Lesson 1
What is Zoology?

Welcome to **zoology**! Did you know that you've actually done zoology before? When you examined an insect or watched a squirrel in your yard, you were, in fact, doing zoology, because zoology is the study of the animals that God made. All animals are included in zoology, even fleas, ants, and spiders. Some people don't realize that critters like these are animals, but they are!

All insects (including this praying mantis) are animals.

Try to picture in your mind all the animals that God created. You could probably spend years trying to study every animal. Instead of trying to study all the animals in one book, then, we will focus on a special group of animals fashioned by God on the fifth day of creation: the flying creatures. Did you realize that the flying animals God created on the fifth day included much more than just birds? The Bible was originally written in a language called **Hebrew**, and in Hebrew, the word used for the flying animals in Genesis is *owph*. The Hebrew word *owph* means "flying creatures." Read the Bible verse below:

> Then God said, "Let the waters teem with swarms of living creatures, and let birds fly above the earth in the open expanse of the heavens." God created the great sea monsters and every living creature that moves, with which the waters swarmed after their kind, and every winged bird after its kind; and God saw that it was good. God blessed them, saying, "Be fruitful and multiply, and fill the waters in the seas, and let birds multiply on the earth." There was evening and there was morning, a fifth day. (Genesis 1:20-23)

Even though this English translation of the Bible (New American Standard) refers to the flying creatures as "every winged bird," the original Hebrew simply says "flying creatures." So the Bible tells us that on the fifth day God made every flying creature, even insects and bats.

Are you wondering which animals, exactly, will be covered in this book? Our study of zoology begins with birds, then bats, then flying reptiles, and it ends with insects. It will be more fun if you can do the insect lessons in early fall, spring, or summer when insects are out and about; so feel free to read the insect lessons when it works best for you. Before you learn about specific types of animals, however, I want you to learn a little about a few general topics such as how zoologists organize the animals they study, how certain animals fly, where animals live, and that some animals go extinct. That's what I'm going to cover in this lesson.

Classification

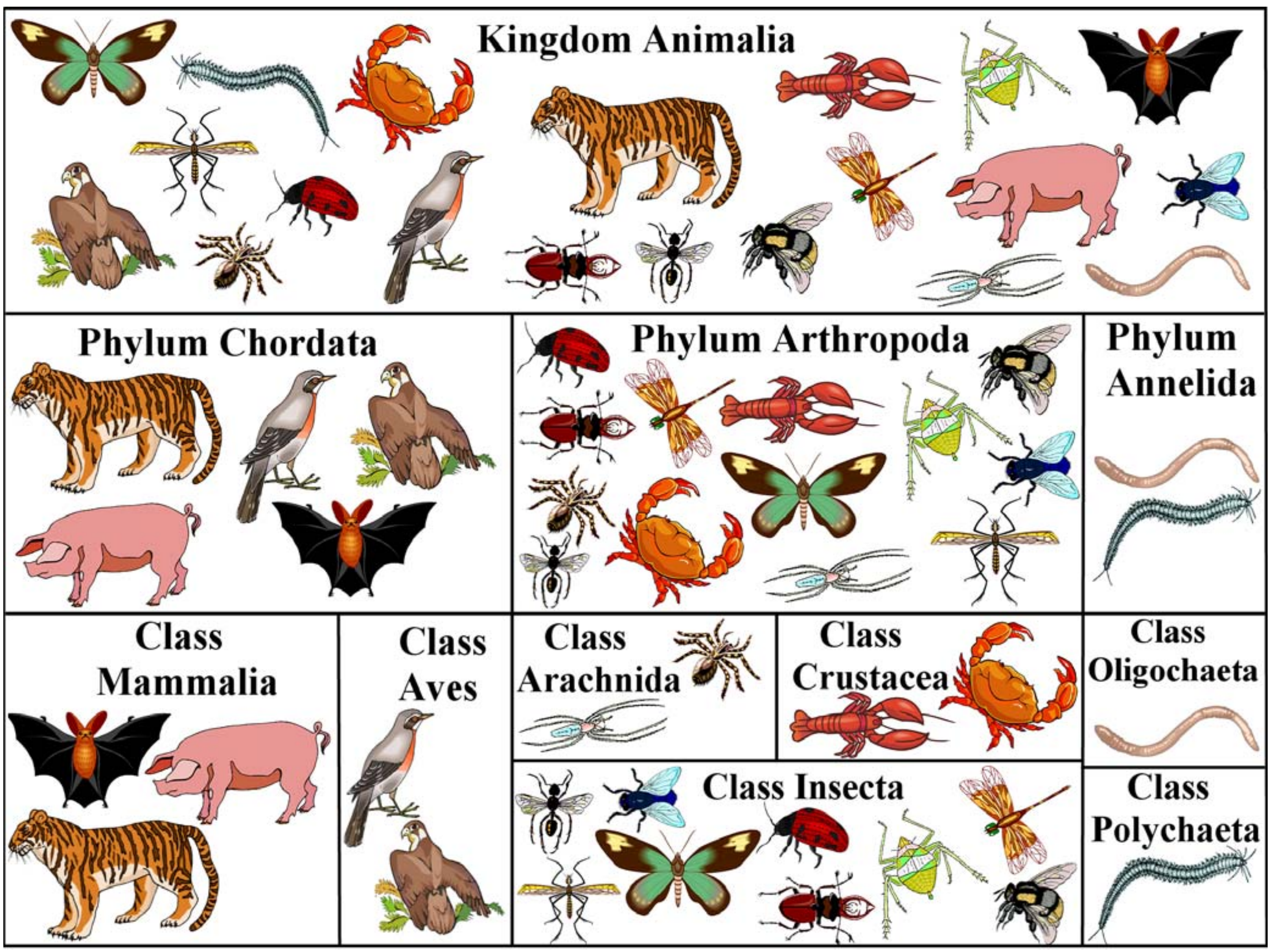
Scientists who study animals are called **zoologists** (zoh awl' uh jists). They have a tough job, because there are a *lot* of animals in creation. In order to help them organize all of these animals, scientists put them into several groups based on how similar the animals are to one another. After they put animals in groups, they then name each animal. Do you remember one of the jobs that God gave Adam in the Garden of Eden? Adam had to name all the animals. Even today, people are still doing what Adam did. Whenever a new animal is discovered, it is put into several groups and then named. This process is called **taxonomy** (taks ahn' uh mee), and it is used to group and name all living things. The names they choose are not English "common" names, but Latin scientific names.

When scientists learn of a newly-discovered animal (there are new animals discovered every year, especially in the insect world), they study it to see how to classify, or group, it. If it has all the features of a butterfly, for example, it is put into the butterfly group, which is called **Lepidoptera** (lep uh dahp' tur uh). That's Latin for "scale wings." It gets even more specific than that, however. If it has tiny front legs, it's put in a special group of butterflies with tiny front legs. Then, if it also has orange coloration, it's placed with other butterflies having tiny front legs and similar colors. On and on it goes, so that the animal is put in smaller and smaller groups until all the butterflies in a group look almost exactly alike. That group is called a **species**, and it is the most specific grouping used when scientists classify animals.

Are you wondering why scientists do all of this grouping? There are many reasons, but one is because when you have animals divided into groups, it is easier to learn about them. If one species of butterfly lays eggs on a certain plant, maybe other similar species lay eggs on a similar plant. If you wanted to attract a certain species of butterfly, you would want to know what kind of food it eats. You might learn what food it eats by studying similar butterflies that are in the same group. In other words, it's easier to study animals when they are divided into groups based on their similarities. Since zoologists spend a lot of time classifying animals into groups, we need to learn about how they do this.

All animals are first put into one big group called the **Animal Kingdom**, or **Kingdom Animalia** (an' uh mahl' ee uh) in Latin. Then, each animal in the Animal Kingdom group is put into a smaller group, called a **phylum** (fye' lum), with other similar animals. That group is then given a scientific name. For example, all animals in the Animal Kingdom with a backbone (also called a "spine") are separated and placed into phylum **Chordata** (kor dah' tuh). Do you have a spine? Yes, you do. You can feel it if you run your fingers over the middle of your back. This means you are in phylum Chordata along with all creatures that have a spine. The easy way to remember this phylum name, Chordata, is to remember that inside of the spine is a special cord of nerves. That nerve cord is so important that if you were to injure it badly, you might never be able to move your arms and legs. No wonder God put it inside the bones in your spine. That cord really must be protected!

Animals that have backbones are often called **vertebrates** (vur' tuh brayts), and animals without backbones (like insects) are called **invertebrates** (in vur' tuh brates). It turns out that there are *a lot* more invertebrates than vertebrates in the Animal Kingdom. Because of this, all vertebrates can be fit into one phylum, but there are so many invertebrates that they must be put in several phyla (plural of phylum). Look at the diagram below. **Arthropoda** (are thruh' pah duh) is one phylum of animals that don't have a backbone. Crabs, lobsters, spiders, and insects are in this phylum. Another phylum that contains animals without a backbone is phylum **Annelida** (an uh lee' duh). Earthworms are put in this phylum. There are other phyla of invertebrates, but I don't want to go into them now.



This drawing illustrates part of the process of classification. The creatures in the top box are all in the Animal Kingdom. They are then grouped into phyla based on their similarities. Then, they are grouped into classes. This is only a partial illustration, as there are many more groups, ending in species, which is the smallest of all the groups.

After being divided into phyla, the animals in each phylum are further divided into groups called **classes**. For example, birds are put in their own class, called **Aves** (aye' veez). Animals that have fur, give birth to babies, and nurse their babies with mother's milk are put into a class called

Mammalia (muh mail' ee uh). Each class is further divided into **orders**, so birds in class Aves are divided into orders based on the special characteristics of each bird. Birds of prey that have a hooked beak, like falcons, are in the order Falconiformes (fal' kuhn uh for' meez); birds that sing are in the order Passeriformes (pass' er uh for' meez); and birds that look like pelicans are in the order Pelecaniformes (pel ih kahn' uh for' meez).

Of course, this happens with all phyla. The creatures in phylum Arthropoda, for example, are further divided into classes like **Insecta** (arthropods with similar features, such as six legs) or **Arachnida** (uh rak' nih duh – arthropods with similar features, such as eight legs). These classes are also further broken down into orders. Can you believe that we are not done yet?

Scientists divide the animals in each order into groups called **families**. For example, in order Falconiformes, we have hawks, eagles, falcons, and other birds of prey. Well, hawks and eagles are in one family because they are pretty similar, while falcons are put in another family. After animals are divided into families, they are then each put in a group called a **genus** (jee' nus). Hawks and eagles are in the same family, but they are each put into their own genus.

Finally, scientists divide the animals in a genus into different **species**. For example, the picture to the right shows two falcons. Because they are so similar, they both belong in genus *Falco*. However, they are not similar enough to be in the same species. As a result, they each belong to separate species. The important thing to remember about animals in the same species is that a male and female from the same species can mate and have babies. Even though the two falcons in the picture have a lot of things in common, they cannot mate with one another, so they belong in different species.

These two birds are very similar and therefore belong to the same genus (Falco). However, they cannot mate and have babies, so they belong to different species.

Latin

You might have noticed that the names for many of the classification groups are long and hard to pronounce. That's because a lot of them come from a language called Latin. Why do scientists use Latin? Well, Latin is a language that no one speaks but many people learn. Therefore, it never changes. English, on the other hand, changes all the time. Several years ago, the word "cool" was only used to describe the temperature. Now, "cool" also means "neat," or "great." The word "neat" once meant "tidy and clean." Now the word "neat" also means "great."

Latin is helpful to scientists because the Latin words they use to name things do not change. So scientists all over the world can work together to try to understand nature even though the scientists may not all speak the same language. For example, a butterfly that we call the "mourning cloak" is called the "Camberwell beauty" in England, and in Germany it is called the "trauermantel." Its scientific name, however, is *Nymphalis antiopa* (nihm' fuh lus an tee oh' puh). Since this name comes from Latin, it doesn't change from country to country. Scientists from every country will know what butterfly is being discussed if it is called by its scientific name.

Binomial Nomenclature

Did you notice that the butterfly I talked about had two names? It turns out that all animals have two names, because when a scientist talks about an animal, he uses the animal's genus and species to name it. This helps scientists know the classification, because by just seeing an animal's name, you know what genus and species it is in. The butterfly I was talking about above, then, is in genus *Nymphalis* and species *antiopa*. Notice that its name is written in italics and that the genus name is capitalized but the species name is not. This is the way all scientists write the scientific names of animals. This two-name system is called **binomial nomenclature** (bye no' mee ul no' mun klay chur).

Try This!

To help you remember the system of classification that scientists use, you can remember this sentence: "**K**ings **P**lay **C**hess **O**n **F**ine **G**lass **S**ets." That's a mnemonic (nih mahn' ik) phrase. It helps you remember the order of classification groups because the first letter in each word is the same as the first letter of each classification group from the largest to the smallest: **K**ingdom, **P**hylum, **C**lass, **O**rder, **F**amily, **G**enus, and **S**pecies.

Can you make your own mnemonic phrase to help you remember the order of the classification system? You will want to make a sentence that makes sense to you and will be easy to remember. The sentence must have seven words that start with the letters given in the diagram below:

Kingdom	Phylum	Class	Order	Family	Genus	Species
K	P	C	O	F	G	S

If you have an animal field guide (or a set of encyclopedias), look up some animals that you already know. Look at the Latin name for each animal and try to pronounce it. Notice that it is written in italics and that the first word (the genus) is capitalized but the second word (the species) is not.

Explain what you have learned about taxonomy and binomial nomenclature.

Flight

Five days after God said let there be light, there were handsome creatures speckling the sky with their majesty and declaring the glory of God with their amazing ability to fly. Today, these creatures remind us how wonderful God is to have made such beautiful, astonishing animals.

We see birds, bats, and insects flying, gliding, soaring, and sailing through the air with ease. How do they do it? How come we can't just flap our arms really fast and join them in the air? Well, God designed these creatures with wings, which we don't have, and a very key ingredient for flight is the *shape* of those wings. The shape of its wings is what gives a creature the ability to lift off the ground. Have you ever heard the terms **lift** and **drag**? These are flight terms which explain why a bird can fly with its wings and why we can't fly with our arms. I will explain these terms in a way that will help you understand what they mean, but you will really have to listen closely.

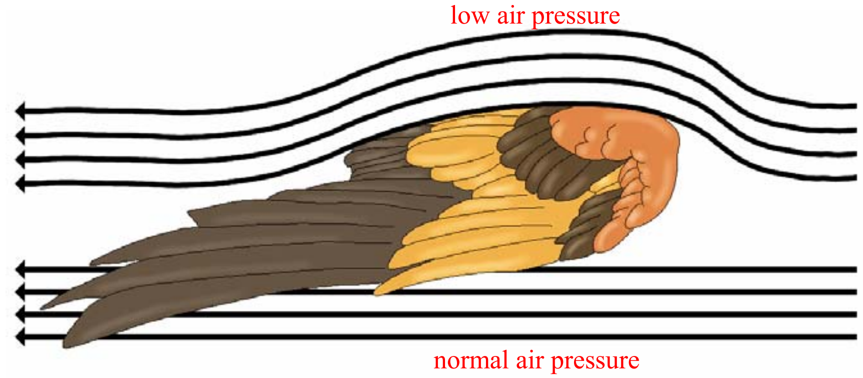
Long ago, in the 1700s, a man named Daniel Bernoulli (bur new' lee) did some experiments with objects under water. Those experiments help us understand how things fly. You might be asking yourself what water has to do with lifting things up into the air. Well, you are going to learn about one of God's invisible creations and how He made the air so that birds could fly. Air, just like water, applies pressure on everything it touches. This is because air is not just empty space like it appears to our eyes; it actually weighs something, just like water. Air really has a lot of stuff in it; microscopic stuff that is in the air all around you. So, when you walk through the air, the stuff in the air is actually pressing against you. Of course, it's a lot easier to walk through air than to walk through water because water is much heavier than the stuff in the air. Nevertheless, walking through air is just like walking through a swimming pool, only easier.

Uplifting Pressure

So the air all around you presses upon you. It doesn't press on you as much as something heavier like water in a swimming pool, but it does press upon you even though you can't feel it. The pressing of air against you is called **air pressure**. If there is a lot of air pressure, the air is pressing hard. If there is only a little air pressure, the air isn't pressing as hard.

Well, Daniel Bernoulli (the scientist I mentioned before) discovered that when he made water move quickly against things that were in shape of a bird wing (this shape is called an **airfoil**), the water moved differently on top of the wing compared to the bottom of the wing. As the water moved along the top of the wing, it actually sped up, which caused it to push with less pressure. The water that moved along the bottom of the wing did not speed up, so it pushed on the wing with the same pressure as always. So the water on the bottom of the wing pushed up more strongly than the water on top of the wing pushed down. What happens if you push up on something more strongly than you push down on it? It rises, doesn't it?

The same thing happens with air and a bird's wing. Faster-moving air on top of a bird's wing pushes down on the wing with low pressure, and the slower-moving air on the bottom of the wing pushes up with higher pressure. As a result, the air pushes the wing up harder than it pushes the wing down. This causes the wing to rise. In other words, it *lifts* the wing. Because of this, scientists say that the difference in air pressure on a wing provides *lift* for the wing.



When air flows across a bird's wing, the air that travels above the wing moves more quickly than the air that travels below the wing. This causes more pressure on the bottom of the wing than on the top, which lifts the wing, making the bird fly.

Try This!

Here is a fun experiment that shows you how air pressure works. You will need a cup completely full of water, two straws, and scissors. Put one straw in the water and cut it so that it sticks out of the water by only about ½ inch. Now, put the cup with the straw in it next to the edge of a counter or table, and squat down so your eyes are level with the cup. Using your fingers to hold the small straw next to the edge of the cup, blow through the other straw at an angle towards the top of the straw in the cup. Angle the straw upwards so that the air coming out of it passes right over the top of the straw in the cup. Keep blowing and blowing. This will make the air move faster over the top of the straw in the water. As a result, the air pressure above the straw in the water will decrease, and when there is less air pressure above the straw, what do you think will happen? Try it and see.

Did a stream of water squirt out the straw that was in the cup? It should have, if you blew at the right angle. Be sure you weren't trying to blow on the water in the cup; blow only on the tip of the straw in the cup. Keep trying until it works. What explains this result? Well, when you blew air over the top of the straw, the moving air could not press down as hard on the water in the straw. The air over the rest of the water in the cup was not moving, so it continued to press down on the water with its full pressure. Since the water in the cup was being pressed down harder than the water in the straw, water was forced up and out of the straw! This is a lot like what happens to a bird's wing. Just as the difference in air pressure over the straw and the rest of the cup lifted water out of the straw, the difference in air pressure between the top and bottom of a bird's wing lifts the wing into the air.

Airfoil

Let's talk more about the shape of a bird's wing so you can understand how God created the wing and the air to work together. Look at the diagram of the bird's wing on the previous page. The shape of the bird's wing is why it experiences lift. As the bird's wing (with its airfoil shape) moves through the air, some air goes above and some air goes below the wing. Because the wing is curved, the air moving over the top of the wing has to go farther than the air moving underneath the wing. In order for the two air flows (the one going below and the one going above) to make it to the end of the wing at the same time, the air on top of the wing must move faster because it has a longer way to go.

As your experiment showed, fast-moving air cannot exert as much pressure as slow-moving air. That pressure difference on a wing lifts the wing (and the whole bird) into the air. As the bird speeds up, the air travels over the wing even faster. As the air travels faster and faster over the wing, less and less pressure is placed upon the top part of the wing. This gives the wing more and more lift, causing the bird to go higher and higher. That is why birds flap their wings – to move faster so that the air travels faster over their wings. Speed is very important in making lift. When a bird flaps its wings, the wings provide a force that makes the bird go faster. Scientists call this force **thrust**. The more thrust that the wings give the bird, the faster the bird goes, and the greater the lift on its wings.

What a Drag

Although the speed of the air over an airfoil gives lift, staying in the air is difficult because there is another force that tends to slow a flying creature or object. That force is called **drag**. Drag resists or pushes against an animal or object as it travels through the air. You have probably felt this drag when you ran against the wind on a very windy day. If you were shaped like a knife, it would be easier for you to run through the windy air, because the air would not drag against you as strongly while you ran. When something can travel through the air without a lot of drag, we say that it has an **aerodynamic** (air' oh dye nam' ik) shape. The reason an airplane isn't shaped like a chair is because it wouldn't be very aerodynamic. It would experience a lot of drag as it traveled through the air. This same thing is true for submarines that travel through water. Even swimmers want to reduce drag; they make themselves as smooth as possible by wearing swim caps and shaving their legs.

Even if it had wings, a pig could not fly. This is partly due to the fact that it doesn't have an aerodynamic shape.

A bird is not shaped like a pig, and a bat is not shaped like a dog. There is a reason for this. God created each flying creature with a body shape that is aerodynamic. Even the long-legged storks and other water birds can trail their legs behind them in such as way as to make themselves aerodynamic.

Explain in your own words what you have learned about lift, thrust, and drag.

Mid-Lesson Break
Your Notebook

Today you will begin a very important notebook in which you will put your own creations, illustrations, images, and artifacts you collect concerning zoology. You will always want to do your best work for your notebook, because it will contain information and data that you will want to keep for the rest of your school years. When you are in high school and want to remember how an experiment turned out and what materials you used, you will check this notebook. When you want to remember something specific you learned about birds, bats, insects, or pterosaurs, you will also check this notebook. Use your best handwriting, and always record as much information as possible. In science, you can never have too much information.

At the end of every reading segment, write down what you learned that day. Speaking it out loud is also helpful, so if you are not yet able to write quickly, you can dictate it to your parent or teacher to write it down for you. In this way, you can make your own zoology book that contains your own knowledge!

You can also put pictures of projects you did in your notebook, or you can record the extra things your family did to enhance your learning, such as going on a field trip or a nature walk. You can add anything you want to your notebook – pictures of flying creatures, feathers (though there are laws about what kinds of feathers you can collect), or insect parts you find out in nature that would lay flat and fit inside your notebook. Remember the mnemonic you did earlier in this lesson? You should put that in your notebook.

Every experiment you do will need to be recorded. You can make copies of the Scientific Speculation Sheet found at the beginning of the book (page iv) to record all your data. Keep this in your notebook as well.

After you have put your classification mnemonic in your notebook, write down what you learned today about classification and flight. Be sure to include a drawing to explain how a wing gets lift, such as the one on page 7.

Optional exercise for older students: Use the library or internet to learn about Carolus (sometimes called "Carl") Linnaeus. He is considered the founder of the classification system you learned about in this lesson. The course website I mentioned in the introduction to this book has some links to information about this very interesting Christian man.

Mid-Lesson Experiment
Experimenting With Glider Design

To better understand how lift works, you will conduct an experiment with two gliders that you will build out of cardboard, straws, clay, and tape. You will make two gliders that are exactly alike except for the size of the wing. One will have a shorter, wider wing; one will have a longer, narrower wing. Based on the knowledge you have about flight, you will make guesses about which glider you expect will fly farther.

Every science experiment has what we call **variables**, which are things that change in the experiment. A good science experiment will have only one variable, so that anything different that happens during the experiment can be assumed to be the result of that one variable. The variable in this experiment will be the size of the glider's wings. We want that to be the *only* variable. As a result, we need to make sure that everything else is the same. The size of the two gliders, for example, must be exactly the same. The way you cut and build each glider must be done in exactly the same way. Both gliders must be made from the same material. Where you test the flying of your gliders must be exactly alike; don't test one in the living room and one in the garage. The reason all these things must be kept the same is because we want to know the effect that wing size has on the distance a glider flies. If other things are different besides the wings, one of those factors may be what makes one of the gliders go farther. To make sure that any difference between the flights of the gliders is due only to the wing size, everything else between the gliders must be the same. This is how you conduct a real scientific experiment.

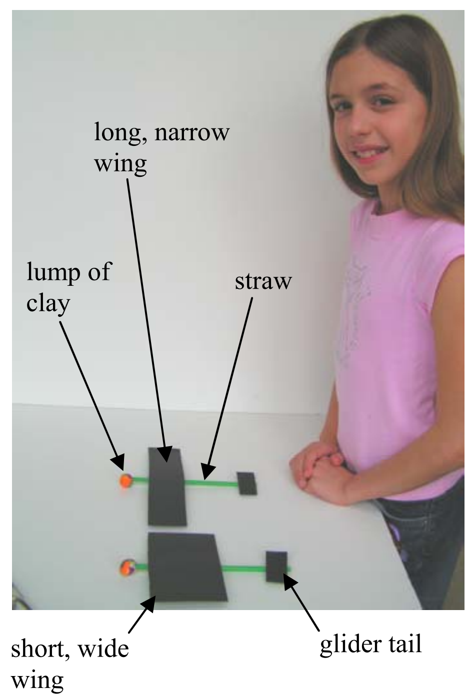
You also need an accurate way to measure your data. Measuring is an important element for many science experiments. How will you measure which glider flies farther? You can measure how far it goes before it lands. You will need a good place to fly them, as well as an accurate way to measure how far they went. A tape measure that can stretch out would be a good indicator. You could also have the same person measure the distance by putting one foot in front of the other over the entire distance of the glider's flight. It needs to be the same person each time. Why do you think that is?

Another key to getting accurate results in an experiment is repeating the experiment enough times to make sure your results are consistent. You need to throw the gliders over and over, measuring again and again to find out if you get the same results most of the time. If the experiment is done only once, it may have been affected by factors that you didn't think of, such as how you threw it, the wind direction at the time, or other things that you didn't consider. All scientists forget to consider a few things here and there, and repeating an experiment over and over again will help make these forgotten factors less important.

Every experiment begins with a hypothesis, or a guess. You need to guess which wing design (a short, wide wing or a long, narrow wing) will enable your glider to fly the farthest. Record your guess on a Scientific Speculation Sheet. Now it is time to perform the experiment and see whether or not your guess is right!

You will need:

- The Scientific Speculation Sheet (with your hypothesis recorded)
- Pen
- Cardboard box (A pizza box or cereal box works well.)
- Straws (You could use paint stirrers which are given away at hardware stores instead.)
- Clay (two small chunks about the size of grapes – both exactly the same size)
- Scissors
- Tape
- Tape measure (or some other device for measuring distance, like a yardstick or someone's feet)



1. Cut two rectangles for the wings: one long and thin (perhaps 1 inch by 8 inches) and the other short and wide (perhaps 2 inches by 4 inches).
2. Cut two smaller rectangles of exactly the same size (one inch by two inches) for the glider's tails. You can color or decorate them if you wish, as long as they are exactly the same.
3. Use tape to attach the tails to the end of each straw in the exactly the same place. Be certain to center the tail on the straw so that it will be balanced.
4. Attach each wing about 2 inches from the front of the each straw. Again, be certain you have the straw right in the middle of the wing so that it is balanced. You may need to use a tape measure to see where the middle is on each wing and tail.
5. Place a small clump of clay on the front of each straw to balance out the weight. This will help your airplane to sail farther as well.
6. If possible, choose a place outside to test your gliders.
7. Throw one of the gliders and measure the distance it travels. Record the result on the Scientific Speculation Sheet.

8. Throw the other glider, trying to do everything exactly the same as you did with the first glider. Once again, measure the distance it travels and record the result on the Scientific Speculation Sheet.
9. Repeat steps 7 and 8 at least ten times, recording each distance on the Scientific Speculation Sheet.
10. Now you need to **average** the results you have for each glider. When you average the results of several different experiments, you are hoping that any variables you couldn't keep the same will cancel each other out. For example, suppose the wind was blowing one way during one of your throws and another way during another throw. This would affect the distance that the glider traveled, but hopefully, if the wind caused the glider to travel farther while it was blowing one direction, it would cause the glider to travel shorter when it was blowing in the other direction. In the end, averaging the results of the throws will hopefully get rid of the wind's effects. To average the results, add them all together and divide by the number of times that you threw the glider. For example, suppose I threw a glider 10 times and got the following results: 12 feet, 13 feet, 11 feet, 9 feet, 10 feet, 11 feet, 12 feet, 13 feet, 10 feet, and 9 feet. I would average them by adding them all together: 12 + 13 + 11 + 9 + 10 + 11 + 12 + 13 + 10 + 9 = 110. Then, I would divide 110 by 10 to get 11 feet. This means that on average, the glider traveled 11 feet.
11. Write the average for each glider on the Scientific Speculation Sheet and compare the two. The glider with the larger average had the wing design that allowed for the longest travel in the air. Was your hypothesis correct?
12. On your Scientific Speculation Sheet, write down the materials you used to make the gliders, the procedure you used to test how well they flew, and what you learned about the best wing design for a glider.

Were you surprised by your experimental results? In general, a long, narrow wing will allow a glider to travel farther than a short, wide wing. This is mostly due to drag. The ends of a wing experience a lot of drag due to the way air travels around them. The longer and narrower the wing, the less the drag, so the farther the glider can travel.

Habitats

Many penguins live in Antarctica, where it is cold. They have been designed to live well in such a habitat.

God's amazing creation is filled with many places that are very different from one another. Some places (like the southern parts of Florida) stay warm all year, while others (like Antarctica) stay cold most of the time. As you probably already know, some kinds of animals prefer a certain part of the earth over other parts of the earth. Penguins, for example, are usually found in colder places, like Antarctica. We call the places animals live **habitats**. I'm sure you have heard that word before. When we keep an animal in a container of some kind, we try to make it as close to its natural habitat as possible. We even call the place we keep the animal its habitat.

God gave each animal special features that help it survive in its habitat. A bird that lives near the ocean, eating creatures found under the water, has feet that can walk on sand or swim in the water. Animals that live in grasslands often are not very colorful so that they are not easily seen and eaten by other animals. God created each animal in the special way that would be best for its habitat. Parrots are brightly colored, matching the fruit that grows on the trees in the forest where they live. Bats are usually darkly colored and hard to see in the dark caves where they dwell. Even the eggs of birds are often perfectly colored for their habitat. Some animals actually blend in so well that they are amazingly hard to see. We say that they are **camouflaged** (kam' uh flahjd). This helps them hide from other animals that want to eat them.

Do you see the lizard in this picture? He is hard to see because he blends in with his surroundings. In other words, he is camouflaged. If you can't find the lizard in this picture, visit the course website.

Oftentimes, people will change the habitat that an animal prefers, making paved roads, parking lots, and buildings. When this happens, animals will either move to another place that is more natural or try to adjust to the changes that have been made. If you drive around the city, you will see birds that once made nests in cliff walls or trees. They now build their nests in the large letters of signs. As another example, Purple Martins* naturally nest in holes they find in trees or rocks. People like to hear them sing, however, so they began making birdhouses to attract them. Purple Martins adapted to these new homes, and now most will only nest in birdhouses that people build for them.

These are bird nests in the letters of a large sign that is on the outside of a local library.

As a general rule, you will find a greater variety of animals in a more natural habitat, such as a park or forest area. If you leave a segment of your backyard to nature, not mowing or spraying it with pesticides, you will find that more birds and interesting insects will make your yard their home or visit it frequently. This is because you are providing them with water, food, and shelter, and that's really all an animal needs in its habitat!

*Please see the note about bird names at the bottom of page 20.

Instinct

"Is it by your understanding that the hawk soars, stretching his wings toward the south?" *-Job 39:26*

All of God's creatures have been given a special gift called **instinct** (in' stingkt). Instinct is a built in need to do something for survival. It's not something a creature thinks about; it's just something the creature does automatically. A baby bird automatically throws its head back, opens its mouth wide, and hollers for food. It is an instinct. Mother cats instinctively wrestle and bite their kittens, teaching them how to fight. Baby bats automatically cling to the cave wall. Birds begin building nests in the spring, even before there are eggs to put in them. Many birds automatically fly towards special places where birds of their kind congregate to have their young. Grasshoppers naturally spit out the contents of their stomach on predators that try to eat them. Emerald moths naturally chew off bits of flowers and stick them to their bodies in order to camouflage themselves. Bees naturally work to take care of the hive and make honey. Butterflies naturally "know" which plant their young need to eat, and that's where they lay their eggs. Birds, bats, and insects are given many instincts, and they follow their instincts without even thinking about it. We will study many such instincts in this book.

This butterfly (*Agraulis vanillae*) knows by instinct that its young will want to eat the plant on which it is laying its eggs.

Instincts are evidence that there is a God who created the world around us. They point to an Intelligent Designer who gives animals the ability to do smart things that will help them to survive. If animals with very limited intelligence can do very intelligent things that keep them alive and well, there must be an Intelligent Designer who gave them such an ability.

The Bible says that man can choose to do what is right or what is wrong. This is a gift God gives to no other creature – the ability to choose how to behave. When we choose to follow God and live for Him, He will lead us and guide us, helping us to make the right decisions for our lives. Animals aren't given this option, because animals aren't made in the image of God. Therefore, they must be given automatic "instructions" that they can follow in order to survive. Those instructions are the instincts that God gave them. Those instincts demonstrate that God takes care of His creation, including the animals.

Extinction

Have you ever heard that some animals are **extinct**? This is very true. We live in a world that is damaged by sin. And because of this sin, the beautiful world that God made, the world that He declared excellent, is not as good as it once was. The result is that people and animals die. Animals become extinct when every single one dies out and there are no longer any of them living on earth. We know of these animals either because they were photographed or described in books before they all died out or we find their preserved remains in the ground. The preserved remains of creatures that were once alive are called **fossils**.

Many animals have become extinct throughout the history of the world. We have recorded a few, but there are many more that have not been recorded. It is a sad thing when this happens, but it is part of living in a world that is captive to sin. One day, there will no longer be any death or destruction. The Bible talks about animals that will live on the earth during that time. Perhaps when God brings down the new heaven and the new earth, animals that were once extinct will be on the new earth.

How does an animal become extinct? There are many ways this can happen. Sometimes, a change in its habitat will cause an animal to die. These changes could be an environmental change like a drought (a long time with no rain) or a long time of cold weather. They could also be the result of a catastrophe like the worldwide flood described in Genesis. Many kinds of animals became extinct after the flood because the conditions of the earth after the flood were not as warm and friendly as they had been before. Many species did not survive the new harsh climates, and we only know about them because we have found their fossils.


This is a drawing of Passenger Pigeons. They are now extinct because people hunted them until there were no more left.

Some animals die out because people hunt them or destroy their habitats. The **Passenger Pigeon**, for example, was a common pigeon that traveled in huge numbers. Scientists believe that at one time there were more Passenger Pigeons than any other type of bird on the earth. They estimate that in the 1800s, there were over two billion of these birds. When traveling from one place to another, they flew in huge flocks that were up to a mile wide and *300 miles long*! When these flocks passed over an area, the sky would be covered with birds, darkening the sun.

That's a lot of birds, and they ate *a lot* of food. When they descended on a place to eat, they would gobble up all the seeds in site. They were shot and killed by the millions each year. Pigeon hunting was very profitable, because back then people ate pigeons the way we eat chicken today. These pigeons, which only laid one egg per year, soon began to die out. The last wild one was shot in 1900 by a 14-year-old boy who had it stuffed. It is now in a museum.

The **Dodo Bird** also went extinct. We know about this bird because when sailors found this flightless bird on an island in the Indian Ocean, they wrote about how strange it was. It would come right up to the sailors, as friendly as could be. The sailors named it the Dodo Bird because they thought it wasn't very smart for being so friendly. They were mighty hungry for meat after traveling the open seas, and they would kill these friendly birds so they could eat their meat. The Dodo Bird also laid its eggs on the ground, which was fine until people brought pigs, monkeys, dogs, and rats to the island. These animals were not a natural part of the island habitat, and they either ate or crushed the Dodo Bird eggs. Within eighty years of its discovery, the Dodo Bird was extinct.

This is a drawing of a dodo bird, which is now extinct.

Animals that are dying out and might become extinct are called **endangered species**. These days, people try to protect endangered species so that they won't go extinct. At one time, the **Trumpeter Swan** was an endangered species. There were once millions throughout North America, but Native Americans and European settlers hunted them for their beautiful feathers and good meat. By the 1900s, there were only a few left on the earth. The United States government made it illegal to hunt them, and people helped them by placing eggs from swans in the zoo into the nests of those in the wild. Soon, the population grew back and they are no longer endangered.

Bald Eagles, once an endangered species, are now thriving.

The Bald Eagle has a similar story. There were once Bald Eagles all over North America. No one is certain why they began to die out. Some believe that it is because the settlers competed with them for the same food. Some believe it is because they were killed by salmon fishermen who didn't want the birds eating the salmon they were trying to catch. Some believe they didn't have enough areas to nest in once people moved in. This is unlikely, since they nest on cliffs and in high trees. Whatever the cause, in the 1960s, there were only a few hundred in the entire world. To protect them, the U.S. government made it illegal to kill them or destroy their nests. If you find that you have an eagle's nest on your property, you are not allowed to disturb it in any way. Even if you were planning to build a house right next to it, you are not allowed to, no matter how much money you paid for the land. Such laws helped the Bald Eagle population to recover and increase. Now there are thousands of Bald Eagles in North America again. Do you have any living near you?

Have you read any books about **dinosaurs** (dye' nuh sawrz)? What about flying reptiles like the **pterosaurs** (tair' uh sawrz)? The pterosaurs and other flying reptiles were created on the fifth day, just like all the other flying animals. We will study them a bit later in this book. They and the dinosaurs are now extinct. We know that they lived on earth at one time because we find their fossils. However, we cannot find any living dinosaurs or pterosaurs today. There are many different ideas about what caused them to go extinct, but the most likely reason is that they died out because of changes to the earth that were caused by the worldwide flood that is discussed in the Bible. Although Noah's ark probably had young dinosaurs from each kind on it (there was plenty of room for them), many creation scientists believe they couldn't handle the new climate that the earth most likely experienced after the flood. As a result, they probably died out.

Extinction Errors

Usually, scientists say they believe an animal is extinct when no one has seen it for a while. When this happens, scientists often begin an expedition to see if they can find the animal in its natural habitat or where the last living one was seen. If they are unable to find the animal after years of searching, they consider it extinct. Sometimes, however, a supposedly extinct animal will turn up again in a different place. For example, the **Blackburn's sphinx moth** (*Manduca blackburni*) was thought to be extinct, because it could not be found in any of its normal habitats. However, in 1984, a small population of this moth was found on a Hawaiian island.

The **Miami blue butterfly** (*Hemiargus thomasi*) is another example of an extinction error. Everyone thought that this butterfly became extinct after Hurricane Andrew wiped out the last known group of the butterflies. In 1999, however, a person interested in butterflies found a whole colony of them in the Florida Keys.

The **Takahe** (tuh kah' ee) was also once thought to be extinct. This bird (its scientific name is *Notornis mantelli*) once thrived in New Zealand. However, in the 1800s, settlers brought red deer to New Zealand, and the deer began eating the grass that was the Takahe's main food source. Also, weasels were brought in to try to control the rat population, and the weasels began eating Takahe eggs. By 1900, it was thought that the Takahe population had been wiped out. However, nearly fifty years later, someone found a group of them living on a remote island off New Zealand. Maybe you will one day rediscover a bird or insect that is currently thought to be extinct!

This is a photo of a Takahe, which was once thought to be extinct.

What Do You Remember?

Explain what you learned about animals and habitats. What is instinct? Can you think of any animal instincts? Explain what you learned about extinction. What is one reason the dinosaurs may have become extinct?

Notebook Activities

Write down all that you remember about habitats, instinct, and extinction. You may also want to include some illustrations (drawings) for this part of your notebook.

Older Students: Scientists often classify animal habitats just like they classify the animals themselves. The largest category in habitat classification is called a **biome** (bye' ohm). Most scientists recognize five basics kinds of biomes on earth. Learn about these five kinds of biomes, their environment, and the animal life found in each. Make a separate notebook page for each biome, illustrating each with the animals. The course website I mentioned in the introduction to this book has links to information on these biomes.

Make a Field Notebook

You are going to make a notebook for when you are out in the field (that means outdoors studying nature). You will draw and write down your observations about the wildlife you see in nature. This notebook needs to be lightweight and small enough to fold and put in your pocket to take on hikes and other outdoor journeys. You can buy nature journals, but they are usually expensive and bulky. Making one is a simple process, and when you use all the pages, you can just make a new one.

You will need:

- Several sheets of plain white paper
- One sheet of thicker, colored paper (such as construction paper) or a thick decorative paper like you would find in a scrapbook store
- A long-arm stapler (If you don't have one, you can go to an office supply store or copy center and use theirs. They might charge you a small fee, but most places allow you to use it for free.)

To make your field notebook, follow the steps below. If they don't make sense to you, look at the pictures on the next page.

1. Put the plain white sheets of paper into a pile.
2. Place the thicker, colored paper on the bottom of the pile.
3. Make a neat pile out of all of the papers, and turn it over so that the colored page is now on top.

4. Once again, make the pile neat.
5. Use a long-arm stapler to staple the pages together right in the middle. Put one staple close to the bottom, another near the middle, and another near the top.
6. Fold the papers right along the staples.
7. Now you have a field notebook that you can carry with you whenever you are outside!



Project
Nature Scavenger Hunt

Nature walks are wonderful and fun. The more often you do it, the more you will enjoy it. You will also begin to notice things you've never noticed before. The more you learn about nature in this book, the more you will know what to look for when you are outdoors.

Today, you will plan an outdoor adventure somewhere that has a natural environment. Parks that allow foliage to grow, fields, or forests are perfect. Be certain the place you choose is not private property. Parks, public land, or nature preserves are best. Read the scavenger hunt list on the next page; it lists things that I want you to find. You will probably not be able to find *all* the things on this list. In fact, it would be very unusual for everything to be in one habitat. However, you will use this list whenever you go out on nature walks. Each time, you will look for the things on this list. When, or if, you find them all, have a parent email me, and I will add your name to the Scavenger Hunt Winner's list on the course website I mentioned in the introduction to this book. In order to be added to the list, you must find the items from this day forward. No items found before today can count towards your total. Of course, if you found something once, you can probably find it again! You may want to print the Scavenger Hunt List and staple it into your field notebook so that you always have it while you are out studying nature.

Scavenger Hunt List

- ☐ Three feathers found on the ground (To keep any feather, it must be from a game bird like a duck, goose, pheasant, chicken, dove, etc. Many other birds are protected as endangered species, and it is illegal to keep their feathers.)
- ☐ A bird with red coloring on it
- ☐ A bird with blue coloring on it
- ☐ A bird's nest (Do not take it home.)
- ☐ A hole in a tree high above the ground
- ☐ A bird soaring through the air
- ☐ A flock of birds
- ☐ A beetle
- ☐ An ant hill
- ☐ A bumblebee
- ☐ A butterfly with yellow colors
- ☐ A butterfly with brown colors
- ☐ A butterfly with orange colors
- ☐ A butterfly that is mostly white
- ☐ A caterpillar (This is the young version of a moth or butterfly.)
- ☐ A bird egg shell on the ground (best found in spring or early summer)
- ☐ A type of bird (other than a duck or goose) that is using water in some way
- ☐ A bat flying through the sky (Look for bats in the evening around dusk.)
- ☐ The sound of a bird singing (See if you can find it by following its sound.)
- ☐ The sound of a woodpecker drumming
- ☐ A grasshopper that has wings and can fly (best found in late summer)
- ☐ A bird carrying food or nesting material
- ☐ A praying mantis or one of its egg cases
- ☐ The cocoon of a moth or the chrysalis of a butterfly
- ☐ An insect or cocoon wrapped inside a leaf
- ☐ A dragonfly
- ☐ A Japanese beetle or June beetle
- ☐ A leaf with eggs laid on the underside
- ☐ A leaf with eggs laid on the upper side
- ☐ A gall (an unusual growth) on a leaf or a plant (oak leaves and branches commonly have them)

For those of you living in Arizona or other desert regions, a different scavenger hunt is available on the course website that I mentioned in the introduction to this book.

A Note about Bird Names

As you go through this course, you will find the names of many different species of birds. Interestingly enough, those who study birds (ornithologists) do not follow the rules that other biologists follow when it comes to the *common* (non scientific) names of bird species. In all other areas of biology, the common name of a species is not capitalized unless it contains a proper noun. Thus, "moon snail" is not capitalized, but the first word of "African elephant" is capitalized. In ornithology, however, common species names *are* capitalized. In this book, then, you will find the common species names for birds capitalized, but the common species names for all other creatures not capitalized. Of course, even ornithologists follow the rules for binomial (scientific) names, capitalizing the genus name and not capitalizing the species name.