CHAPTER 6 - FOSSIL FISH, AMPHIBIANS, AND REPTILES

In the last chapter we saw how the concepts of Initial Complexity (complex-to-simple) and Initial Disorganization (simple-to-complex) lead to general predictions about what we should find in the fossil record. Following are a few of the many transitions that would have had to take place in the evolution of life:

Steps for which no transitional fossils have been proposed:

- From non-living chemicals to life.
- From the first life to some sort of cell (presumably prokaryotic).
- From prokaryotic to eukaryotic cells.
- From single-celled to multi-celled organisms.
- From exclusively soft-bodied creatures to those with hard parts.
- From invertebrates to vertebrates.

Steps for which at least one type of fossil has been proposed as a transition:

- From exclusively aquatic creatures to amphibians.
- From amphibians to reptiles.
- From one major type within reptiles and amphibians to a different type.
- From reptiles to mammals and birds.
- From one major type within mammals and birds to a different type.
- From some lower insectivorous creature to primates.
- From lower primates to monkeys, apes, and humans.

This chapter will deal with a few specific sequences in the fossil record that have mistakenly been presented as fossil transitions.

As noted in the last chapter, Initial Complexity interprets the rock strata as ecological communities, whereas Initial Disorganization interprets them as time periods. Even using the latter interpretation, the timing of many so-called transitions is wrong.

I. CLASSIFICATION SYSTEMS.

A. LINNAEAN SYSTEM.

Visual # 6-1

For many years biologists used the Linnaean system of classification, named for its inventor Carolus Linnaeus. Animals and plants were grouped according to similarities, without any attempt to determine why those similarities existed.

In the Linnaean system, the highest taxon is the kingdom. Kingdoms are divided into Phyla. These are divided into Classes, which can also be divided into Subclasses. Subclasses may include multiple Orders, which may be divided into Suborders. These in turn may be divided into Families, which can be divided into Subfamilies. Each of these may contain multiple Genera and Species.

B. PHYLOGENETICS (CLADISTICS).

In the last few decades, more and more biologists, paleontologists, and textbook authors have shifted to a different system known as phylogenetics or cladistics. This system takes for granted that the diversity of animals and plants is due to evolution (Initial Disorganization). Diagrams look much like trees, with everything being related to everything else. The groups that are considered to be the closest relatives are placed closer on the trees. For example, everything that has any kind of nerve column along its back would be grouped together; within that group, everything that has a backbone; within that one, everything that has teeth; within that one, everything that has a certain type of teeth, and so on.

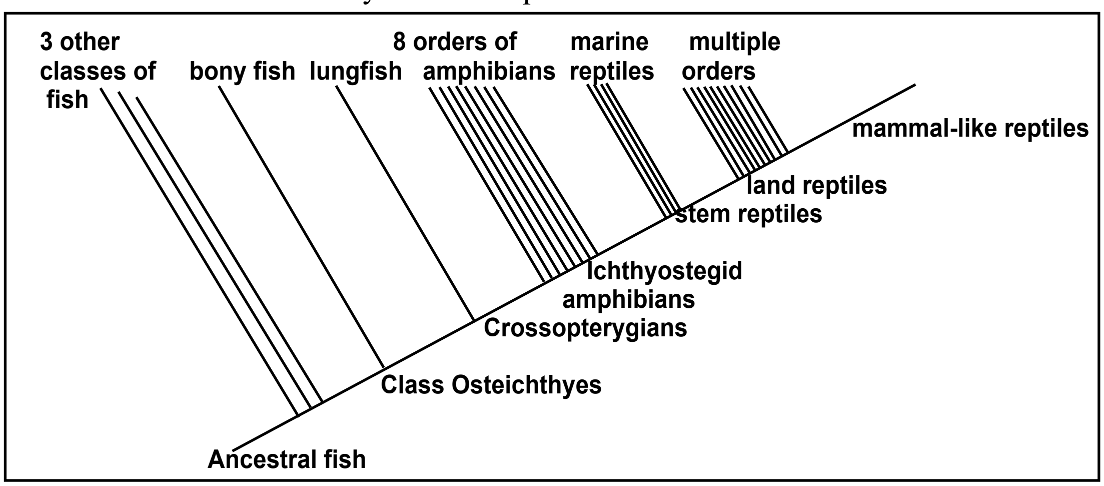
Certain prefixes and suffixes identify the groups. For instance:

- The prefix plesi- indicates something thought to be the evolutionary ancestor of something found higher in the fossil record. For instance, plesiadapiformes are claimed to be the ancestor of adapiformes, part of the lineage supposed to lead to humans.

- The suffix -formes means of the same general form. e.g., lemuriformes.
- The suffixes -don or -dont (pteranodon, mastodon, cynodont, creodont, pteranodon) indicate something to do with teeth.
- The prefix cyno- is derived from the Greek word for dog. Thus, cynodonts had teeth somewhat like those of dogs.
- "-pod" (arthropod, tetrapod, theropod) indicates something having to do with feet.
- The syllable "rhin" indicates something about the nose.
- The syllables "ceph" or "cephalo" indicate "head."
- "Cer" or "cera" indicates horns.
- The suffix -apsid (synapsid, diapsid, therapsid) has to do with openings in the skull. Anapsids have no holes on each side of the skull behind the eyes, synapsids have one, and diapsids have two. Therapsids are synapsids with a reptilian type lower jaw.
- The suffix -saur indicates a lizard-like structure.
- The suffix -morph indicates that something was of a certain form.

The alleged relationships between groups are presented in diagrams known as *cladograms*. As an example of a cladogram, following is a simplified version of how fish are supposed to have evolved into amphibians, which then evolved into reptiles, and so on. There need not be any known transitional forms in order to produce cladograms such as this, which are used to claim evolutionary relationships in science textbooks.

Visual
6-2



Some unknown type of ancestral fish is supposed to have given rise to all the known classes of fish including jawless, armored, cartilaginous, and bony forms. The latter, Class Osteichthyes, included a group of fish known as crossopterygians and others known as lungfish. One of these types is supposed to have evolved into amphibians. The amphibians in turn evolved into many other types of amphibians as well as "stem reptiles." The stem reptiles are then supposed to have given rise to multiple types of marine and land reptiles, and so on. These later produced mammals, including humans.

Cladists do not necessarily group organisms by traditional classes or orders, but instead according to how they are believed to be related.

- Even though fish do not have legs, the types supposed to have given rise to four limbed animals are classified along with them as *Tetrapodomorpha*.
- Since amphibians are considered to have a common ancestry with reptiles, the term "amphibian" is seldom used. Instead, both types are classified as *Reptiliomorpha*.
- If there is uncertainty about what type an animal belongs to, it is sometimes given its

own clade name. For instance, *Seymouria* is considered an amphibian, but is often placed in Order Seymouriamorpha. Likewise, *Diadectes* is considered to be a reptile, but many place it in Order Diadectomorpha.

Most cladists take evolution as fact. When the connection between two groups is missing, they say those groups are *paraphyletic.* This means simply that the transitions have not yet been discovered. Creationists, on the other hand. say the transitions are missing because they never existed.

II. FISH TO AMPHIBIANS.

Initial Complexity leads us to conclude that fish and amphibians were brought into existence as two distinct categories and have always remained distinct. Initial Disorganization takes it for granted that amphibians were not created as a distinct group but instead evolved from lower life forms such as fish.

Visual # 6-3

> References to standard geologic time scales will be used throughout this material. Even if the geologic time scale is correct, evolution is nowhere to be seen in the fossil record.

A. MOST COMMON TEXTBOOK SCENARIO.

Visual # 6-4

All the major types of fish (jawless, armored, cartilaginous, and bony) are found in strata of the Cambrian through Devonian. The lowest layer known to contain amphibians (ichthyostegids) is the Devonian.

Visual # 6-5

Visual # 6-6

The most common scenario for how fish evolved into amphibians is that some of them lived in fresh water lakes during times of periodic drought. Because of random mutations in their DNA, some happened to acquire fins that were stronger than those of their relatives. More mutations within the group with stronger fins gave some of them the ability to breathe both in water and in air without either drowning or suffocating. As the lakes dried up, the fish with both stronger fins and the ability to breathe air dragged themselves to other bodies of water while the others died. The process repeated as more mutations occurred. Gradually, the fins developed into legs until amphibians finally appeared.

> Some may have heard of "walking fish" such as mudskippers and certain types of Asian catfish. These are not connected to the hypothetical ancestors of amphibians. They belong to **Subclass Actinopterygii**, but amphibians are supposed to have evolved from crossopterygian fish of subclass **Sarcopterygii**.

If amphibians evolved because of droughts, we should see mass extinctions of freshwater fish. However, the Devonian is known as the "Age of Fishes" because so many new kinds of fish appeared, and afterward are found in many higher strata (interpreted as geologic ages).

B. WHY WOULD FISH EVOLVE INTO AMPHIBIANS?

1. CONTRAST OF BASIC EXPLANATIONS FOR ORIGIN OF AMPHIBIANS.

a. Initial Disorganization:

Visual # 6-7

- Life began about 3.5 billion years ago (see the Oparin-Haldane hypothesis in Chapter 3) then remained in the water for over 3 billion years, throughout the Pre-Cambrian, Cambrian, Ordovician, and Silurian.
- The first amphibians had to evolve from some earlier types of fish.
- Amphibians evolved and came out onto land during the Devonian when some type of crossopterygian fish evolved into amphibians of Order Ichthyostegalia.
- The information in the DNA of the evolving ancestors must have gradually become more and more complex as a result of a great many beneficial mutations.

b. Initial Complexity:

- Divisions of the geologic column represent ecological communities (biomes) rather than time periods.
- Fish have always been fish and amphibians have always been amphibians.
- Amphibians are not found in strata below the Devonian because those strata represent oceanic environments rather than the swampy or marshy areas where amphibians normally live.
- Mutations in DNA lead to deterioration rather than increasing complexity.

2. GENETIC INFORMATION IN DNA.

Some authors say that ancient organisms "invented" or "explored" a new physical characteristic. Such terminology ignores the source of physical features. The phenotype (the physical features) depends entirely on the genotype (the information in DNA).

DNA often contains hundreds of millions or billions of "base pairs" of the nucleotides Adenine, Cytosine, Guanine, and Thymine (A, C, G, and T). It is not the number of nucleotides but their arrangement that determines physical structures. Living things cannot arbitrarily decide to rearrange their DNA so as to "invent" something. The sequence must already be present or must be changed through random mutations.

When considering whether mutations are sufficient to produce new structures, we should take into account the error prevention and correcting mechanisms we saw in Section III of Chapter Four. (Sarfati, 2018, 24-26; Brutlag & Kornberg, 1972; Radman & Wagner, 1988, 40-46)

- First, a series of enzymes known as ligases, helicases, and topoisomerases separate, unwind, and prevent the two halves of the DNA strand from becoming tangled. (Visual # 6-8)
- Next, DNA polymerases assemble the correctly matching nucleotides Adenine and Thymine and Cytosine and Guanine into matching halves of a new DNA strand. Because of the matching numbers of hydrogen bonds between the nucleotides, only about 1 in 100,000 matching attempts results in a copying mistake (Visual # 6-9)
- Then, enzymes known as proofreading exonucleases move rapidly along the newly formed DNA strand to detect and correct errors. This brings the number of mistakes down to about 1 in 10,000,000. (Visual # 6-10)
- Then, some of the polymerases recheck the new DNA strand. If they find any errors, they snip them out and repair the defective sections. This reduces the rate of errors to about 1 in 10 billion base pairs. (Visual # 6-11)

A key question is: *could sufficient numbers of mutations slip through these mechanisms to cause living things to change to radically different types?*

3. INSUFFICIENCY OF DROUGHT SCENARIO.

The previously mentioned drought scenario implies that animals must have evolved the features they needed to survive. This is remarkably similar to the discredited doctrine of Lamarckianism.

French biologist Jean Baptiste de Lamarck preceded Darwin by several decades. He attempted to explain the appearance of new features and the loss of old ones by the use and disuse of body parts. It is evident that as organisms use certain parts of their anatomy those parts become more developed, and as they stop using them those parts atrophy. Lamarck believed that their offspring would inherit the changes. The most famous example of this belief is his 1809 story about how giraffes developed long necks. (Visual # 6-12) He said that they must have lived in an area subject to periodic drought. When the weather dried up, so did the trees. The shorter giraffes starved as soon as the lower leaves were gone. Only those who stretched their necks enough to reach the higher ones survived. They passed on their longer necks to their offspring, who repeated the process for many generations. Finally, the familiar long-necked giraffe had evolved.

Lamarckianism has been thoroughly discredited. The effects of use and disuse are not passed on to offspring. Repeated experiments such as cutting the tails off 100 successive generations of mice have shown that the characteristics of each organism are determined solely by the DNA it inherits from its parents. Use and disuse has no effect on DNA. Thus, droughts would have no effect on the DNA of the fish that were allegedly evolving into amphibians.

C. FISH PROPOSED AS ANCESTORS OF AMPHIBIANS.

Visual # 6-13

Both fish and amphibians are members of Kingdom Animalia, Phylum Chordata, and Subphylum Vertebrata.

Since biologists and paleontologists may have different opinions about how cladograms should be arranged, the boundary separating one clade from another at lower levels is often blurred. However, we will use traditional Linnaean taxonomy, in which groups are more clearly defined. The fish classes within Vertebrata are Agnatha (jawless), Placodermi (extinct armored fish), Acanthodii (extinct "spiny sharks" of the Silurian through Permian, often included within Osteichthyes below), Chondrichthyes (cartilaginous skeletons, e.g., sharks), and Osteichthyes ("higher" bony fish).

Amphibians are alleged to have evolved from fish of Class Osteichthyes. In Linnaean taxonomy, Osteichthyes is divided into two subclasses.

- Subclass Actinopterygii includes familiar ray-finned fish (webs of skin supported by bony spines) such as those eaten in restaurants or kept in aquariums, and
- Subclass Sarcopterygii includes Order Crossopterygii, lobe-finned fish with fleshy fins. This group contains the three suborders Rhipidistia, Actinistia, and Stuniiformes. Rhipidistia includes Family Tristichopteridae, which includes the types presented as transitions to amphibians.

1. COELACANTHS (Order Crossopterygii – in some systems Superorder Crossopterygii, Order Actinistia).

Visual # 6-14

Since the Devonian fish *Eusthenopteron* looked more like an amphibian then any other type, it is often presented as the last fish leading to amphibians. Textbooks and popular media commonly place its picture side by side with the amphibian *Ichthyostega* to show how similar the two animals are.

Eusthenopteron is considered to be an early coelacanth-type animal. The coelacanths were thought to be extinct for over 60 million years until the first specimen of the genus *Latimeria* was caught off the coast of Madagascar in 1938. Since then, many others have been caught, all of which are virtually identical to their fossil counterparts.

Because we have been able to directly observe living coelacanths, many made-up stories about their alleged ancestors have been exposed as false.

- Unlike the hypothetical transitional forms in the past, coelacanths do not live in fresh water lakes near sea level. They live deep in the ocean. No known drought has ever been serious enough to dry up hundreds of feet of ocean.
- The "lungs" are actually swim bladders which the fish can inflate or deflate to adjust its buoyancy, like the ballast tanks on a submarine. They can inflate them with gases from the blood or reabsorb the gases back into the blood. They have little to do with breathing.
- Using deep-sea submersibles, scientists have observed coelacanths in their native

habitat. They never use their fins for anything like crawling or walking, even on the sea bottom.

2. LUNGFISH (Order Dipnoi).

Visual # 6-15

Lungfish belong to different group of lobe-finned fish than coelacanths. All of the Devonian types, e.g., *Dipterus* and *Uranolophus*, are believed to be extinct. The modern types live in shallow waters in Africa, South America, and Australia. Though they are not as similar to *Eusthenopteron* as coelacanths are, many followers of the simple-to-complex (evolutionary) school of thought believe that lungfish are a more likely candidate for the transition to land.

- Modern lungfish live in shallow water.
- Their lungs function as swim bladders but also allow the fish to store oxygen. Australian lungfish can breathe either by using their gills or by swimming to the surface and gulping air. African lungfish bury themselves in mud during the dry season and can live up to a year breathing by means of their lungs. South American lungfish (also called American mud fish) breathe through gills as larvae, but rely on their lungs as adults.
- The fins are sometimes used for slithering through mud, though the fish move them in a very different fashion from any known animal that walks.

Because of these contrasting characteristics, many evolutionists now believe amphibians evolved from some type of ancient lungfish rather than coelacanths.

3. THE NOTOCHORD: ANATOMICAL PROBLEM WITH BOTH TYPES.

Visual # 6-16

There is a major problem with both types of proposed ancestors. All vertebrates begin their embryonic development with a *notochord*, a flexible rod of cells supporting the body. Eventually, the notochord of almost all vertebrates – including amphibians (Annona et al., 2015) – is replaced by a segmented spine. Afterward, the notochord remains only in the form of the cartilaginous substance between the vertebrae.

Coelacanths and lungfish are exceptions to this rule. They never acquire a segmented backbone but retain an uninterrupted notochord throughout their lives (Reynolds, 1897, 66, 70; Bates, 2015; Redmer, 2020; Schmitz, 1998).

Visual # 6-17

Animals do not grow notochords or backbones because they need them, but because their DNA contains the instructions to produce them. In order for either the coelacanths or the lungfish to be the ancestor of amphibians, their DNA would have to undergo a great many mutations. These would have to make it through the previously described error correcting mechanisms so as to eventually produce a segmented backbone instead of an uninterrupted notochord, in addition to all the other differences seen below.

Though one could insist that such changes are possible, they are not supported by evidence.

D. GENERAL DIFFERENCES BETWEEN FISH AND AMPHIBIANS.

As noted previously, the extinct crossopterygian fish *Eusthenopteron* does bear a superficial similarity to one extinct type of amphibians known as ighthyostegids. However, there are many major differences.

1. MAJOR ANATOMICAL DIFFERENCES..

- A few types of amphibians such as some extinct aistopods and living caecilians do not have legs. However, all those that do possess legs have pectoral and pelvic girdles rigidly attached to the backbone on one end and to the legs on the other. Fish fins, on the other hand, are loosely embedded in muscle. No known living or fossil fish has a pelvic girdle or any intermediate structures showing how one might have gradually developed.

- The pectoral girdle of fish (analogous to shoulders) is attached directly to the skull. In amphibians, it is attached to the vertebral column (Benton, 2005, 77). This allows amphibians to have necks, whereas fish do not.
- The skull of the amphibian would no longer be supported by water so the muscles that support it would need to be much stronger.
- There are different numbers of bones in the skull of amphibians and fish, and a difference in their sizes and arrangement. (Colbert, 1980, 75)
- Since most of a fish's weight is supported by water, its fins do not experience much stress when it rests on the bottom. If it came out of the water it would be subject to much greater forces. The fins, the muscles supporting them, and the backbone would all have to be strong enough to bear the full weight.

Visual # 6-18

- The circulatory system is different.
- The eyes would have to change to work primarily in air instead of water. Eyelids and tear glands would be needed to prevent drying when out of the water.
- Fish do not have eardrums; ichthyostegids did. (Colbert, 1980, 90)
- The breathing apparatus is significantly different in the two categories. With the exception of adult South American lungfish, even the fish that are able to survive in air primarily breathe in water. On the other hand, larval amphibians breathe through gills. Once they mature they breathe primarily through lungs, though some are also able to breathe directly through their skin.
- Fish propel themselves mainly through motion of the body and tail, with the fins used primarily for balance and steering. In amphibians the main source of propulsion is the legs (Clack, 2012, 51-52). Legs are supposed to be derived from fins, rather than the body and tail.

Visual # 6-19

2. ***METHOD OF FERTILIZATION.***

Many creatures reproduce by internal fertilization, in which the sperm of the male is deposited inside the body of the female. Many others use external fertilization, in which the female deposits her eggs than the male comes by and sprays his sperm on them.

a. ***Internal.***

Since we know from direct observation that living lungfish and coelacanths use internal fertilization (Anthony & Millot, 2017) it seems most likely that the other crossopterygian fish also used the internal method (Clack, 2012, 62).

b. External.

Except for caecilians (snakelike forms with no legs), amphibians rely on external fertilization. (Duellman & Trueb, 1994, 77–79.) In order for fish to evolve into amphibians, identical mutations in DNA would have had to produce all the above changes in both a male and a female, while simultaneous non-identical mutations would have had to produce complementary changes in their reproductive systems. Instead of keeping her eggs inside, the female would have had to expel them into the environment. Meanwhile, instead of seeking copulation with a female, the male had to begin to spray his sperm on the eggs.

In order for the species to survive, this would either have had to happen to a great many individual males and females at the same time and place, or to one extraordinarily fortunate pair who happened to have exactly the correct matching mutations. It would have to happen not just for one species, but for every one of the new types of amphibian.

Visual
6-120

3. *METAMORPHOSIS.*

Most people are familiar with tadpoles, which are the immature larvae of frogs. Though frogs may be the most familiar amphibians, most of the other types (except newts) also go through the process of *metamorphosis* in which the animal undergoes a complete change from the larval to the adult form.

A group of Paleozoic amphibians known as labyrinthodonts include the only forms similar to fish and are thus believed to be the ancestors of all the other amphibians. At least some of the labyrinthodonts underwent enough metamorphosis from larvae to adults that the larvae were incorrectly placed into a new subclass, Phyllospondyli (Romer, 1966, 90-92; Case, 1946, 325-420; Colbert, 1980, 99). If the amphibians evolved from some sort of fish, the process of metamorphosis that led to the misclassification must have had its source in the DNA of their fish ancestors.

The fish believed to be the ancestors of amphibians were either crossopterygians or lungfish. The former belonged to Class Osteichthyes, Order Crossopterygii or Coelacanthiformes, Suborder Rhipidistia, and either *Eusthenopteron, Panderichthys*, or a close relative. The lungfish belonged to Suborder Dipnoi.

a. Absence of metamorphosis in either crossopterygians or lungfish.

Some of the extinct *Eusthenopteron* specimens were over a meter long, or about 3 and a half feet. Though we do not have any living individuals of this type to study, scientists have been able to analyze hundreds of fossils as small as 27 mm (about an inch) and have not found even a single specimen going through a larval stage (Cote, 2002, 488, 501). As for living coelacanths and lungfish, none have ever been seen going through any form of metamorphosis.

b. Metamorphosis in non-crossopterygian fish.

Though non-crossopterygian fish are not believed to have anything to do with the evolution of amphibians, for the sake of completeness we will include those that go through varying degrees of metamorphosis.

i. Subclass Actinopterygii ("ray-finned fish").

Most of the familiar modern fish such as trout, bass, and catfish belong to this subclass. Some of them do undergo a greater or lesser degree of metamorphosis, but they are not considered ancestors or close relatives of amphibians. Several examples:

- Several types of **eels** undergo a gradual yet radical metamorphosis, going through as many as five stages of development over several years. However, eels are not considered ancestors of amphibians because (1) they are of the wrong subclass and (2) they first appear in the Cretaceous, at least a hundred fifty million years too late.
- In the young of **flatfish** such as flounders and halibut, the eyes are on opposite sides of the head. The animal experiences a partial metamorphosis in which the head changes shape so that both eyes end up on the same side. Though the body also changes shape, the animal maintains its overall fishy appearance the whole time.
- **Salmon** undergo a partial metamorphosis as they change from being suited for fresh to salt water. However, there is not much change in shape.

In most other bony fish, the only thing that could be considered metamorphosis is that they absorb the yolk sac while they are developing.

Visual
6-21

ii. *Class Agnatha* (jawless fish).

One group of agnathans, the lampreys, have skeletons made of cartilage rather than bone. They undergo partial metamorphosis in which their bodies become longer, their eyes develop, and their dorsal fins separate into two sections. However, they maintain the same overall eel-like appearance from hatching until death.

To summarize: None of the fish supposed to be ancestors or relatives of amphibians go through metamorphosis, yet most amphibians do.

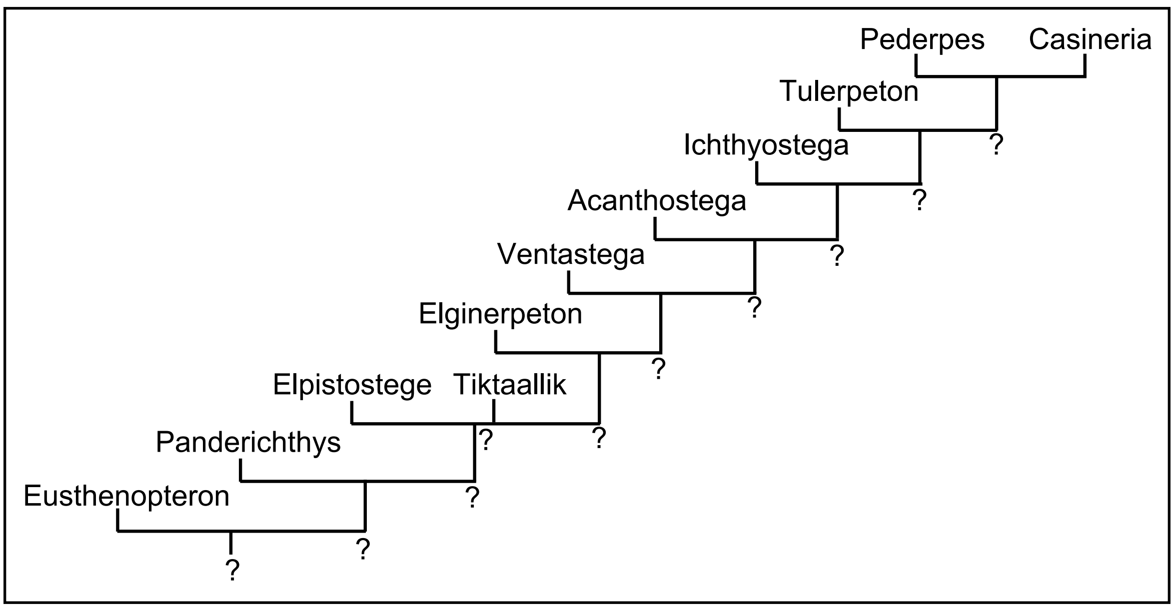
It would be difficult for periodic droughts to produce all the mutations needed to bring about the above anatomical features, method of reproduction, and metamorphosis that transformed fish into amphibians. **Initial Disorganization** leads us to believe that the mutations and the transitional forms carrying them have simply not yet been discovered. **Initial Complexity** says that the features of fish and amphibians are the products of information placed into their DNA in a fully functional condition.

E. AMPHIBIANS PROPOSED AS THE EARLIEST TYPES.

Despite widespread acceptance of specific types as intermediates, the fossil record of alleged transitions from fish to tetrapods (four-footed animals) is extremely poor.

According to Clack (2009, 214), the consensus among paleontologists is as follows.

Visual
6-22



There is an excellent record of *Eusthenopteron*, for which well over a thousand fossils are known. However, as of this writing (2021) we have not recovered a single specimen of either *Tiktaalik* or *Panderichthys* with a complete backbone. The evidence for *Panderichthys* is so fragmentary that some artists do not attempt to show any details about its backbone – see Carroll et al., 2004, 347. There is only one complete fossil of *Elpistostege* (Cloutier et al., 2020). *Elginerpeton*, considered by some the earliest true tetrapod (Ahlberg, 1995), is known from fragmentary remains.

Ventastega is known only from fragments. There are enough skull fragments to allow reconstruction of most of the the skull. Part of the pectoral (shoulder) girdle and a small part of the pelvis have also been identified (Ahlberg et al., 2008, 1199-1203; Clack, 2012, 177-179). However, as of this writing, no vertebrae are known. However, the fragments of the pectoral (shoulder) girdle and possible pelvic girdle are compatible with legs. From the perspective of Initial Disorganization *Ventastega* was a transition; from the perspective of Initial Complexity it was an amphibian.

Visual # 6-23 As of 2005, *Acanthostega* and *Ichthyostega* fossils were the only two Devonian tetrapods known from nearly complete postcranial skeletons (Ahlberg et al., 2005, 137). Many interpret them to be fully amphibian rather than transitional. In fact, within the amphibian Subclass Labyrinthodontia, ichthyostegid amphibians received their name from *Ichthyostega*. *Tulerpeton*, *Pederpes*, and *Casineria* seem to simply have been amphibians.

1. ABSENCE OF INTERMEDIATES.

In the cladogram above, the ancestor of *Eusthenopteron* is shown with a question mark because it is unknown. There are a number of Devonian lungfish such as *Dipterus*, *Griphognathus*, and *Uranolophus*, but they are considered relatives rather than ancestors of *Eusthenopteron*. Likewise, the common ancestor of *Panderichthys*, *Elpistostege*, and *Tiktaalik* is shown with a question mark because it, too, is unknown. The same is true of *Elginerpeton* and *Ventastega*.

Despite imaginative drawings, no one has ever discovered an actual common ancestor for any two of the alleged transitional forms above. We do not have a single fossil of anything with structures showing how the previously noted anatomical features might have developed.

Though Initial Disorganization would lead us to believe that the transitions *must* have existed, there is no physical evidence for them. Initial Complexity would lead us to believe that they never existed.

2. ALLEGED TRANSITION (TIKTAALIK) OUT OF SEQUENCE.

Visual # 6-24 For the sake of argument, let us assume that the ages on the geologic column are correct. The fossil fish *Tiktaalik* has been proposed as a transition between fish and amphibians because it had some characteristics that seem similar to amphibians. The problem is that it is far out of evolutionary sequence.

Tiktaalik is dated about 383 MA (million years ago). However, tracks of creatures that had four legs have been found in at least four locations around the world: the Holy Cross Mountains in Poland, dated to 395 MA, about 12 million years before *Tiktaalik;* Valentia Slate, Valentia Island, Ireland; Tarbat Ness, Scotland; and Genoa River, Victoria, Australia (Niedźwiedzki et al., 2010; Ahlberg, 2019, 122-123). Whether the creatures that made the tracks lived in water or on land, *Tiktaalik* is at least 12 million years too late to show the transition from fins to legs.

Though many believe that there must be some intermediate form between fish such as *Eusthenopteron* and the earliest amphibians, there are only general ideas as to what the transitions might have been rather than specific candidates. The earliest known amphibians, *Acanthostega* and *Ichthyostega* (from the Upper Devonian), were fully formed with legs and not fins.

F. UNEXPLAINED ORIGIN OF NON-LABYRINTHODONT AMPHIBIANS.

Visual # 6-25 Cladistic nomenclature is very fluid, so few classify animals exactly the same way. This book follows the Linnaean system instead. In the Linnaean system, Class Amphibia is divided into three subclasses, each containing three orders. One of the subclasses is still alive, but the other two are believed to be extinct.

As previously noted, the most common textbook scenario is that some type of crossopterygian or dipnoid fish evolved into labyrinthodonts such as *Ichthyostega*. However, even though there are some similarities between fish and ichthyostegids, such a scenario is not sufficient to explain where the other five Paleozoic amphibian orders or the three modern ones might have come from. Most have little or no external resemblance to fish, all had major internal differences from fish, some had no legs at all, and some had hundreds of vertebrae of a radically different type.

1. *STRUCTURE OF BACKBONE AND VERTEBRAE*

Besides the anatomical differences between fish and amphibians, there are also major differences in the spines of different types of amphibians.

All members of Phylum Chordata begin their embryonic development with a *notochord*, a flexible rod of cells supporting the body. In Subphylum Vertebrata (the chordates that develop a backbone) the notochord becomes surrounded by bone. Though coelacanths and lungfish retain an uninterrupted notochord throughout their lives, almost all other vertebrates develop a segmented spine in which the only remnants of the notochord are the cartilaginous cushions between the vertebrae.

In the cases where the spine is segmented into individual vertebrae, each has a pulpy nucleus running front to rear through its center. Around the pulpy parts are bony *centra*, which may be arranged in several possible ways. Depending on the type of animal, there will probably be *neural arches* on the top through which nerves run and, at least in fish, *haemal* (blood) arches on the bottom. There may also be bony protrusions called *processes* that allow connection with muscles or other bones.

a. Rhachitomous vertebrae (multi-part centra).

Visual # 6-26

All types of vertebrae have a bony *centrum*, which may be composed of a single bone or of several parts. The centrum in *rhachitomous* vertebrae is composed of a single horseshoe-shaped bony piece called an *intercentrum* or *hypocentrum* spanning the ventral (bottom) half of the spinal cord, a smaller *pleurocentrum* on each side of the spinal chord, and a neural arch on the dorsal (top) side (Reynolds, 1897, 171; Clack, 2012, 208). The neural arch interacts with but is not fused to the spinal cord or the other bones. The intercentra and pleurocentra form as sections of the notochord *ossify*, i.e., turn into bone (Clack, 2012, 418; Romer, 1996, 93).

There may also be various processes such as *zygapophyses* (bony protrusions going from one vertebra to the corresponding part of the next) allowing interaction with other vertebrae or with ribs, muscles, and the like. The presence of zygapophyses indicates that the vertebral column was probably better suited for weight-bearing.

i. Crossopterygians and lungfish.

Visual # 6-27

Despite having an uninterrupted notochord, living and fossil crossopterygians and lungfish have rhachitomous vertebrae with centra composed of multiple parts. However, there do not seem to have been zygapophyses (Ahlberg, 1998, 108; Carroll et al., 2005, 350). The absence of such processes would have made their backs rather weak.

ii. Order Ichthyostegalia.

Ichthyostegalia was the only one of the extinct orders that resembled fish. It had vertebrae more or less similar to the rhachitomous ones of its alleged fish ancestors (Carroll et al., 2005, 350). The zygapophyses are poorly preserved but definitely present (Ahlberg et al., 2005, 139).

iii. Order Temnospondyli.

Likewise, one of the criteria for animals to be classified as Order Temnospondyli is that they had rhachitomous vertebrae.

iv. Order Anthracosauria.

Anthracosaurs are considered by many to be the ancestors of reptiles. Though there was considerable variation within the intercentra and pleurocentra, they too had vertebrae considered as rhachitomous.

b. Lepospondylous vertebrae (one-part centra).

Visual # 6-28

Lepospondylous or "husk-type" vertebrae are considered more primitive than the rhachitomous type. The centrum is a spool-shaped or hourglass-shaped ring of bone (Clack, 2012, 418-420). If the bone does not form from the cartilage of the notochord but instead forms as a single piece from the tissue surrounding it, the spine is called *lepospondylous* (Colbert, 1980, 104). There is usually no bracing between one vertebra and the next. Such an arrangement cannot support much weight.

2. EXTINCT AMPHIBIANS.

Six orders of amphibians are known only from Paleozoic or Mesozoic strata, as well as three that are alive at present.

Visual # 6-29

Subclass Labyrinthodontia ("folded tooth") received its name because of the internal structure visible when the teeth are sliced open. They had rhachitomous vertebrae, some of which were quite similar to those of reptiles.

Though cladograms show all the labyrinthodonts as related, no specific transitional forms have been proposed as either common ancestors or transitions. Labyrinthodonts included:

a. Order Ichthyostegalia (very late Devonian through Mississippian, 395-359 MA), up to ten feet long, somewhat crocodilian in overall shape. This is the only order that contained forms (e.g., *Ichthyostega, Acanthostega*) that looked somewhat fishlike. Thus, it is widely believed to have included the transitional forms from fish to amphibian.

An immediate problem arises when trying to connect *Ichthyostega* with animals that walk on land. Recent studies (Pierce et al., 2012; Ahlberg et al., 2005) have shown that neither its front nor hind legs could have rotated enough to give it a normal mode of walking, and that its hind legs were probably not strong enough to propel it anyway. The authors conclude that it most likely pushed itself forward on land by arching its back, digging the hind feet in, then straightening out in a fashion similar to inchworms or seals.

b. Order Temnospondyli (Mississippian through Cretaceous, 330-120 MA), water-dwellers with flat bodies and small limbs, e.g., *Eryops*.

c. Order Anthracosauria (Mississippian through late Triassic, 330 - 230 MA), proposed as the most likely group from which reptiles evolved.

This group is called anthracosaurs because some of the first fossils were found in anthracite coal seams. Since coal is made of decayed plant material, they must have been buried in massive amounts of vegetation. This goes against the usual scenario that says animals die next to a body of water, fall into it, are gradually buried and fossilized, and eventually come back to the surface due to erosion. Instead, the large scale burials amid vast numbers of plants points to catastrophic deposition. (See Chapter 5.)

3. AMPHIBIANS ON THE GEOLOGIC COLUMN.

The concept of Initial Disorganization automatically implies that strata represent time periods. Initial Complexity, on the other hand, allows for the possibility that the suites of fossils used to identify the strata represent ecological communities instead.

a. Subclass Labyrinthodontia.

Though dates are subject to change, following are the commonly accepted ages

Visual # 6-30

for the fish supposed to have evolved into labyrinthodont amphibians: *Eusthenopteron* about 385 MA, *Panderichthys* about 380 MA, *Tiktaalik* about 375 MA, *Elpistostege* about 385-380 MA, and *Elginerpeton* about 375 MA. That is, all the fish supposed to be developing into tetrapods are found in the Devonian. Initial Complexity would lead us to interpret the environment in which these fish are found as shallow-water close to sea level.

The forms generally accepted as true amphibians are commonly dated as follows: *Ventastega* about 375-360 MA, *Acanthostega* about 365 MA, *Ichthyostega* about 365-360 MA, *Tulerpeton* about 365 MA, *Pederpes* about 348 MA, *Casineria* about 340-335 MA.

- The first four are assigned to Order Ichthyostegalia, dated from about 395-359 MA.
- *Casineria* is based on a single incomplete fossil. It is of uncertain classification, considered by some to be an amphibian, but by others a reptile (Smithson et al. 2012, 4536).
- *Pederpes* is also based on one fairly complete fossil. At first it was thought to be a sarcopterygian (lobe-finned) fish, but in 2002 Clack analyzed it and decided it was a tetrapod (Clack, 2002). This classification has been accepted ever since.

  The taxonomic classification of *Pederpes* is not fully settled. It has been placed in a catchall clade called Family Whatcheeriidae along with *Whatcheeria* (named after the city of What Cheer, Iowa.) There is enough uncertainty about this group that it has not been definitely assigned to any order or class.

b. Subclass Lepospondyli (early Mississippian to Permian, dated about 350-255 MA). As implied by the name, they all had lepospondylous vertebrae. They included:

Visual # 6-31

i. ***Order Aistopoda***, long snakelike forms with up to several hundred vertebrae. Most had no limbs and no pelvic girdle.

ii. ***Order Nectridea*** also included some forms with no legs.

The nectrideans are supposed to have evolved in two directions. Some became eel-like, while others developed flattened and broadened skulls and heads, and long, flattened tails..

iii. ***Order Microsauria***, small amphibians similar to lizards and salamanders. They had small limbs and were covered with scaly armor. (O'Gogain, 2017)

The labyrinthodonts are the only forms fairly close in overall shape to the alleged fish ancestors of amphibians. Since they appear at a lower level in the fossil record, they are commonly presented as the ancestors of the lepospondyls. .However, there are no proposed transitional forms.

Any such transition would have needed DNA with the potential to produce major differences in structure and development:

- Labyrinthodonts had DNA that produced rhachitomous vertebrae. The transitions evolving toward lepospondyls would have needed to acquire a chain of mutations producing simpler spool-like vertebrae. This would have fit better with the idea of complex to simple than with simple to complex.
- At least some of the labyrinthodonts seem to have gone through metamorphosis from the larval to the adult stage (Romer, 1966, 90-92; Case, 1946, 325-420; Colbert, 1980, 99). However, enough fossils of the young of Aistopoda and Nectridea have been unearthed to show that these, at least, did not go through a larval stage involving metamorphosis (O'Gogain, 2017).

4. LIVING AMPHIBIANS (Lissamphibia).

The modern amphibians (Subclass Lissamphibia) are found in strata from the Permian to the present. Three orders are alive today. All have the same type of vertebrae characteristic of Subclass Lepospondyli above.

a. ***Order Urodela*** or ***Caudata***, salamanders and newts. These have more cartilage and less bone than other amphibians.

b. ***Order Apoda*** or ***Caecilia***, snake-like or eel-like forms with no limbs. Burrowers.

c. ***Order Anura*** or ***Salientia***, frogs and toads. Frogs and toads have a different body plan from any other amphibian.

No known forms connect the six Paleozoic orders with the three modern ones. Nothing in their structure indicates where they came from. (Romer, 1971, 52-55 & 403; O'Gogain, 2017, Colbert, 1980, 106).

- All of the living amphibians have the "more primitive" lepospondylous vertebrae rather than the rhachitomous vertebrae typical of crossopterygians and Subclass Labyrinthodontia. Since the transition from fish to amphibian is supposed to have taken place only once and since three of the Paleozoic orders had the type of vertebrae considered more advanced, the modern orders would have had to take a major step backwards.
- Most modern amphibians (except for newts) go through metamorphosis. However, careful study of lepospondyl fossils at all stages of development has not shown a single case of metamorphosis.
- Some propose that lissamphibians might have evolved from temnospondyls rather than from lepospondyls. However, besides the fact that there are no similar forms in the two subclasses, the temnospondyls had the wrong kind of vertebrae.

Visual # 6-32

Since we are unable to do experiments on the past, the idea that fish evolved into amphibians can neither be proven nor disproven. It is based on the idea of Initial Disorganization that it HAD to happen, and on inferences concerning the similarities of certain fossils to other fossils and to living forms. However, there is no positive fossil evidence that amphibians evolved from fish, and a great deal of DNA evidence against it.

III. AMPHIBIANS TO REPTILES.

The physical characteristics of every living thing are determined by the information in its DNA. Animals and plants do not get what they need; they get what their DNA gives them.

A. WHY WOULD AMPHIBIANS EVOLVE INTO REPTILES?

The young of amphibians (e.g., tadpoles) look much different than the adults. However, once they are fully mature it can be difficult to tell the difference between the skeletons amphibians and reptiles. Many of the differences have to do with the soft parts of the animal, which are usually not preserved. Thus, it may be difficult to tell whether a fossil was an amphibian or a reptile.

Some of the major differences:

Visual # 6-33

- ***Skin:*** Every known reptile has scaly skin. Amphibians have slick and wet skin, so they need to stay near water to keep from drying out. Even though toads feel drier than frogs, they have glands to keep the skin moist.
- ***Maturation:*** Newly hatched reptiles are a miniature version of adults. Newly hatched amphibians (e.g., tadpoles) look much different than the adults.
- ***Breathing:*** From the time a reptile hatches it uses lungs to breathe. Amphibians start with gills and develop lungs later (except for lungless salamanders, which breathe through their skin).

- ***Fertilization:*** Reptiles reproduce by internal fertilization, where the sperm of the male is placed inside the female. Amphibians usually fertilize externally, that is, the female releases eggs into water, then the male swims by and releases sperm.

  The only known amphibians that fertilize internally are some of the modern caecilians, legless forms that resemble worms. They are considered rather primitive and are not connected to any of the Paleozoic or Mesozoic amphibians by any known fossils.

  The ancestral labyrinthodont amphibians would presumably have relied upon external fertilization. Through mutations in DNA, their descendants evolved into reptiles that somehow developed internal fertilization. However, the unknown amphibians that evolved into the modern lissamphibians did not experience such mutations. They continued to rely on external fertilization, except for some unknown forms that evolved into the "primitive" caecilians millions of years later. Alone among the amphibians, this group also acquired mutations that led to internal fertilization.

Visual # 6-34

- ***Eggs:*** The factor that makes it easiest to identify whether an animal is an amphibian or a reptile is the type of egg. Amphibians have a seemingly simple, more or less clear gelatinous egg that must be kept moist so as not to dry out. There are up to six layers or domains in the egg (Altig & McDiarmid, 2007). Reptiles, on the other hand, have an *amniotic* egg surrounded by a leathery or hard shell containing several sacs. Besides the shell, there are over a dozen other divisions such as the amnion, chorion, allantois, albumin, and amniotic sac, from which the name of the egg type comes.
  - Some authors (e.g., Romer, 1957, 57) refer to the "invention" of the amniote egg as a major step forward in the evolution of life. An invention implies an inventor, but living things do not invent any new structures. They simply manifest the features encoded in their DNA.
  - There is no known creature, either living or fossilized, that has any sort of in-between egg (Colbert, 1980, 110).
  - Visual # 6-35 There would have to be a great many random mutations in the DNA of even one ancestral female to cause her to start laying amniotic eggs instead of gelatinous.
  - Reptiles cannot fertilize amphibian eggs and vice versa. At least one transitional male at the same time and place would have to acquire a great many complementary random mutations so that his sperm could fertilize the drastically new type of egg.
  - The animals would also have to switch from the external fertilization of amphibians to the internal fertilization used by reptiles.

  The change would have to take place in a single generation. A single extraordinary female would have had to live in the same place at the same time as one or more males who acquired exactly the correct complementary mutations. If not, there would be no next generation.

  No one has proposed any specific animal as the transitional form.

B. AMPHIBIANS AND REPTILES ON THE GEOLOGIC COLUMN.

Reptiles are supposed to have evolved from some sort of amphibian, believed to be either a temnospondyl or something similar.

It is easy to tell larval amphibians and reptiles apart since the former are aquatic and the latter are terrestrial. Once the amphibians reach the adult stage, though, some of their skeletons are so similar to reptiles that it is difficult to tell them apart. Such was the case with *Seymouria* and *Diadectes*. The former was thought to likely be a reptile until larvae of *Discosauriscus*, considered to be a close relative, were discovered with gills (Clack, Visual # 6-36

2012, 355; Romer, 1996, 95). Since no known reptiles go through an aquatic stage, *Discosauriscus* is an undisputed amphibian. And since *Seymouria* is considered a close relative, it is also believed to have been an amphibian.

Diadectes is accepted by most as a very early reptile despite the fact that we have not found either eggs or larvae. Its skeleton is very similar to that of *Seymouria*, though there is a significant difference in size. The largest known specimens of *Seymouria* were about two feet (600 mm) long (Benton, 2005, 110), whereas *Diadectes* was up to ten feet (Romer, 1966, 97). However, *Diadectes* appears too late in the fossil record to be the first reptile.

- The commonly accepted age of its alleged ancestor *Seymouria* is in the early Permian, about 280-270 million years ago (MA).
- *Diadectes*, supposed to be its descendant, is also dated to the early Permian, about 290 MA. Few authorities pay attention to the fact that this is about ten million years too early.
- The earliest undisputed reptile is *Hylonomus*, dated about 315 MA (early Pennsylvanian). This predates the supposed amphibian ancestor of reptiles, *Seymouria*, by about 35 million years and the reptile supposed to have evolved from it, *Diadectes*, by about 25 million years.

One could make an argument that perhaps the dating is wrong. If so, how can we be certain that any other dates are correct?

IV. CHAPTER SUMMARY.

Living things including fish, amphibians, and reptiles could have come into existence in one of two ways.

A. REASONS FOR BELIEF IN INITIAL DISORGANIZATION.

Visual # 6-37

Living things were less complex and organized than at present and increased in organization. Initial Disorganization implies that changes should show an overall trend from simple to complex.

Arguments for initial disorganization are threefold:

1. **Philosophical:** Many reject the possibility that there might be some sort of intelligent influence outside the scope of nature. If there is none, then simple-to-complex evolution is the only possibility.
2. **Stratigraphic:**
   Geologic strata represent time periods.
3. **Paleontological:** Fossils can be arranged on charts to show a progression from fish to amphibians to reptiles and so on.

B. REASONS FOR BELIEF IN INITIAL COMPLEXITY.

Living things were at least as complex and organized as at present and decreased in organization. Initial Complexity implies that changes should show an overall trend from complex to simple.

Arguments for initial complexity are twofold:

1. **Philosophical:** Those who accept the Bible as the Word of God recognize that it clearly teaches conditions of initial complexity with a subsequent trend toward deterioration.
2. **Stratigraphic:**
   The ages of geologic strata are a matter of interpretation. It is reasonable to interpret them as representing ecological communities.
2. **Genetic:**
   - The physical features of every creature (its phenotype) depend on the contents of its DNA (its genotype).

- Environmental influences are insufficient to produce new features unless those features are already encoded in the DNA in the form of recessive genes.
- Though some mutations may be neutral, most are harmful or fatal. Almost none are beneficial. The kinds of major differences between fish and amphibians, within amphibians, and from amphibians to reptiles, would require too many mutations for the organisms to survive, let alone evolve. For instance:
    - Contrast in notochord between crossopterygians/dipnoids and amphibians
    - Change in types of vertebrae (rhachitomous vs. lepospondyl)
    - Development of legs and associated support systems
    - Change in breathing, hearing, vision apparatus
    - Change from internal to external fertilization and vice versa
    - Change to metamorphosis or lack thereof
    - Change from gelatinous egg to amniotic.

Neither one can be proven by experimentation. The student must examine the evidence as thoroughly and carefully as possible, but must ultimately place faith in what seems most reasonable.