SCIENCE **UNSNARLED**

Video Workshop Transcript

Welcome to *Science Unsnarled!* I'm Janice Price, one of Rainbow's team of consultants. As far as I'm concerned, this workshop could have been called Snarling Science. You see, I'm *Experimentally Challenged*. I have NEVER wanted to dissect a cow's eyeball at my kitchen table. Nor have I wanted to simulate an erupting volcano by mixing baking soda and vinegar. In fact, I'm almost positive that dissecting eyeballs, building volcanoes, and all sorts of other ooey, gooey science experiments were NOT in my job description when I signed my homeschooling contract years ago.

I have to admit that I'm not 100% convinced that you really need to do experiments in order to learn science. And yet, as a homeschool mom the expectations for experiments remained—and those expectations meant that science was my most feared homeschool subject. (We all have one of those, don't we?)

I suppose some people don't like doing labs because they just don't like science. But that's not me. I love science topics—find them fascinating, in fact. I just don't like the mess. I don't like the irritation and frustration of trying to gather the stuff for experiments. I don't feel confident or competent. I suppose I'm afraid that they won't come out right.

Fortunately, others are not like me. Donna, another of Rainbow's consultants, taught science in a small Christian school. Donna gets very excited at the prospect of investigative science. In fact, she's put together a science workshop called Bring Out the Scientist in Your Child where she enthusiastically introduces various experiments and scientific activities and talks about the importance of having a positive attitude toward science.

Deanne, another of our consultants, was a nurse who hated science in school. As a homeschool mom, however, she found she loved nature studies and ultimately fell in love with science after hearing Dr. Jay Wile speak at a homeschooling convention.

Sara, our newest consultant was a public school French teacher. Science was not her strong point; she took only the classes she had to take. Sara does not like body science, or cutting anything up, but she does like to garden.

Which one of us do you identify with? Do you have a fully developed plan for how you want to approach science in your homeschool? Or is contemplating the subject a little like staring at a pile of hopelessly tangled electrical cords? We're going to work at that pile of cords, one tangle at a time, until we have each cord straightened out and a sense of how all the different aspects of science fit together. We'll look first at how science curriculum is organized and what is expected of homeschoolers in terms of preparing their students in this area.

Then we'll examine how you nurture a scientifically enthusiastic atmosphere in your homeschool. Don't worry, I have some solutions for those of you who are like me and don't want the mess of all those science labs. We'll talk about those next. Then to tie everything together we'll look again at our FAMILY factors and how they affect our choice of science curriculum.

Science education wasn't standardized in the public schools until the 1890s. It was just a scatter of subjects. I suppose that's why there's no mention of science subjects in our old-fashioned notion of readin', 'ritin', and 'rithmetic. An elementary science focus on natural phenomena—otherwise known as studying nature—gradually grew into coverage of a wide array of topics from the major branches of science: life science, earth science, physical science, and later, chemistry. "In-the-field" experiments, things like watching caterpillars become butterflies or tadpoles become frogs, are found in many classrooms and science books include suggested experiments and experiences.

Secondary science provides more focus on lab work including experiments that are consistent among curricula. There is a heavy emphasis on teaching facts and principles and on college prep. A current trend incorporates technology and "issues" such as environmental education.

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In many US states, K-12 educators must adhere to rigid standards or frameworks of what content must be taught to which age groups. Unfortunately, this often leads teachers to just "cover" the material, without truly "teaching" science. In addition, the process of science, including such elements as the scientific method and critical thinking, is often just plain overlooked. This emphasis on standards tends to produce students who pass standardized tests, but without ever having developed complex problem solving skills.

What to do about physics is one science education dilemma. Fewer and fewer high school students are taking physics, largely because many states only require 3 science credits for graduation – and these usually are satisfied by earth and space science, biology, and chemistry. However, the lack of physics makes it harder for students to take scientific courses in college.

Recently colleges and universities have upgraded their expectations for 9th grade physical science. High schools are now requiring their college-bound 9th grade students to take a course that includes introductory physics education combined with introductory chemistry. This is meant to enrich a students' understanding of both physics and chemistry, and allow for more detail to be taught in 10th grade biology and in 11th grade chemistry; it also aims to increase the number of students who go on to take 12th grade physics or AP science courses. AP courses are becoming "routine" expectations for students pursuing a math or science career path.

Interestingly, A Beka and Bob Jones, which is curricula widely used by private Christian schools and homeschoolers, has used this 9th grade physical science scope and sequence for years.

So what does all this mean for us in our homeschools? First of all, as always, we should be aware of what our state requires of us. Secondly, we should have an understanding of how the curriculum we choose interacts with those requirements. But the bottom line is that the actual "standards"—particularly at the elementary levels—are usually easily met with inexpensive workbooks like *Spectrum Science* which leaves us free to develop whatever approach we want towards real science education.

You, as a parent, play an important role in the process of homeschool science. The way you feel about a topic is reflected in the way you teach it or present it. If science isn't the love of your life, or if you're like me and are experimentally challenged, let it be a well-kept secret. Identify your particular challenge, find a solution, and work toward generating a positive attitude.

Science is nothing more than being aware of the world around you and then thinking about it. Science is literally all around us. We really can't separate science from our lives. It's exciting to think about:

—the *way* things work
—*why* they work,
—*who* thought of them
—*why* did they think of that?

Try to look at everything and ask questions! We need to model and teach this to our children. When our children are little they ask questions all the time and we don't think they'll ever stop. You probably know the old saying, "We spend the first 2 years of our children's life teaching them to walk and talk and spend the rest of their lives telling them to be quiet and sit down!" Sometimes we put too much effort into that and should try to be more like a three-year old. Teach your children to be investigative science reporters. And remember, there should always be another question.

We all know that Thomas Alva Edison was a great inventor. Did you know that he was also homeschooled? His inventions came from experiments in his science lessons and then explorations he later did on his own. He asked questions—lots of questions—and tried out his ideas in a lab in the basement of his home. (I'm guessing his mom was not experimentally challenged.)

We know that he invented the light bulb so we assume that he was always successful. Not so! Many of Edison's experiments were highly unsuccessful. He blew up and burned down two different labs. But, he never gave up! Was he a failure? Do you know anyone who would think that now?

In addition to teaching our children to ask questions, we need to teach them to observe. Watch the way things move and what they do. These things make them unique. Elephants move completely differently from worms but what makes them move the way they do?

What are some things you can do in your home to develop observation skills? How about watching an ant or worm farm? Or keeping bird feeders and houses? Growing frogs from tadpoles… Keeping a fish tank or a more exotic habitat for ladybugs, or praying mantis… Raising "sea monkeys" (or "triops," as they're called now).

Scientists spend hours observing even the tiniest changes or movements in microscopic creatures. Some things are hard to observe, like wind, air, sound waves, light waves. In these cases we observe the effects of those things. We can watch how the tops of trees bend or how a flag waves. We can see the effects of wind damage after a tornado.

Teaching your children to observe the world around them—and, of course, to ask questions is a great start. But you're likely to find that just looking won't be enough. Let them take things apart to see what they look like.

When something stops working, let your children take it apart. After all, it's not like they're going to damage it. You can even step up the learning a notch by having them research what the components are and the function of each. Although we'll talk more about research possibilities in a little while, now I'll just mention that the *New Way Things Work* is a great resource.

If the idea of "de-structing" something doesn't appeal to you, you can encourage your kids to build things! Items like paper towel and toilet paper tubes, milk jugs, and empty canisters are all items that can be used to build and create. Children can also use kits to build things. *Legos, K-Nex,* erector sets, *Lincoln Logs*… They're not just fun, they're educational as well! Toys like these help students understand the laws of physics, simple machines, structural principles, and a host of other science concepts.

When your child shows an interest in a subject, make sure there are materials available so they can research that topic and expand their interest: reference books like the *Handbook of Nature Study*, *Kingfisher Science Encyclopedia* or the *Usborne Book of Science*, or if you want a biblical worldview—the *World of Science*.

Keep other things handy too: magnifying glasses, field guides, etc. bug boxes and viewers .

You'll probably also want to keep a sketch pad available for drawing and recording details on critters your child finds or is interested in. Or something like the *Wonders of Nature Sketchbook*. This gives them a starting point for more investigations. And if your child is not "artsy"? Use a digital camera to photograph the animal. Print the picture and glue it into the notebook.

You don't know where these childhood hobbies and interests can lead. Werner Von Braun was interested in rockets as a child. He fixed up his wagon with fireworks and rocketed through the streets in his neighborhood. And look where that start propelled him—he's known as the Father of Modern Rocketry.

Research on any science topic should include a look at what other people have to say. There are good books—such as the *Story of Inventions*—written about scientists and their inventions. There are also books about various science subjects. You can often find these at garage sales, library sales, or used curriculum sales—not to mention on the Rainbow website or in our catalog.

There are also some great science videos available. For the younger crowd, we carry *Little Hardhats*, *Magic School Bus*, *Eyewitness Science*, and *Go Science!* as well as the *Standard Deviants* series for older students. From Christian publishers we have the *Wonders of God's Creation* and the *Moody Science* videos. PBS as well as the Discovery and History channels offer videos which are available from libraries or Netflix.

As we talk about observing, asking questions, and researching, that brings us to the dreaded (at least by me) L-word—LABS! But labs, demonstrations, and explorations are just an extension of the activities we've been talking about. If labs are your "thing" and you enjoy everything about them, then fast-forward through this next section. However, if you are like me even a little bit—for whatever reason, then you'll want to know about my four solutions for dealing with science labs.

Solution #1: Recognize that you do not *have* to do experiments.

Why do we assume that experiments or investigations or observations MUST be part of any science study? Why can't we just read about the scientific method? After all, at the introductory level, we're not really investigating situations where the results are not known. Why can't we just look at pictures? With so many resources at our disposal why can't we just rely on the internet or videos?

The bottom line is that WE CAN. Just realizing this, by itself, can be very freeing. I have a friend who homeschooled five children and never did a single experiment at home. And what do you know? Three of those five children went into science-related fields at the college level. Go figure! Although state requirements vary, labs are typically only required at the high school level and sometimes not even then. That leaves many, many years when you do not HAVE to do experiments. Now, my friend's children did do high school labs—we'll talk about her approach to that later.

First of all, you can "do" your science as reading courses:

- *Bob Jones* or *Houghton-Mifflin Science* or the *Apologia* elementary science series are good, solid texts that you can use as reading texts—and continue reading right through the experiments and activities. It's not the way the courses are designed but they do provide solid information.
- When children are very young, you can use the *Nature Readers* or a Charlotte Mason style nature study—like those found in *Pocketful of Pinecones*.
- Another idea for early elementary children is to approach science as an extension of their reading practice. There are wonderful series—like the *Let's Read and Find Out* series—that are grade-level readers on science topics.
- You can also take a Literature Approach to Science—either the *History of Science* course from Beautiful Feet, the *Story of Science* by Joy Hakim, or your own collection of biographies and living books can provide an interesting historical perspective to science.

Even high school level courses can be approached this way. Some high school science curricula—like those from *Paradigm Accelerated* or *Starline Press*—require very few experiments and are designed to be mostly reading courses.

Others—like *Lifepacs & SOS*, *Science Shepherd*, and *Apologia* have lab and/or lecture videos to supplement the courses—while others like *Biology 101* and *Chemistry 101* are essentially a video course plus outside reading.

The first solution, then, is to recognize that you do not HAVE to do science experiments in order to study science. However, that means you will miss out on some exciting life experiences.

Most science courses are designed to include experiments. So, why? What are the reasons for doing hands-on science labs?

- Sometimes experiments are used to introduce a lesson or to teach and demonstrate a concept.
- Sometimes experiments provide clarification of a concept. For some students, reading and hearing the information is just not enough—they need a visual.
- Sometimes experiments are used to grab the attention of the audience. They intrigue the student. They generate questions.
- Sometimes, it's to model the scientific method. Or perhaps a better way to look at is to train students in the scientific method. It's the method, after all, that leads to new ideas, new inventions, new patents, new ways of looking at our world. The scientific method is: ask a question; form a hypothesis (figure out what you think will happen.); test your hypothesis (see what really happens); collect data; form a conclusion; and then, ask again.

Sometimes experiments are done Just For Fun! If you keep some of those reasons in mind, instead of eliminating or ignoring experiments, you might decide to utilize…

Solution #2: Loosen up! Realize that you can do experiments with an investigative, questioning attitude—just for fun.

Doing science experiments doesn't necessarily have to fit neatly into a course of study—they can be done just to question, just to think, just to generate interest. There are lots of good resources for simple experiments that utilize household items—*Janice Van Cleave's Spectacular Science Projects* or *Science for Every Kid* series, for instance. *Real Science 4 Kids* has a new series along these lines called *21 Super Simple Experiments*.

What if an investigation or a lab doesn't do what you think it should? Has it failed? Are you like me and afraid of such failures? The truth is that even a "failed" experiment can provide lots of good information and serve as a catalyst for other investigations. Dr. Keller, author of *Real Science 4 Kids*, offers this perspective: "There are no failed experiments, only unexpected outcomes."

Do you worry about how to answer all the questions? Are you concerned that a question may come up and you won't know the answer? If being uncertain of your information and uncomfortable with not knowing the answers is a major reason for your being Experimentally Challenged, maybe you'll be more comfortable with…

Solution #3: Do whatever you need to do to "manage" your experiments.

First of all, you can use homeschool-friendly courses that are well laid out, give complete instructions for the activities/experiments, and use easy-to-obtain household items:

- *Apologia* Courses
- Gravitas *Real Science 4 Kids*
- *Science Odyssey*
- *God's Design for Science* series

Secondly, complete equipment and supply kits are available for some courses like the—*Reason for Science* grade specific courses as well as the *Apologia* and *Science Shepherd* courses.

Lastly, you can use software, science kits and models. Kits sometimes give kids the confidence to try something they wouldn't try on their own:

- *Young Scientist's Club*
- *Magic School Bus*
- *Science Wiz*
- *Home Science Adventures*

But If you just can't muster up any enthusiasm for science labs, then you might want to take…

Solution #4: Locate and utilize alternative sources of scientific enthusiasm.

Your mission (and it's not an impossible one) is to find someone like Donna who is willing to teach a class or tutor your child.

In homeschool co-ops, science is usually taught by a mom who LOVES science and often is trained in scientific method. Our very first co-op experience was just four families. We did several types of things including art but one mom loved to do science experiments, and I quickly realized this was a way to remove ooey, gooey messes from my home.

Not surprising, then, my family was part of a co-op that had various science classes and ultimately at the high school level provided labs for the Apologia courses. Be warned, though, you will probably need to be prepared to make a co-op contribution in some other area.

Enrichment classes are similar to co-ops but they usually have an enrollment fee rather than work contribution. These classes tend to be taught by an enthusiastic and trained *someone* who is compensated. This was the approach my friend took toward high school sciences. Ultimately, your student can take community college courses, and those will provide labs.

Be on the lookout for other local resources. Check local museums and nature centers for classes. Find people in your community who have special interests or hobbies.

Our pastor's wife—who had been trained as a lab technician—taught my oldest daughter her biology labs. She even had her own microscope.

One gentleman has a high-powered telescope and lets students and adults come to his home for viewings. He is very knowledgeable and has the students step out a scale model of the solar system before it gets dark. After dark he points out constellations, solar systems, planets and moons. The adults enjoy this as much as the students.

Another gentleman has a hobby of building model airplanes. He has developed a workshop to use with boy scouts, girl scouts, church groups, and home school groups. One of the things he does is help the kids build the perfect paper airplane.

There are many science-related places within driving distance of most of our homes. Keep a folder of possible ideas for field trips. That way you have the information when you get ready for a trip. Pick up flyers from different locations. Get a visitor's guide for your area or the area you plan to visit. Check with your friends to see where they like to go. Many times you'll know if it is somewhere you want to go by getting first hand information from someone who's been there.

We've done quite a bit of cord unsnarling, don't you think? We've looked at state laws and requirements. We talked about how to develop an investigative, science-sensitive environment in our homes. We've considered the different options for overcoming our fear of—or distaste for—science labs.

Let's turn now to our last cord: the FAMILY factors. These factors—faith, approaches, money, individuals, life, and you—are what make your family unique. You need to find science curriculum that FITS your family in these areas.

So far in this workshop I've spent quite a bit of time talking about the "Y" portion of our FAMILY factors—You—particularly as it relates to science labs and your attitude toward science. Let's take a look at some of the other factors and how they impact your science curriculum choices.

"F"—FAMILY—Faith

Science is one curriculum area where the worldview of the publisher/author can make a significant difference. Christian publishers, at least in terms of homeschool curriculum, will typically assume the fact of a six, twenty-four hour day creation (in other words, a young earth). They will typically also assume catastrophism (in other words, the effects of a world-wide flood). Secular publishers or authors will often write from the perspective of assuming Big Bang and evolution to be a proven fact (in other words an earth that is billions and billions of years old). Other politically correct topics such as sex education and environmental awareness will sometimes show up as well. Some publishers—both Christian and secular—will cover science from a neutral perspective. In other words, they will focus on the observable facts and not present information that is based either on creationism or evolutionism.

Our science comparison charts label the various curriculum products that Rainbow carries as Bible-Based, Secular, or Neutral. The biblically-based science curriculum are on one chart. The secular chart includes both secular and neutral curricula. These charts can be found on our website by searching for "comparison charts."

Be aware of the worldview of your material. Although, kids can glean good information from material published by either perspective, many parents will preview the material before allowing children, especially young children, to read or watch. Deciding how to handle materials from a worldview different than your own is a personal decision – some choose to read and discuss the opposite point of view—especially with older children—and others choose to not use materials that are out of sync with their own beliefs.

"A"—FAMILY—Approaches

In terms of science, each approach has some specific characteristics.

With Traditional Textbooks, elementary levels are usually intended for use with a single grade level and tend to cover selected topics from each branch of science—life science, physical science, chemistry, and earth & space science—during the year. These tend to also be grade-level readers so the amount of detail is limited. Over the course of six years, most of the basic topics in each branch have been covered but each is covered without a great deal of depth.

Middle school science will typically become science branch studies: one year for life science; one for earth and space; one for physical science. The entire year is spent on a single branch and coverage is more in-depth. These courses are also important because they are preparing the student for high school science and they have an emphasis on scientific method—observing, recording, etc.

High school science courses include biology, chemistry, and physics starting in 9th grade. Sometimes a general science or physical science will be done in 9th grade with biology starting in 10th grade. *Apologia*—in so many ways a blessing to homeschoolers—also provides advanced courses in each of these areas. However, it's always important to make sure we're comparing apples with apples. Most high school biology courses include a section on human anatomy but *Apologia* does not, preferring to expand that content into a separate advanced biology course, *Human Body: Fearfully and Wonderfully Made*.

Traditional textbook courses that are intended for classrooms – like *Bob Jones*, *Abeka*, and *Holt*—have been difficult to do at home as lab sciences. Lab equipment and supplies have been hard to find and/or expensive. *Apologia* was the first series of college-prep high school science courses that were user-friendly for homeschoolers. *Apologia* labs were do-able at home or in a local homeschool co-op. Although some equipment is typically necessary, it's kept to a minimum. Other homeschool-friendly courses, like *Science Shepherd*, are now becoming available.

The Charlotte Mason approach focuses on nature studies or living book approaches—especially at the elementary level, although the *Discovering Nature* series from Queen Homeschool continues into high school subjects. *Apologia's* elementary series takes a Charlotte Mason approach: in depth studies, narration, notebook work, activity, and projects. Notebooking journals and lapbook options are supplementary.

Science-based unit studies such as the Amanda Bennett *Oceans* study relates the science topics back to other subjects. Also, literature-based unit studies such as *Five in a Row* or *Prairie Primer* will cover science as part of their studies.

Classical approaches science in a hands-on, investigative, exploratory manner. Interestingly however, Susan Wise Bauer does not recommend experiments in the grammar stage as it may be too frustrating. She also recommends that the sciences be studied in a four-year pattern that roughly corresponds to the periods of scientific discovery: biology, classification and the human body (subjects known to the ancients); earth science and basic astronomy (which flowered during the early Renaissance); chemistry (which came into its own during the early modern period); and then basic physics and computer science (very modern subjects). This approach provides continuity between history, humanities and science in a classical home.

There are beginning to be some science curricula developed specifically with classical learning models in mind. *Elemental Science*, *Classiquest Science*, and *Memoria Press* science are classical in approach.

"M"—FAMILY—Money

Money concerns for science are similar as for other subjects. Complete programs will be more expensive but if you have several children and can replace consumable components it cuts the cost per child.

In general whether or not a program is consumable or non-consumable is important. Non-consumable just means that when you are done with the program it is still useable—for another child or to be sold.

Another consideration under the money heading is whether or not a program can be used by multiple ages. In other words, can you use the same program at the same time for all (or most) of the children in your family. This can make science programs more affordable and is very doable—particularly in the elementary and middle school years. It becomes harder with the high school courses. Unit Study and Charlotte Mason both lend themselves towards multi-age studies.

High School science is expensive. Biology labs require microscopes and dissection equipment. If you go the route of co-ops or outside classes of some sort, equipment costs might be less but the class itself might be expensive.

We could say quite a lot about microscopes but I'll keep it simple and refer you to our microscope comparison chart (also available on our comparison chart page). Search for "comparison charts" to find this chart.

For elementary purposes, magnification to 100x is about right and scopes should be especially sturdy. *Pocket microscopes*, the *Zorb* digital scope and the *Brock Magiscope* fit into this category.

High school courses require 400x magnification. In addition to the *Apologia* lab kit, we sell Able and Walter microscopes that meet these specs. 1000x magnification is only required for college level courses—or medical and science professions.

An interesting alternative if money is very tight is the Microslide Viewer and slide sets. These provide a lower magnification because the images are photographs of magnified slides.

There are some excellent support materials available for science, particularly high school science. *DIVEs*, *Red Wagon Tutorials*, and the *Apologia* Instructional DVDs all help to make high school science more do-able at home. However, they also add expense. If your children are still young you might want to establish a high school science fund so you'll be better prepared for these expenses as they arise down the road.

On the other hand, elementary science experiments need not be difficult or require expensive science equipment! There are plenty of options that use household items.

"I"—FAMILY—Individuals

Since the individuals in our families are so, well, individual, you may need to take advantage of some of the adaptations that are available with some science courses. *Apologia* offers MP3 audio books of their junior and high school science courses. These are good for auditory learners and struggling readers.

More investigation and less text is often helpful for hands-on learners. Models (like the Cell models), kits and alternative learning methods—like card games, coloring and activity books—are also helpful for some types of learners. Other possibilities include the *For Kids* series, *Inventions You Can Build Yourself*, and the *Milestones in Science* Kits.

And then, of course, there are lapbooks. Lapbooks are available for the *Apologia* courses as well as some general studies and provide a hands-on method of collecting information for review and assessment purposes.

The various educational levels of our children as well as their learning style and abilities will impact our curriculum choices. As we've already talked about, if you have students at the high school level, special planning is involved. If a student is college bound, then make sure you know the requirements for specific fields as well as the entrance requirements for particular colleges or universities. If your student is interested in pursuing a career path in a science or medical field, AP courses are a good idea. Likewise, the stronger the lab experience, the better.

"L"—FAMILY—Life

Almost every homeschool has to make special arrangements for unusual situations at some point. It might be a mid-year pregnancy, or health issues, or a family move. All of these make an impact on how much time you have available to teach science. Deanne started doing nature studies with her children when she was on bed-rest following a surgery. It was something her children could do somewhat independently. Others might choose to use a non-mom-intensive curriculum during these times.

One new idea in science education that fits into this less-mom-intensive category is the *Science Fusion* series. These are complete online courses with accompanying worktexts. The online component is a video lesson that includes simulations, animations, and video demonstrations as well as a teacher management center/student tracking systems that assist the teacher in planning, teaching, assessing, and tracking progress. These are great for students who learn better with a visual/auditory element.

"Y"—FAMILY—You

We've already discussed your approach to labs. There are other considerations under this category.

How much support will you need to teach science? If you are uncomfortable with the subject then you are likely to find yourself choosing curricula that is either scripted (like *McRuffy* science) or allows the student to work somewhat independently—like *Starline*, *Paradigm Accelerated*, *Lifepacs* and *Switched-On-Schoolhouse*. Extra support is also provided with CD-ROMs like the *DIVEs* we mentioned earlier. Simple, usable lesson plans like those available for the *Apologia* courses are also helpful.

The FAMILY factors are designed to help you sort through the 160-some pages of science options that Rainbow provides. If this information seems sketchy, you might benefit from watching Choosing Curriculum the FAMILY Way where we spend much more time on these factors. The goal is to find and choose the science curriculum that will best FIT your family.

We've covered a lot of territory in this workshop. If we haven't completely unsnarled all your science cords, please give us a call and talk to one of us at Rainbow.