UNIT TWO

TURTLE BIOLOGY

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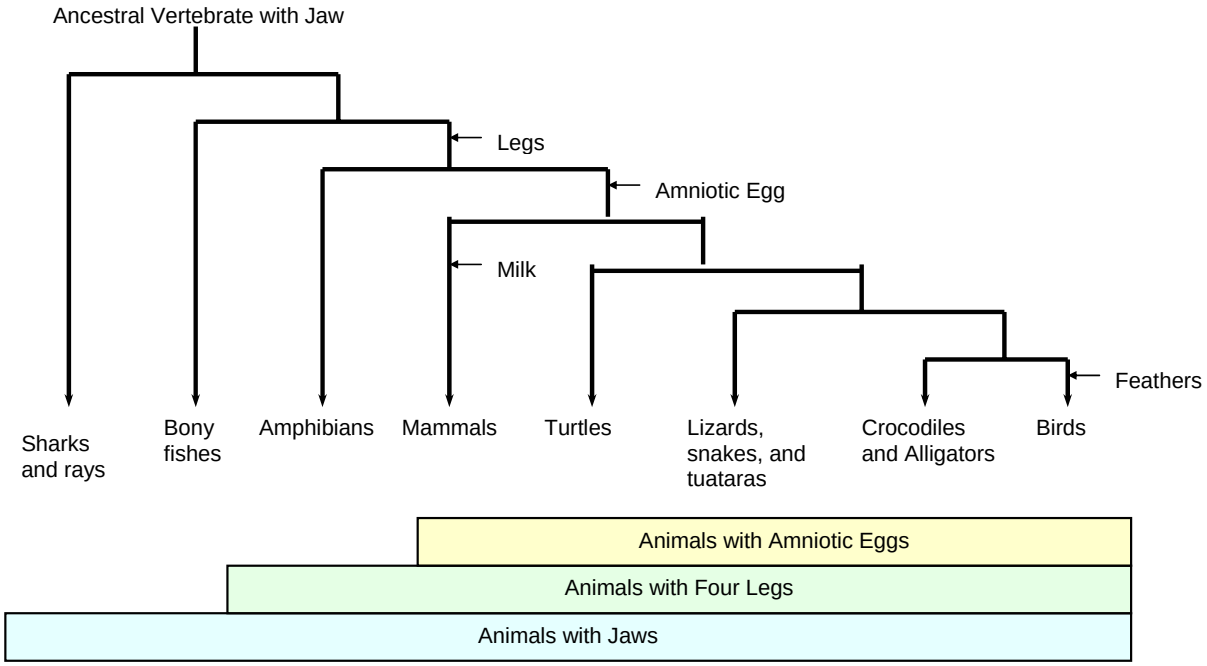
Science Expectations met in this unit:

Activity Number: Activity Name	Strand	Specific Expectations		
		Understanding Basic Concepts	Developing Skills of Inquiry, Design and Communication	Relating Science and Technology to the World Outside the School
5: Camouflage	Grade 2 – Growth and Changes in Animals	4, 8	1, 2, 3, 4, 5	
	Grade 4 – Habitats and Communities	5	1, 3, 5	
	Grade 6 – Diversity of Living Things	3	1,3, 5	2, 5
	Grade 7 –Interactions Within Ecosystems		1, 3, 5	
6: Today's Picnic Specials Are…	Grade 2 – Growth and Changes in Animals	4	1, 3, 4, 5	1, 4
	Grade 4 – Habitats and Communities	5	3, 4, 5	
	Grade 6 – Diversity of Living Things		3, 4, 5	
7: Turtle Appetites	Grade 4 – Habitats and Communities	5	3	
8: Turtle Tally	Grade 2 – Growth and Changes in Animals	9	3, 4, 5	1, 3
	Grade 4 – Habitats and Communities	1, 5	1, 3, 4, 5	2, 4, 5
	Grade 6 – Diversity of Living Things		1, 3	5
	Grade 7 – Interactions Within Ecosystems	2, 8	1, 3	1, 6, 7
9: Congratulations, It's A Girl!	Grade 4 – Habitats and Communities	4, 5	1, 3, 4, 5	
	Grade 7 – Interactions Within Ecosystems	2, 8	1, 3, 4, 5	

SECTION ONE:
I'm Hot, You're Not

Introduction: Where do Reptiles fit in?
Turtles (Testudines) are in the class ***Reptilia***, along with three other groups: tuataras (Sphenodontia), lizards and snakes (Squamata), and alligators and crocodiles (Crocodilia). Reptiles are aptly described as relics of the past. The first reptiles appeared in the Mesozoic era (248 to 65 million years ago), and have diversified to exist in many different habitats across the ***biosphere***. The earliest turtle fossils are over 220 million years old.

Below is a tree showing the phylogeny (evolutionary relation between species and related species) of jawed vertebrates, including reptiles. Reptiles have unique traits that allow them to be easily distinguishable from other classes of animals. They are separated from amphibians by the presence of an ***amniotic egg***, from mammals by characteristics like the absence of milk and presence of scaly skin, and from birds by the absence of feathers. Reptiles have scaly skin and most have complex, shelled, ***amniotic eggs*** that are internally fertilized. All reptiles are ***ectotherms*** ("cold-blooded") and with the exception of snakes, possess true claws. Also below is a chart illustrating different characteristics that can be used to distinguish reptiles from other animals.



Characteristics of Different Animals					
	Fish	Amphibians	Reptiles	Mammals	Birds
Eggs Laid on Land or in Water, or no eggs?	In water	In water	On land	No eggs	On land
Ectothermic or Endothermic?	Ectothermic	Ectothermic	Ectothermic	Endothermic	Endothermic
Scaly skin or smooth skin?	Scales	Smooth skin	Scaly skin	Smooth skin	Scaly skin
Mucus-covered (slimy) skin?	Yes	Yes	No	No	No
Gills?	Yes	Yes (in aquatic stage)	No	No	No
Fur?	No	No	No	Yes	No
Legs	No	Yes	Yes	Yes	Yes
Milk?	No	No	No	Yes	No
Feathers?	No	No	No	No	Yes

Ectotherms
Turtles, like other reptiles, are ectotherms, meaning that they maintain and alter their body temperature by acquiring heat from the environment. As a result, turtles do not need to rely on frequent eating to fulfill their basic bodily functions. By contrast, mammals and birds are endotherms, meaning they use their food energy to maintain a constant body temperature, and therefore must eat regularly.

Behavioural Thermoregulation
The term “cold-blooded,” often used to describe ectotherms, is misleading because the blood of an ectotherm is not actually cold. By varying their exposure to sun or shade, ectotherms can raise or lower their internal body temperature. This process is called ***thermoregulation***. Reptiles are often seen basking in the sunlight so they can warm up their bodies, or sitting in the shade and swimming in the water to cool themselves down. **Behavioural thermoregulation** allows reptiles, including turtles, to function optimally in all conditions. By contrast, mammals and birds *metabolize* food for energy and then use that energy to maintain a constant body temperature (around 37°C for humans, including students!).

<If you are interested in having your class experience real reptiles or turtles, consider a tour of The Toronto Zoo. See Appendix 3: Zoo Tours With Curriculum Links and find out how you can take your lessons outside of the classroom!>

SECTION TWO:
Structures for Survival

Shells -- A home on your back!
Turtles belong to the order *Testudines* and they are easily distinguished from other reptiles by possessing a shell. The design of this successful adaptation has changed little in almost 200 million years. The shell protects the turtle's short, wide body. The head, legs and tail of the turtle protrude from this shell. The shell's protection is largely responsible for the turtle's relative invulnerability, and may explain why turtle species occur in a wide variety of habitats. However, with the exception of softshell turtles, the shell makes the turtle many times heavier and slower than any other reptile of comparable body length.

A turtle's shell has the ability to regenerate. If the turtle suffers a small injury from predators, fire, or other harm, the undamaged areas of the shell will grow out and the damage should heal.

The bone under the shell is comprised of a tough material called ***keratin***. As the turtle grows, successive layers of keratin are added beneath existing layers. Species such as box turtles, tortoises and wood turtles possess noticeable growth rings from these keratin layers. A common misconception is that the number of growth rings indicates the exact age of the turtle. In fact, several rings may be laid down in one season and growth rings may wear out as the turtle ages. In very old turtles, the shell may become completely smooth.

The shell is composed of two main pieces: the upper (dorsal) shell, known as the ***carapace***, and the lower (ventral) shell, known as the ***plastron***. A bony bridge connects the two pieces. The length of the carapace is used as a measurement for turtle length. On many turtle species, the plastron has a ***hinge*** that allows it to tightly clamp the plastron and carapace together to provide further protection to the turtle from predators. The shell is fused to the turtle's ribs and acts as part of the turtle's skeletal system. Shells can vary greatly in appearance from hard and bony to soft and leathery. Shells can be ridged, scaly or even covered with bright spots. Turtle species can be distinguished by these characteristics, since each species has different coloured and shaped shells.

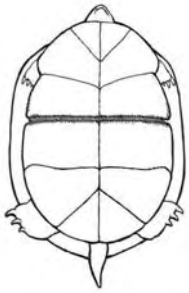
Scutes

Both the carapace and the plastron are covered with a top layer of horny plates called ***scutes***. Scutes, which are made of keratin, vary in thickness and cover a layer of interlocking bones. In some families of turtles, the horny covering of the scutes has been lost and the bony material of the shell has been greatly reduced. These two traits have been replaced by the presence of a tough, leathery skin and as such, these turtles are often referred to as softshell leatherbacks.

Figures 1- 4: Turtle Shells and Scutes

Comment: Get better scan of this plastron

Carapace of a hard-shelled turtle
(Like that of the northern map turtle)



Plastron of turtle, showing hinge
(Like that of a Blanding's turtle)

Carapace of a soft-shelled turtle
(Like that of the spiny softshell turtle)

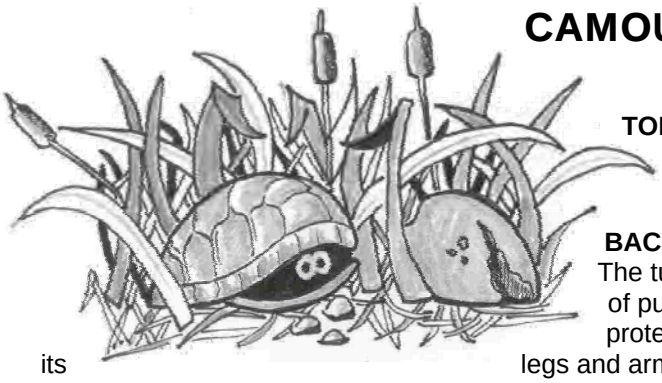
Plastron of snapping turtle showing its reduced size.

How do you breathe with that heavy thing on your back?

Turtles breathe through lungs and many turtle species have evolved to develop accessory methods of respiration. Certain species of turtles are able to stay submerged for prolonged periods of time. These turtles are able to survive underwater due to ***pharyngeal respiration,*** where oxygen is obtained through gas exchange in the mouth cavity, and also in the ***cloaca***. This type of respiration is important when turtles are resting underwater or hibernating where it is underwater for months at a time.

The shell acts as a barrier to respiration, as it prevents the turtle's chest from performing the expansion and contraction action necessary to pump air in and out of the lungs. The lungs are the only compressible organs within the shell, and therefore activities that are unrelated to respiration may cause the lungs to fill or empty. In order to make room for the head and limbs when they are retracted inside the shell, air is expelled from the lungs. Turtles must exist on nearly empty lungs when disturbed for prolonged periods of time.

ACTIVITY #5:
CAMOUFLAGE



TOPIC

What are the special adaptations of the shell that make it useful to a turtle?

BACKGROUND INFORMATION

The turtle shell has been adapted to serve a variety of purposes. For example, the shell is used for protection: when the turtle is threatened, it can tuck its legs and arms inside the shell. Since the turtle is a slow-moving creature on land, it requires a way of protecting itself from predators. The markings on the shell provide the turtle with camouflage in the surrounding environment, helping it hide from predators.

For further information, refer to Section Two: Structures for Survival.

MATERIALS

Student work sheet
Coloured pencils, markers or paint
Construction paper
Scissors
Glue

METHOD

Teachers may wish to begin by displaying a variety of shell structures of different types of turtles and have the students guess what type of habitat the turtle occupies. The idea that the colour, markings and texture of the shell are dependent on the habitat of the turtle should be discussed.In this activity, students will design their own version of the turtle shell adapted to a specific environment of their choosing. Design features should include colour, markings, scute shape and size, texture of the shell (smooth or rough) and pattern of the shell. All design features must relate to the habitat the students have chosen for their turtle. Students can be creative and develop alternative features that would aid their turtle in its unique environment. For example, a turtle could have green or yellow colouring on the shell to blend into sand or shade, or be camouflaged due to sediments or algae on the shell. Students will use their ideas for the design and create a diagram of the shell, outlining its features and the reasons for the specific adaptations.

EXTENSIONS

Students can create a three-dimensional model of the turtle shell that they have designed. Using a paper plate as the base, students can glue pieces of coloured construction paper to reproduce the scutes of the turtle shell. If the shell is soft, then coloured pencils or paint can be used to design the pattern of the shell. Students should be encouraged to be creative and use a variety of materials and shapes in their design. For example, to create a “ridge” effect, students can fold stiffer materials such as cardboard and glue it onto the paper plate.

ACTIVITY #5:
CAMOUFLAGE

HABITAT OF TURTLE:

COLOUR AND MARKINGS:

SHELL TEXTURE AND SIZE:

SPECIAL ADAPTATIONS:

SECTION THREE:
Turtle Sense

See no evil, hear no evil
Turtles can respond to vibrations, but have poor hearing. Some scientists even believe that turtles do not have ears at all; others maintain that they have an external opening covered by a membrane. Turtles are considered to be virtually mute, although some species vocalize by expelling air during copulation. A few species, mostly tortoises, also cluck or grunt quietly during courtship.

Its sense of smell is one of the turtle's most advanced senses. Turtles utilize two modes of smell: the nose and ***Jacobsen's Organ***, a structure found in the roof of the mouth which is directly connected to the brain and is used to detect scent particles in the air. In aquatic species, this sense is so well developed that they are able to smell underwater. Sea turtles use the unique composition of the sand and ocean to locate the beach where they were hatched and to deposit their own eggs in the same location. In addition, as many fishers have experienced, turtles can trace the scent of fish to locate a convenient meal hung over the side of a boat.

Another unique feature is the turtle's acute vision, with its ability to perceive colours. To protect their eyes from dirt, sand or other objects, turtles have a transparent scale membrane covering each eye.

SECTION FOUR:
So, What's for Dinner?

Structures for feeding
Turtles have solid skulls that lack temporal openings, and jaws that lack teeth. Instead, turtles possess beaks, which are designed according to their function. ***Carnivorous*** turtles have sharp, hooked beaks that enable them to grasp and slice or rip apart flesh. They swallow food whole, or use their front feet to rip it into smaller pieces. ***Herbivorous*** turtles have beaks with flat, broad, crushing surfaces to help break down plant material. Species that eat hard-shelled molluscs, such as the map turtle, also have this type of beak.

The limbs of turtles are another unique facet of their anatomy. Attached to the inside of its ribcage, the limbs are adapted to the environment in which the turtle lives, or more specifically to the medium in which it travels. Terrestrial turtles often have heavy, scaled limbs, with the hind legs helping to support the turtle's weight, and the shovel-like forelimbs adapted for digging. (Turtles that live exclusively on land are called tortoises. All tortoises are turtles, but not all turtles are tortoises). Turtles that live in water have webbing between their toes. Aquatic turtles range from semi-aquatic to fully aquatic, with the degree of webbing increasing accordingly. Ontario's highly aquatic eastern spiny softshell turtle has well developed webs on all limbs. Sea turtles, which are marine species, have modified paddle-like feet that they use like flippers to glide through the water.

What do you like to eat?
Turtles exist in almost all parts of the world, except Antarctica. Therefore, they must be able to find food specific to the area in which they live. Turtles can be carnivores, omnivores or herbivores. Even the carnivorous snapping turtle alters its diet to take advantage of floating seeds.

The diet of a carnivorous turtle includes frogs, fish, invertebrates and small birds. The diet of a herbivorous turtle includes aquatic plants and seeds.