TwoOldGuys™ Study Guides
BI114 Biological Concepts for Teachers
Chapter 2. Diversity of Life
2.5. Reptiles, Amphibians, Fish

Based on Indiana's Academic Standards, Science, as adopted by the Indiana State Board of Education, Nov 2000.
Numbers refer to the age-appropriate grade-level for the content.

Review

We developed a tentative definition of life, and applied it to all known life-forms consistent with the cognitive development of the 8th grade mind. To outline the known living things, we expanded the 20-Questions classification scheme to include several ranks of taxa which are recognized as artificial: Kingdom, Phylum, Class, Order, Family, and Genus; plus one real taxon: the species.

The artificial taxa are defined by enumeration. We have already covered the Mammals, Birds, Bugs and the more familiar plants. This section will continue to develop definitions by enumeration for the major taxa with which your students may be familiar.

Reptiles (class Reptilia)

grade 3: to 8:

The defining characteristic of the Reptiles is that they are typically covered with scales. Examples of reptiles include lizards, snakes, and turtles. Fossil reptiles are known as Dinosaurs, the "terrible lizards," where "dino-" means terrible and "-saur" means lizard.

grade 5: to 8:

The reptiles are cold-blooded, so their body temperature will vary over a fairly wide range before they respond to change the temperature back to 'normal.' Reptiles have a 3-chambered heart; consisting of a single pumping chamber (ventricle) and two collecting chambers (auricles, or atria). The right atrium collects blood from the body; and the left, from the lungs. This arrangement causes the heart to mix blood with oxygen (from the lungs) and blood without oxygen (from the body). Because all living warm-blooded animals have a four-chambered heart, it is hypothesized that the four-chambered heart is required to support the higher energy requirements of being warm blooded [it costs energy to regulate temperature precisely]. The four chambered heart is considered to be more efficient because all of the (oxygenated) blood from the lungs is sent to the body, while all of the (un-oxygenated) blood from the body is sent to the lungs. The brain is a simple one, with separate paired structures called lobes for the sense of sight and of smell. The conscious brain (cerebrum) is barely larger than one of the two optic (sight) lobes. The cerebral cortex is found in animals from the reptiles up to birds and mammals. The primitive brain (or brain stem) is about the size of one of the two olfactory (smell) lobes.

The young develop in leathery-shelled eggs, which are generally laid and abandoned by the adults. Only in rare cases do the parents care for the young. There is now fossil evidence that some of the bipedal dinosaurs had nesting behavior similar to that in social birds such as penguins, probably including communal care of young.

The dinosaurs are divided into two major groups: the four-legged, and the two-legged or bipedal. The best known, among human children, of the four-legged dinosaurs were plant eaters such as *Brachiosaurus*, while

the best known bipedal dinosaurs were carnivores such as *T. rex*. These examples however did not occur at the same time. The familiar four-legged dinosaurs lived mostly during the Triassic (220 – 175 Myr BP), and the familiar bipedals lived during the Jurassic (175 – 65 Myr BP). In spite of what your students may have seen on cartoon shows, the cavemen (younger than 2 Myr BP) probably never saw a living dinosaur (older than 65 Myr BP).

Types (sub-classes) of Reptiles (class: Reptilia)

Lizards

Among the earliest fossil reptiles (around 220 – 200 Myr BP), are a number of species that resemble modern lizards. Among the living lizards, most are terrestrial carnivores with four clawed feet. Many lizards can detach their tail then regrow new tails. Because of this, sometimes birds (like roadrunner, which does not eat grain but does eat lizards) will attempt to capture a lizard and end up with only the lizard tail. The lizard escapes and the bird does gain some food.

Snakes

Snakes are believed to be closely related to lizards, and to have evolved relatively recently (remember that a "short" time on the geologic time scale is millions of years). In Starr & Taggart (Appendix I) the snakes are classified as lizards (subclass Lepidosaura). Snakes are legless, although a few have hip bones. This suggests that the snakes evolved from lizards by loss of the legs. The snakes are terrestrial (some can swim very well) carnivores. A few snakes are poisonous: the pit vipers have hollow fangs with poison resembling bee venom, and the cobras have grooves along their back teeth with a chemically different

type of poison. For humans the pit vipers are far less poisonous, but can kill weakened individuals (the elderly, the very young, etc.).

Crocodiles (& alligators)

The crocodiles and alligators are considered to have evolved from the dinosaurs (4-legged) of the early Triassic, and in the classification scheme in Starr & Taggart (Appendix I) are included in the same subclass Archosaura with these dinosaurs. The modern crocodilians are semi-aquatic with a muscular tail used for swimming. They are carnivorous, and are particularly known for their powerful jaws with numerous sharp teeth.

Turtles (& tortoises)

The turtles and tortoises, subclass Anapsida, have heavy shells into which they can pull their head and legs. The turtles are aquatic or semi-aquatic, and tortoises are terrestrial. Neither turtles nor tortoises have teeth but do have sharp beaks, used for ripping apart the animals that they eat. Fossil turtles are known from the Triassic. Current thinking is that the turtles evolved separately from the "true reptiles," and that they branched off the main evolutionary line earlier than the rest of the reptiles.

Dinosaurs

The 1st group of dinosaurs in the fossil record (Triassic) are 4-legged, or quadripedal. One major group of Triassic reptiles, the *Lystrosaurus* group, were more like mammals than like typical reptiles (Starr & Taggart, 338), and may have given rise to the Mammals. We are now finding increasing numbers of 2-legged (bipedal) dinosaurs from the

Triassic, but they tend to be the size of a turkey or smaller. This group probably gave rise to the bipedal dinosaurs of the Jurassic. The Triassic ended with a major "catastrophe that left a string of five craters in what is now France, Quebec, Manitoba, and North Dakota" (Starr & Taggart, 338), resulting in a mass extinction event.

The surviving bipedal dinosaurs from the end of Triassic extinction became the raptor group of bipedal carnivores – such as *Tyrannosaurus*. A number of scientists have suggested that these creatures were more bird-like than lizard-like, and probably warm-blooded like modern birds. There were also small lizard-like reptiles and crocodilians in the Jurassic. Additional reptiles from the Jurassic include the fish-like *Ichthyosaurs*, and *Pleiosaurs*; plus the flying *Pterosaurs*, which were neither bird-like nor related to birds. Toward the end of the Jurassic (about 120 Myr BP), there was a global warming event and an episode of extreme lava flows and gigantic volcanoes. It is unclear whether the volcanic activity caused the global warming, or the global warming caused the volcanic activity. There was either a prolonged extinction event (20 Myr), or a series of smaller extinction events during the Cretaceous which finally ended when a massive meteor struck the Earth in the Gulf of Mexico and the Yucatan peninsula (65 Myr BP), which triggered the abrupt mass extinction event that ended the Age of the Dinosaurs. After the end of Cretaceous extinction event, the Birds and Mammals took over the world of the Tertiary period, which a few scientists believe has not yet ended although most agree that the current geologic time period is the Quaternary (or post-Pleistocene glacial period). If the group that thinks the Tertiary has not ended is correct, then the Pleistocene glacial period has also not ended, and the glaciers will return!

Amphibians (class Amphibia)

In the older textbooks, the amphibians were described, in an almost dictionary-like definition, as “able to live under water and on land” (Patterson, 15). A more contemporary view is that these animals represent the first step between the aquatic Fish and fully terrestrial animals (Reptiles, Birds, and Mammals). Basically, the amphibians are terrestrial, but barely. All of them have at least a brief aquatic stage in their life cycle, and their skins must remain moist at all times. These animals are typically "naked," having no covering over the skin – no scales, feathers, fur… , partially because they ‘breathe’ through the skin. Technically the Amphibians lack teeth, although many have bony bumps under the gums that resemble teeth.

As the most primitive of the land-dwelling animals with backbones, these animals are cold-blooded, with 3-chambered hearts. Their brains are simpler than the reptilian brain. My impression of frog brains in dissection is that the poor beast has exhausted its entire brain capacity by coordinating the jump, and by coordinating the catching of flies with their tongues. Amphibians lay eggs which are shell-less, but often embedded in jelly.

It is commonly believed that these primitive land animals probably evolved from lobe-finned fish. The most primitive of the Amphibians, the mud puppy salamander, uses its tail for swimming nearly identical to a fish, and even walks with a similar ‘swimming’ sway to its body. When mud puppies run, they switch to a more snake –like crawl, even tucking the legs next to the body to improve their speed. An important observation, as plot material for section 4.2 of this text is that all modern Amphibians are carnivores that eat almost entirely insects and other invertebrates (worms).

Toads, order: Anura

Toads are the most terrestrial of all amphibians, but they still must keep their skin moist or they will quickly suffocate. Toads hind legs are adapted to hopping (short jumps), and they are skillful at catching insects and worms with their tongues.

Frogs, order: Anura

Frogs exhibit a remarkably complex jumping behavior: they first 'jump' with their front legs to lift the head end upward, then they jump with the hind legs to provide the main power of the jump, and complete the jump by snapping their hips from a shallow angle to flat relative to the back adding a boost to the jump. However, they do not land, but merely plop back to Earth.

One exception to the diet of insects and worms is the South American bullfrog, which has been observed catching and eating mice!

Salamanders, order: Caudata

Salamanders' legs are poorly developed, most slither or swim with tail. The living animals are either semi-aquatic or fully aquatic carnivores, feeding on Insects and aquatic invertebrates. Some salamanders can grow not only new tails, but also new legs. There are also leg-less salamanders, classified as a separate order, Apoda (caecilians).

Fish (classes Osteichthyes, Chondrichthyes, Agnatha)

Most fish are strictly aquatic, with fins used to support swimming. These animals are either covered with scales or "naked." Fish may have a dorsal (back) fin and up to three tail fins (caudal or tail, second dorsal

and anal), plus a pair of pectoral (shoulder) fins and a pair of pelvic (hips) fins. All are cold-blooded, with a 2-chambered heart and a simple brain.

Bony fish (class Osteichthyes)

The familiar fish are ray-finned, with fins that are fan-shaped swimming structures. The intriguing group are the lobe-finned fish, with fins that are fleshy with longer bones, capable of supporting limited "walking." There are also lung-fish that have "lungs," actually using for breathing when out of water. If both characteristics were in the same animal, both lobe fins and lungs, this would make a good candidate for the ancestor of the early amphibian, a fish-like salamander.

Cartilaginous fish (class Chondrichthyes)

The cartilaginous fish include the sharks and rays, whose skeletons lack bony development (calcification).

Jawless fish (class Agnatha)

This is a group that you can probably ignore successfully. Few, if any of your students will have heard of them. If asked by a student, who spends way too much time watching nature shows on television, you should be able to get away with describing them as primitive fish, almost like living fossils.

Works Cited

Patterson, R. F., ed. *New Webster's Expanded Dictionary, 1993 edition.* Miami, FL: P.S.I. & Associates, Inc., 1993.

Starr. C. & R. Taggart. *Biology, the Unity and Diversity of Life, 10th edition*, Appendix I. Belmont, CA: Thompson - Brooks/Cole, 2004.