2: What Next?

"Okay," says your mom, "it's time for science." What will happen next? Will you get out a book and sit on the couch to read it for 45 minutes? If so, you probably don't like science. Now please don't misunderstand—reading can be fun and exciting. But I've read a lot of science books, and, believe me, it can be the most boring experience that a kid (or a grown-up) ever had.

When we "do science" we want to do more than read, memorize and take tests. We want to do more than just melt into the couch with our book. We want to EXPLORE! We want our minds to go places that we can't go in our bodies. We want to search the planets, the stars, our galaxy, and the outer reaches of the universe for answers to questions.

But not all our questions are to be answered by looking at things larger than ourselves. Some of the answers are to be found by looking at the small grain of sand, the tiny particles within the grains or the microscopic plants and animals stuck to them. Do you know that there are more living creatures in a single **gram** (about the weight of a paper clip) of rich garden soil than there are people living in the United States? These are the kinds of fascinating things I want you to experience. In the meantime, you'll learn a lot of important things—things you'll use over and over again throughout your lifetime.

Bacteria are tiny living things that live on the skin, inside the mouth and intestines, and throughout our environment. They feed mostly on dead matter. Most are harmless or even beneficial, but there are a few of them that cause diseases.

I also want you to learn about us. What are we made of? How do my lungs work? What happens to that leg of chicken after I swallow it? Are there other tiny creatures living inside me? *What are they eating?*

Just as importantly, or even more importantly, a good science book will help you understand *relationships*. Is there really a relationship between the stars and me? If so, what kind of a relationship do we have? What can I learn about God or any of his created things by looking into the telescope or microscope? How can I help other people through a study of science?

These are the questions that make people decide they love **nature**. Space, heavenly bodies, living things, tiny particles—all of these things are topics in the *study of nature*, which we call **science**. Because of your fascination and excitement about these things, some of you will decide that you want to be scientists some day.

But you don't have to be a scientist to be excited about nature and to enjoy studying it and appreciating it as God's gift to us. Please join me on this great adventure of exploration and appreciation of nature's fascinations.

The Colors of the Universe

If you haven't noticed by now, you are taking a science course that we called ***The Colors***. Why is it called ***The Colors***? Good question! It's because science is easier to study if we divide it into different topics. To help you remember those topics, we assigned colors to them.

Whenever you see a red dot in this book or a red block that has information in it, it's because we are studying the subject of **physics**; if you see the color yellow, the subject for that day is **chemistry**; if you see a blue dot we are discussing **biology**. These are the three largest, most important subjects in science. We call them **basic sciences** or **pure sciences**. Every science subject, every college science course and every job in science can be connected to one, two, or all three of these topics. In the next few paragraphs, I'd like to describe them to you.

Physics (Red)

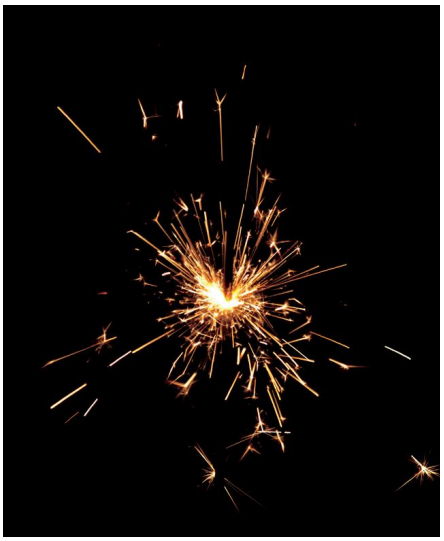
When you get to high school, I hope you will consider taking a class in physics. **Physics** is the study of the simplest things in the universe. Go ahead and ask—if they are that simple then why do we have to study them? Well you see, it's precisely *because* they are so simple that we *need* to study them. If you want to understand anything complex, you have to understand the simple stuff first. I'm going to start teaching you the simple stuff now so that, when you get to high school and college, you'll have all the information you need to understand the not-so-simple stuff.

Even though I say physics is simple stuff, don't be fooled. I don't mean that it will always be easy. When we say *simple* in physics we mean **basic**. We mean something that is uncomplicated (like mass, weight, simple motions, simple machines, etc.) so that the complicated stuff (such as the weather, environment or complex machines) can be understood to be a number of these simple principles acting together.

In physics we will study **forces**, **energy**, **matter** and **motion**. If you don't know what these words mean yet, don't worry—I'll teach them to you. But these are the simple, basic things in nature. That's why we study them in physics.

Chemistry (Yellow)

I know you. At your age I was just like you. I wanted to experiment by putting different kinds of things (**substances**) together at random to see what might come of them. Just as fun would be some kind of chemical reaction that I could use to play a trick on my friends.



A sparkler is a fine example of a chemical reaction. It is made up of a metal that can oxidize, such as aluminum or titanium, a strong oxidizer, such as potassium nitrate, and a combustible binder, such as nitrocellulose.

I'm afraid you'll never understand how these things happen or be able to do them well if you don't understand chemistry. Chemistry describes the kinds of processes that make two things explode when you put them together. Now, because I have training in chemistry, I can safely make an explosion without killing anyone.

Okay, so chemistry has to do with explosions and practical tricks, but just what *is* it? **Chemistry** is the science of substances. It's a study of the properties of different "kinds of stuff" and how they behave, both alone and when they are put together with other kinds of stuff.

The only reason chemicals do anything at all when they are placed together is because of the forces that you will learn about in physics. And the only reason explosions explode is because of energy, which you also learn about in physics. So, you see, you won't really understand *why* chemistry does what it does unless you understand some physics.

You will be doing some chemistry in your schooling, but you will come to understand it because you are learning your physics too. Anytime you see a yellow dot or block, you will be studying chemistry. And, yes, you will be allowed to mix some chemicals together. You might even get a reaction that you can use to play a trick on your friends (all in good time).

Biology (Blue)

When you get to high school, you will almost certainly take a class in biology. What will you study in that class? **Biology** is a study of *living* things. Even though living things (we call them **organisms**) are very complex, they can be best understood by breaking them down into simpler parts. Organisms are plants, animals, and also tiny creatures (*microbes*) that are too small to see without a microscope.

In biology we are interested in living things while they are yet alive, but also after they are dead. An example might be the dead leaves that fall from trees. They are made of the same

things that living things are made of. They may still have about the same shape that they had before they died. But because they are much more organized than ordinary, non-living chemicals we have to think of them as biological.

Things that are made by living things are also thought of as biological, even if they are not alive. For example, sometimes you see the outside shell ("exoskeleton") of a cicada clinging to a tree trunk. (A cicada is the insect that makes that loud buzz from the treetops in the summertime.) Even though that exoskeleton is not living, it is still thought to be *biological* because it was made by something living. It is still correct to consider it biological even though the insect that made it is long gone.


Cicada pupa exoskeleton

The **chrysalis** of a butterfly is biological because it is made by a living insect, just as the web of the spider is biological because it is made from spider "goop." Even the waste material you have to clean from the bottom of your fish tank is biological, because it started out as a living thing (whatever the fish ate) and is processed in the fish's gut by the fish and by the bacteria that live in there.


Chrysalis

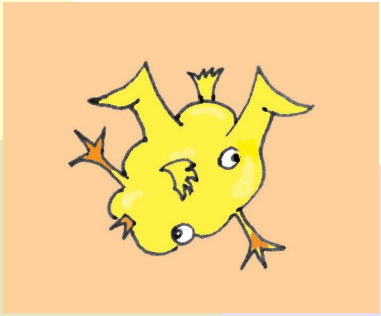
Hair and toenails are biological, although they are dead. That's because they are made of once-living cells which have since died and become filled with tough protein. (We will not refer to non-living things, such as rocks or clouds, as *dead* if they were never alive to begin with.) On this page there is a close-up picture of a hair. I decided not to put in a picture of my toenails. (You're welcome.)


Web of a funnel-web spider


Hair Shaft 400X

The flour you cook with is ground up from wheat (a living, grassy plant). Is it biological? Yep!

Where do eggs come from? From chickens. Are chickens alive? Yes. Are scrambled eggs biological? Yes. Scrambling them doesn't stop them from being biological.



Do scrambled eggs come from scrambled chickens?

To understand organisms, you have to understand the chemicals from which they are made. You also have to understand the reactions that take place in organisms that keep them alive. In other words, if you want to understand organisms, you need to know some chemistry. We already said that if you want to understand chemistry, you have to understand the physics that make chemicals do what they do. Therefore, you can't possibly hope to understand organisms if you do not first know some basic physics *and* chemistry.

Anytime you see a blue dot on a lesson or a blue box with questions in it, you will know that you are studying biology. In those lessons, we will be talking about organisms.

As you go through this book and your lab book, you will be doing lessons in physics, chemistry and biology. There are also some lessons that involve more than one of these sciences or all three of them at once. There will be some math, logical thinking and other exercises that will help you on your way to speak the language and learn the discipline of science.

To remind you what kind of lesson you are working on, you can simply slide the left-hand book pages a little to the right and uncover the color codes found inside the front cover of the book. They'll tell you what kind of lesson to expect until you have been doing this long enough to remember the colors on your own. For example, for your next few textbook days, you'll be doing General Science lessons. Those lessons apply to all the different branches of science equally well.