because of concern about swine flu, a newspaper report states that schools are urged to remove sick students and staff from classrooms as soon as possible and to have more cleaning and hand washing in the school.
>
> What is one question concerning the spread of swine flu that could be investigated scientifically?

For example:

> Does using hand sanitizer every two hours reduce the number of people getting swine flu?

Ideas for next steps*:*

A site to support and or extend your lessons (also for FI classes)
http://www.musee-afrappier.qc.ca/en/index.php?pageid=3510&page=3510-eduzoom-f

107-6 Provide examples of how science and technology have been involved in identifying and controlling growth of microorganisms

The following site has an activity called “Colonizers of the Human Body (Intermediate)” identifying some helpful and disease-causing microorganisms.
http://www.musee-afrappier.qc.ca/en/index.php?pageid=3110c&page=3110c-games-micro-e

Videos of helpful microorganisms used in food production can be found at:
http://www.musee-afrappier.qc.ca/en/index.php?pageid=3110b&page=3110b-video-library-e

The following site has an activity called “A Bacterium to the rescue of the environment” which shows how bacteria can be used to help clean up an oil spill.
http://www.musee-afrappier.qc.ca/en/index.php?pageid=3110c&page=3110c-games-micro-e

The following site has an activity called “Public health on page one” that has students identify the type of microorganism causing meningitis.
http://www.musee-afrappier.qc.ca/en/index.php?pageid=3110c&page=3110c-games-micro-e

Steven Johnson talks about the 1854 cholera outbreak in London and how the source of it was identified in “Steven Johnson tours the Ghost Map” at http://www.ted.com this is a site that requires you to register, however registration is free.

Activities from *Project WET K-12 Curriculum and Activity Guide*:

“No Bellyachers” beginning at page 85. This activity uses a game called No Bellyachers Tag which simulates the spread of disease. By adjusting the amount of playing space, it demonstrates how population density is a factor.

“Poison Pump” beginning at page 93. This activity gives students data from a 1854 cholera outbreak and asks them to find the source and stop the epidemic.

More information about the *Project WET K-12 Curriculum and Activity Guide* (1995) can be found at http://www.cwra.org/branches/ProjectWet/goals.aspx This resource is obtained by attending a Project WET inservice. Information about facilitators can be obtained from Susan Bone, Education & Engagement Unit – Atlantic Environment Canada, Dartmouth, NS (ph) 902-426-1704

107-1 Describe products and techniques that can be used at home to protect against unwanted microorganism growth

The Aliant learning center at http://learning.aliant.net has two Bill Nye videos that you may find helpful. “Germs” and “Antibiotics”

Diversity of Life

Strand - Adaptations and Natural Selection

General Curriculum Outcomes	Specific Curriculum Outcomes
204-1 propose questions to investigate and practical problems to solve	204-1, 205-8 propose questions about the relationship between the structural features of organisms and their environment, and use a variety of sources to gather information about this relationship
205-8 identify and use a variety of sources and technologies to gather pertinent information	
301-15 compare the adaptations of closely related animals living in different parts of the world and discuss reasons for any differences	301-15 compare the adaptations of closely related animals living in different parts of the world and discuss reasons for any differences
105-1 describe examples of scientific questions and technological problems that are currently being studied	105-1,107-6 describe reasons why various animals are endangered, and describe efforts to study their population size and ensure their continued existence
107-6 provide examples of how science and technology have been used to solve problems around the world	
301-16 identify changes in animals over time, using fossils	301-16 identify changes in animals over time, using fossils
105-5 identify examples of scientific knowledge that have developed as a result of the gradual accumulations of evidence	105-5 identify the theory of natural selection as one that has been developed based on the gradual accumulation of evidence
106-3 describe examples of improvements to the tools and techniques of scientific investigations that have led to new discoveries	106-3, 107-11 identify paleontologists as people who study fossils, and describe examples of improvements to some of their techniques and tools that have resulted in a better understanding of fossil discoveries
107-11identify examples of careers in which science and technology play a major role	

Asking Questions about Adaptations of local species

Outcomes:
204-1 - Propose questions to investigate and practical problems to solve (about the relationship between the structural features of organisms and their environment)
205-8 - Identify and use a variety of sources and technologies to gather pertinent information

Lesson Activity Overview
The focus of this lesson will be to work on the skill of testable questions, the context for these questions will be the relationship between the structural features of organisms and their environment. Simply put, students should be developing testable questions about how local organisms have adapted to their local environment.

In classroom discussion, teachers can encourage students to ask questions about the adaptations and structural features of organisms. For example, students could ask, "Why does this frog have such a long tongue?" Questions like these should be rephrased to "What does the frog do with its long tongue?" and used as the basis of an investigation.

Students can study the organisms they found in their field study to see the features that they have that help them live in their particular habitat. Ensure that students have used a variety of sources to gather the information on their organisms.

Depending on the goals of the School Improvement Plan, teacher's should be structuring small research projects around goals of the school. The curriculum does not indicate if this should be a small research paper or a visual power point presentation to the class, so teachers should plan according to needs of the school.

Assessment: Informal Formative
Ensure that students have participated in discussions related to developing testable questions about their species of choice

Assessment: Formal Formative
Ensure that students have created a testable question about the relationship between the structural features of an organism and their environment.

Ensure that students have used a variety of sources to gather information about their specie.

Comparing Adaptations

Outcomes:
301-15 - Compare the adaptations of closely related animals living in different parts of the world and discuss reasons for any differences
205-8 - Identify and use a variety of sources and technologies to gather pertinent information

Lesson Activity Overview
The previous lesson focussed on the adaptation of organisms that are local to New Brunswick and the adaptations their species have made to survive in our environment and climate. This lesson focusses on exploring similar organisms that live in different parts of the world (e.g., arctic hare and snowshoe hare), and inquire about the structural differences in these organisms, and how these structural differences help them in their environment.

Similar to the previous lesson, there is no specific way in which students have to present there findings, this is a suggestion of how to proceed modeling the concept of inquiry.

1. As a class, brainstorm examples similar to arctic hare and snowshoe hare.

2. Develop as many different examples of similar organisms that live in different parts of the world (adaptations).

3. In small groups, select one of the examples that have been presented in the brainstorm of similar organisms that live in different parts of the world and research their similarities and differences.

4. Each group will present their findings to the class. (since there is no direct implications to the curriculum students should be given their choice of how they want to present, but a common rubric of expectations should be developed ahead of time)

Assessment: Formal Formative
Ensure that students groups have presented a comparison of similar animal species that live in different parts of the world and reasons for differences (adaptations).

Studying Endangered Species

Outcomes:
105-1 - Describe examples of scientific questions and technological problems that are currently being studied (reasons why various animals are endangered, and describe efforts to study their population size and ensure their continued existence)
107-6 - Provide examples of how science and technology have been used to solve problems around the world

Lesson Activity Overview
Students can inquire into the conditions that have led to the endangerment of various species. Students can investigate local and global examples to see how information about population size is determined, and what efforts are being made to ensure the survival of these species. This will encourage students to be aware of and develop a sense or responsibility for the welfare of living things.

The best way to make this lesson tangible for students is to study a local issue. The definition of Endangered Species is not limited to species with under 100 organisms still living. In fact, students should understand that animals such as Moose would qualify since the hunting season and numbers are limited to help study their population size and ensure their continued existence.

As a class, develop an understanding of the term Endangered Species. Also, create a list of species, both local and global that are endangered and identify the parameters of their population and efforts to continue their existence.

In the Miramichi area, an investigations could take place into the populations of Striped Bass and Atlantic Salmon. Contact the Miramichi Salmon Association and Department of Fisheries and Oceans. It is critical that both sides of the argument present their findings to students.

Other investigations would also be welcomed. However, the discussion and research will mean more to students if they can relate to the topic, so students should have choice of species to be studied.

Assessment: Formal Formative
Have students create a journal entry that outlines their understanding of the term Endangered Species and ensure it meets the criteria and they can implement the definition to examples.

Fossils...Natural Selection

Outcomes:
301-16 - Identify changes in animals over time, using fossils
105-5 - Identify examples of scientific knowledge (theory of natural selection) that have developed as a result of the gradual accumulation of evidence
106-3 - Describe examples of improvements to the tools and techniques of scientific investigation that have led to new discoveries (tools used by Paleontologists)
107-11 - Identify examples of careers in which science and technology play a major role (Paleontologist)

Lesson Activity Overview
Students should explore what types of fossils have been found and theories that exist about what caused particular organisms (e.g., dinosaurs) to become extinct. Field trips to fossil exhibits or local sites are encouraged. The use of software, the Internet, print resources and audiovisual resources would also be good sources of information about fossils.

Students should explore evidence of natural selection from studies of bacterial strains that are resistant to antibiotics. Superbugs have developed due to the overuse of antibacterials creams. Students can explore genetic research on genetically modified organisms, for example tomato, potato, corn, and fish.

Students should also investigate the tools and techniques paleontologists use to acquire knowledge about fossils. The focus is on how paleontologists used to do their work (finding and cleaning fossils, trying to piece together skeletal remains, trying to estimate the age of the fossils) and contrast this with some of the modern techniques and tools available (computer generated drawings of dinosaurs, carbon-dating so that a more accurate age of the fossil can be determined). The goal is for students to see that improvements in scientific techniques and technological tools can lead to better scientific knowledge, and not to be able to explain how these new techniques and technological tools actually work.

This section provides an excellent opportunity for students to explore a variety of science-related careers related to the diversity of life.

Assessment: Informal Formative
Ensure students have explored changes to organisms based on the gradual accumulation of evidence from fossils.

Ensure that students can identify Paleontologists as a scientist who acquire knowledge about fossils and can identify the tools they use.

Assessment: Formal Formative
Students should create a journal entry that outlines their understanding of how animals have changed over time and how fossils are the evidence.

Ensure that students can explain the theory of natural selection and relate their understanding to examples from class.