Homeschool Science Activity & Video Series

Includes detailed project steps, explanations and key concepts, tips & tricks, and access to instructional videos.

Designed by real scientists for our future generation.

Supercharged Science

www.SuperchargedScience.com

A collection of quick and inexpensive science experiments that work you through electricity, introduce you to chemistry, and present project ideas guaranteed to get your kids excited to do science.

Thank You for purchasing the *Homeschool Science Activity & Video Series.*

I hope you will find it to be both helpful and insightful in sparking young minds in the field of science!

INTRODUCTION

Do you remember your first experience with *real* science? The thrill when something you built yourself actually *worked*? Can you recall a teacher that made a difference for you that changed your life?

First, let me thank you for caring enough about your child to be a homeschool parent. As you know, this is a huge commitment. While, you may not always get the credit you deserve, never doubt that it really does make a difference.

This book has free videos that go with it to show you step-by-step how to do each experiment. You can view the videos at: SuperchargedScience.com/scienceseries.htm

Access code: ESCI

Go to this page now so you can get a preview of the videos.

Think of this activity book as the "Idea Book", meaning that when you see an experiment you really like, just take it and run (along with all its variations). For example, if you find yourself drawn to building your own DC motor, our ideas are just the beginning. Try building your motor in various sizes, with different wire, and so forth. Does the strength of the magnet matter?

A Word About Safety… make sure you work with someone experienced when you're working with new stuff you're unsure about. Just use common sense—If it seems like it could be dangerous, ask for help. **Are you ready?**

Table of Contents

Introduction…………………..………….2
Flying Contraptions………………...4
Squealing Air Horn..……………..…..6
Polarization of Light…………….….8
Homemade DC motor…………….10
Bouncy Ball……………………….….12
Teaching Science Right..………….14

"The future belongs to those that believe in the beauty of their dreams."
~Eleanor Roosevelt

Flying Contraptions

Activity

Mathematically speaking, this particular flying object shouldn't be able to fly. I mean, it doesn't even look like an airplane!

There are endless variations to this project, including changing the size and number of loops. You can even tape two of these together for a double flyer!

Materials

Index card
Straw
Tape
Scissors

Experiment

To start with, watch the video for this experiment at:

SuperchargedScience.com/scienceseries.htm

Access code: ESCI

1. Carefully cut the index card into thirds lengthwise.

2. Take two of the index card strips and tape them end-to end to make one long strip.

3. Take the third strip and form it into a circle and tape it into place.

4. Take the longer strip from step #2 and form it into a ring. Tape it together.

5. Tape one ring onto one end of the straw.

6. Tape the other ring onto the other end of the straw.

7. Hold it small-end-first and give it a good, hard throw. It should sail across the room!

What's Going On?

There are four forces at work with your flying machine.

Gravity is pulling it downward, but air (lift) keeps it up.

The way airplane wings generate lift is by having a curved surface on the top which decreases the air pressure, and since higher pressure pushes, the wing generates lift by moving through the air.

But what about a flat wing?

If you drop a regular sheet of paper, it flutters to the ground. If you wad it up first, you'll find it falls much faster.

The air under the falling paper needs to get out of the way as gravity pulls the paper, which is a lot easier when the paper is wadded into a ball.

For a flat wing (like on a paper airplane) to glide through the air, it needs to be balanced between gravity and the air resistance holding it up. In order for a glider to fly, the center of pressure needs to be behind the center of gravity.

The "center of gravity" is the spot on an object where it balances perfectly on a pencil tip. It's the balance point for the mass of the object.

The "center of pressure" is the balance point in flight: imagine putting the object in a fast stream of air (like floating a ball in the air from a hair dryer).

By placing the pencil tip on the top surface, you can also balance it in the stream. That spot is called the center of pressure, and for every flying object to work, you need to know where both of these are located and which one you want to occur first.

By adding paper clips to a paper airplane, you move the center of gravity and center of pressure around to find the perfect balance.

When we use math to add up the forces (the pull of gravity would be the weight, for example), it works out that there isn't enough lift generated by thrust to overcome the weight and drag. When I say, "mathematically speaking" I mean that the numbers don't work out quite right.

There are a number of 'unsolved' mysteries still in science... maybe you'll be able to help us figure them out?

Questions to Ask

1. Does it matter where the rings are located along the length of the straw?

2. Does it matter how many rings you have?

3. What happens if you throw it backwards?

4. How can you get your flying invention to spin during flight?

Comments about this project from new pilots:

"Fantastic!! Aurora. My son is working on several paper airplaines to see if it makes a difference to use a shorter straw or a thinner paper ring. Great project. Thank you", María Z

"IT WORKS! My boys doubted you! Not anymore…thanks for making science super fun!" Sara W.

"We redid the experiment with a super size drink straw and it FLEW! our index card (4 x 6) was too heavy for a normal straw. That was why it didn't fly the first time. What a great experiment! Mom says that she can't believe she actually made an airplane that flies." Rebekah

"Great experiment. We experimented with the different ways to throw it. My daughter, who is more into art than she is science, is having fun decorating her card pieces with drawings and my son has moved onto experimenting with changing the sizes of the hoops and the length of the straw. He is also going to attach several together to see how they fly." April P.

"I can't believe this!! My mom had alot of fun doing this and so did I." Tara and Linda

"We were out of straws but we had CHOP STICKS and it worked! Ha – great fun – Thanks Aurora! – Mom I REALLY, REALLY, REALLY LIKED IT!" Hannah age 11

"My kids were able to make this all by themselves with me just supervising (They are 7 & 8 years) so they were really impressed that they were able to fly and and figure it out themselves. We only had "bendy" straws so I assumed it wouldn't work, but it did!" Kelli S.

Air Horn

Activity

Molecules are vibrating back and forth at fairly high rates of speed, creating waves. Energy moves from place to place by waves.

Sound energy moves by longitudinal waves (the waves that are like a slinky). The molecules vibrate back and forth, crashing into the molecules next to them, causing them to vibrate, and so on and so forth.

All sounds come from vibrations. In this activity, we will create a vibration that resonates to make a very high-pitched squeal kids around the world will appreciate.

Materials

Straw

Film canister or other small, plastic container with a snap-on lid (M&M containers work well)

Scissors

Balloon

Pen or razor with adult help for making holes in the canister

Experiment

To start with, watch the video for this experiment at:

SuperchargedScience.com/scienceseries.htm

Access code: ESCI

Do be careful with the razor and scissors!

1. Using your pen or razor, make a hole in the bottom of the canister slightly smaller than the straw.
2. Slide the straw into the hole and makes sure that it slides in snugly and does not fall out.
3. Make a hole in the side of the canister (around the middle). Use a razor with adult help.
4. Cut off the neck of the balloon and throw it away.
5. Cut up one side of the balloon so it lays mostly flat on the table. You want a 'sheet' of latex.
6. Stretch the balloon over the open end of the canister and snap on the lid. This is your drum head. It must be tight for this air horn to squeal properly!
7. Insert your straw up through the bottom hole.
8. This is the hard part: Blow in the *side* of the canister through the hole you made *while* you adjust the straw so that the very tip is barely touching the balloon inside.

This is a very delicate adjustment, so take your time!

You know you've got it when the nearest grown-ups cover their ears.

What's Going On?

You should see that the sound is coming from the vibration. As long as the balloon vibrates, you hear a sound. Sound is vibration.

The thinner the balloon or the tighter it's stretched, the faster it vibrates. Another way to say "vibrating faster" is to say higher frequency. In sound, the higher the frequency of vibration, the higher the pitch of the note. The lower the frequency, the lower the pitch of the note.

The average human ear can hear sound at as high a frequency as 20,000 Hz, and as low as 20 Hz. Pianos, guitars, violins and other instruments have strings of various sizes so that they can vibrate at different frequencies and make different pitched sounds.

When you talk or sing, you change the tension of your vocal cords to make different pitches.

What's causing the balloon to vibrate? Energy. Energy causes objects to move a distance against a force. The energy from your breath through the hole is causing the balloon to vibrate.

Your ear drums move in a very similar way to the balloon. Your ear drum is a very thin membrane (like the balloon) that is moved by the energy of the sound. Your ear drum, however, is even more sensitive to sounds than the balloon which is why you can hear sounds when the balloon is not vibrating. If you ear drum doesn't vibrate, you don't hear the sound.

When something vibrates, it pushes particles against a force (creates energy). These pushed particles create longitudinal waves.

If the longitudinal waves have the right frequency and enough energy (loudness), your ear drum antennas will pick it up and your brain will translate the energy into what we call sound.

Questions to Ask

1. Does the length of the straw matter?
2. What happens if you blow through the straw instead?
3. Do you really need the straw?
4. What if you use a water balloon (which is thinner) instead?
5. Does it matter if you use a flexible straw?
6. Will this device work underwater?
7. Can you hear the squeal if you used this in outer space (and you could breathe somehow)?
8. How far away can you hear the sound?
9. Can a young child hear more frequencies than an older adult? Why?

Polarized Light

Activity

Ever notice how bright the moon is during full moon, and how dim it is near new moon? This is a problem for astronomers when using a telescope. The moon is sometimes too bright to look at!

Astronomers use a rotating polarizing filter to adjust the amount of light that enters into their eye.

You and I use polarizers everyday in sunglasses to cut the glare so we can see more detail.

In this activity we're going to twist light using polarizers to reveal colors we didn't see before.

Materials

An old pair of polarized sunglasses—pick one you don't mind putting tape on the lenses. (You can get a cheap pair at drug and grocery stores.)

Clear tape (not milky-white, but see-through *clear*)

Bright, sunny window

Experiment

To start with, watch the video for this experiment at:

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Access code: ESCI

1. Pop out the lenses of your polarizing sunglasses.
2. Stack the lenses, one on top of the other and look through both sets of lenses at a sunny window.
3. Rotate one pair a quarter turn (90°). The lenses should block the light completely at 90° and allow light to pass-through when aligned at 0°. These lenses allow some light to pass through but not all. When you rotate the lenses to 90°, you block out all visible light.

What's Going On?

You use the "filter" principle in the kitchen. When you cook pasta, you use a filter (a strainer) to get the pasta out of the water. That's what the sunglasses are doing – they are filtering out certain types of light.

Rotating the lenses 90° to block out all light is like trying to strain your pasta with a mixing bowl. You don't allow anything to pass through.

Going Further

1. Now place several layers of tape in different directions over one of the lenses (not both).
2. Please one lens on top of the other and rotate—you should see a beautiful rainbow of light as it twists through the polarizing layers!

Polarization has to do with the direction of the light. Think of a white picket fence – the kind that has space between each board. The light can pass through the gaps in the fence but are blocked by the boards. That's exactly what a polarizer does.

When you have *two* polarizers, you can rotate one of the 'fences' a quarter turn so that virtually *no* light can get through – only little bits here and there where the gaps line up.

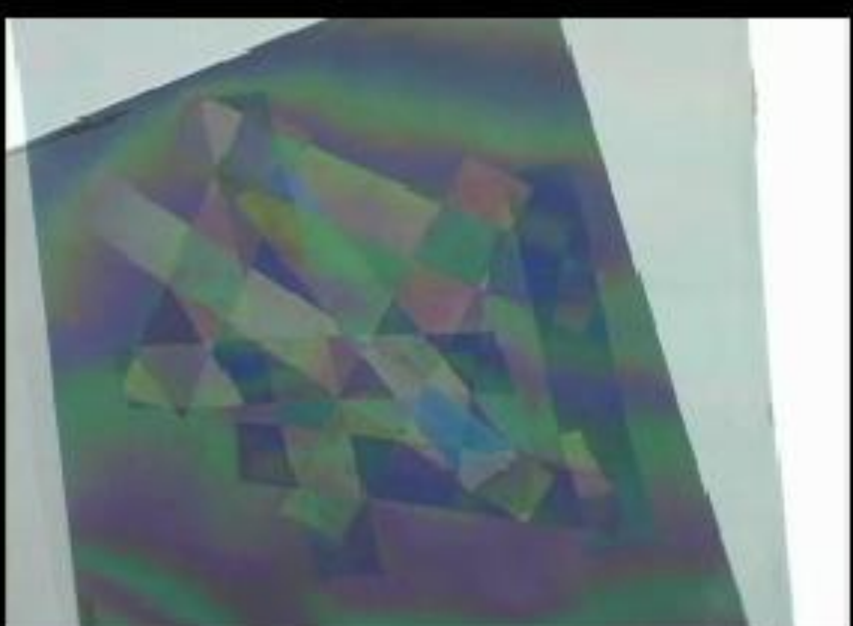
Most of the way is blocked, though, which is what happens when you rotate the two pairs of sunglasses.

Your sunglasses are polarizing filters, meaning that they only let light of a certain direction in. The view through the sunglasses is a bit dimmer, as less photons reach your eyeball.

Polarizing sunglasses also reduce darken the sky, which gives you more contrast between light and dark, sharpening the images. Photographers use polarizing filters to cut out glaring reflections.

Questions to Ask

1. What kinds of tape work best?
2. Does it matter which lens is on top?
3. What if you use a flashlight instead of a sunny window?
4. What if you try other clear objects, like a clear plastic fork, CD jewel case, or cassette tape holder?
5. What if you flex the lens (gently) while viewing?
6. Does it matter how many polarizers you use?
7. What if you use colored light instead of white?



Educational Gift Ideas

Today, a whole range of educationally approved toys and games are available.

Consider these items:

- Giving a subscription to a scientific magazine:
- *Scientific American*
- *Popular Science*
- *Popular Mechanics*
- *MAKE Magazine*
- An easy-to-assemble crystal radio from Radio Shack
- Binoculars (Orion's 10x50 UltraViews are outstanding)
- An aquarium or terrarium
- Chemistry set (C1000 by Thames and Cosmos is the best one on the market)
- A model R/C airplane
- Biography of an inventor like Tesla, Einstein, Franklin, or Edison
- Microscope (Observer IV by GreatScopes is excellent)
- Telescope (a personal favorite is a 6-8 inch Dobsonian from Orion
- A magnifying glass
- Night time star gazing with your local astronomy club
- This guide book!

HOMEMADE DC MOTOR

Activity

Did you know that when you run electricity through a coil of wire, it turns into a magnet? It's called an electromagnet, and it's a special kind of magnet that you can turn on and off.

We're going to make a DC motor that uses the attraction between a permanent magnet and an electromagnet to spin the rotor. Are you ready?

Materials

Magnet
D cell battery
Sandpaper
Rubber band
Two paper clips
Magnet wire (26g works the best: Radio Shack Part #278-1345)
Pliers (to bend the paper clips)

Experiment

To start with, watch the video for this experiment at:

SuperchargedScience.com/scienceseries.htm

Access code: ESCI

1. Start out by winding the magnet wire around a D-cell battery 12-15 times. Coil the wire around the circular loop to keep the wires together. Be sure that the "ears" are straight (see photo below). This is now your 'rotor'.

2. IMPORTANT! Remove the insulation by sanding the entire length of both "ears", flip the rotor over, and sand only one "ear" side, leaving the insulation intact on the side of the remaining "ear".

3. Wrap the rubber band around the battery lengthwise. Untwist a paper clip to make the shape shown:

4. Make two of these paper clip shapes. You can use pliers to help make the shape.

5. Place one end of the paperclip (the left side shown in the photo below) under the rubber band in the center of the each end. The loop on the right end is where the rotor will hang (you can flip it over or bend a bit if it falls out too much.

6. Slide the rotor into the loops.

7. Place the magnet on the battery just under the rotor under the rubber band (you can use an additional rubber band to secure if needed). You want the rotor to be as close to the magnet as possible without hitting it. Give it a spin, and you're off!

Troubleshooting: Usually problems arise when checking the connection between the battery and paper clips. Hold the battery with the fingertips in the center of each battery end and squeeze to make a good connection. If it still fails to spin, check your rotor: one ear should be insulation-free, the other should have a stripe of insulation down its length.

If you're still having trouble, check the ears to be sure they are straight. The rotor needs to be able to spin nicely, so ensure it is well-balanced. Egg-shaped rotors just won't turn.

What's Going On?

Wow! When you run electricity through any wire, it turns slightly into a magnet. When you stack wires on top of each other (as you did with the coil of wire), you multiply this effect and get a bigger magnet.

The coil of wire is the O-shaped ring. When the sanded parts of the "ears" are connected to the paper clip, current flows through the circuit. When this happens, everything connects together and turns the coil wire into an electromagnet, which is then attracted to the magnet on the battery.

When the O-ring rotates, it moves around until the un-sanded portion breaks the connection and turns it back into just a coil of wire. The coil continues to float around in a circle until it hits the sanded parts again, which re-energizes the coil, turning it back into an electromagnet, which is now attracted to the magnet on the battery, which pulls it around again—and round it goes!

How does a real motor work?

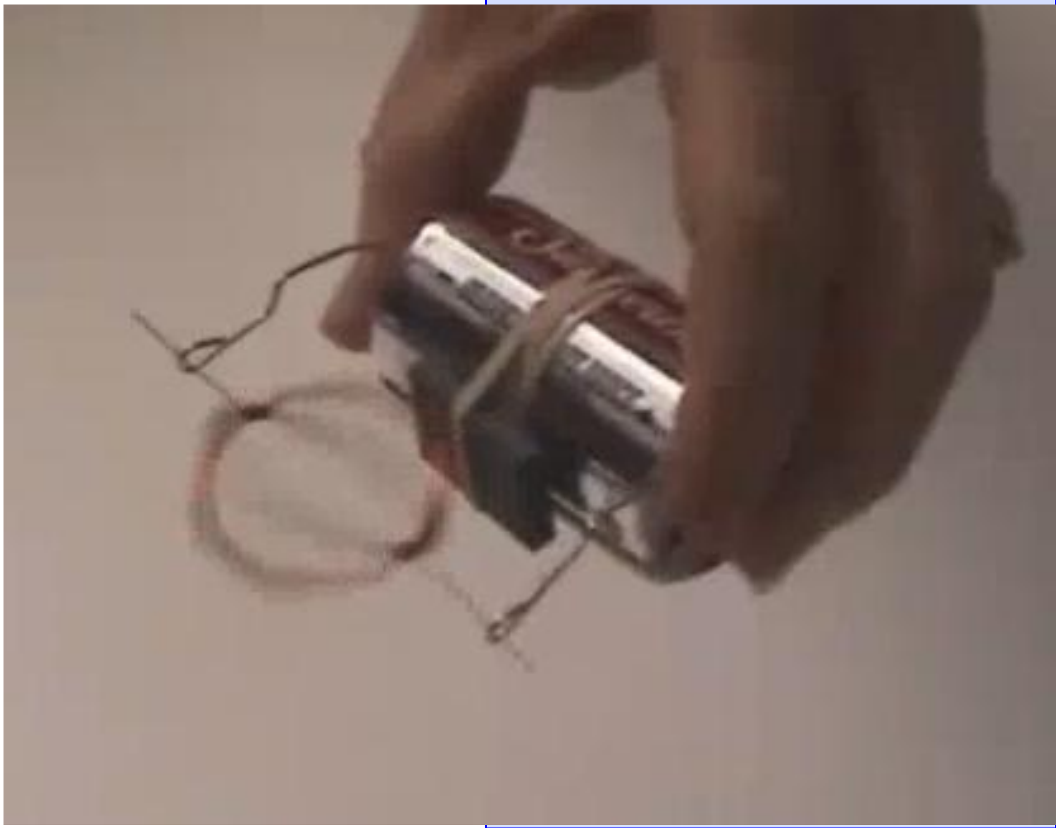
Imagine you have two magnets. Glue one magnet on an imaginary record player (or a 'lazy susan' turntable) and hold the other magnet in your hand.

What happens when you bring your hand close to the turntable magnet and bring the north sides together?

The magnet should repel and move, and since it's on a turntable, it will circle out of the way. Now flip your hand over so you have the south facing the turntable.

Notice how the turntable magnet is attracted to yours and rotates toward your hand.

Just as it reaches your hand, flip it again to reveal the north side. Now the glued turntable magnet pushes away into another circle as you flip your magnet over again to attract it back to you. Imagine if you could time this well enough to get the turntable magnet to make a complete circle over and over again— that's how a



Bouncy Ball Polymer

Activity

This is one of those 'chemistry magic show' type of experiments to wow your friends and family.

Here's the scoop: you take a cup of clear liquid, add it to another cup of clear liquid, stir for ten seconds, and you'll see a color change, a state change from liquid to solid, and you can pull a rubber-like bouncy ball right out of the cup.

Materials

Sodium silicate (from the pharmacy or www.sciencecompany.com

Ethyl Alcohol (*not* isopropyl alcohol)

Disposable cups

Popsicle sticks

Gloves (optional)

Experiment

To start with, watch the video for this experiment at:

SuperchargedScience.com/scienceseries.htm

Access code: ESCI

1. In one cup, measure four tablespoons of sodium silicate solution (it should be a liquid). Sodium silicate can be irritating to the skin for some people, so wear rubber gloves when doing this experiment!
2. Measure 1 tablespoon of ethyl alcohol into a second cup. Ethyl alcohol is extremely flammable—cap it and keep out of reach when not in use.
3. Pour the alcohol into the sodium silicate solution and stir with a popsicle stick.
4. You'll see a color change (clear to milky-white) and a state change (liquid to a solid clump.
5. Using gloves, gather up the polymer ball and firmly squeeze it in your hands.
6. Compress it into the shape you want—is it a sphere, or do you prefer a dodecahedron?
7. Bounce it!
8. Be patient when squeezing the compound together. If it breaks apart and crumbles, gather up the pieces and firmly press together.

Store your bouncy ball in a Ziploc bag.

What's Going On?

Silicones are water repellent, so you'll find that food dye doesn't color your bouncy ball. You'll find silicone in greases, oils, hydraulic fluids, and electrical insulators.

The sodium silicate is a long polymer chain of alternating silicon and oxygen atoms. When ethanol (ethyl alcohol) is added, it bridges and connects the polymer chains together by cross-linking them.

Think of a rope ladder—the wooden rungs are the cross-linking agents (the ethanol) and the two ropes are the polymer chains (sodium silicate).

Questions to Ask

1. Before the reaction, what was the sodium silicate like? Was it a solid, liquid, or gas? What color was it? Was it slippery, grainy, viscous, etc.?
2. What was the ethanol like before the reaction?
3. How is the product (the bouncy ball) different from the two chemicals in the beginning?
4. Was the bouncy ball the only molecule that was formed?
5. Was this reaction a physical or chemical change?

Did you know? Silly putty is actually a mixture of silicone and chalk!

What IS Science?

Science is more than a classroom… it's actually pretty difficult to define. Science is not about what we know, but rather about how we face what we *don't* know.

It's not a textbook of principles, set of rules, or collection of factoids. It's a process, a *thing* you do.

Science is what happens when you ask questions, get back answers, and try to figure and make sense of it all.

Science gives you a way to ask questions and get back answers. There are many different ways to do this, the *Scientific Method* being only one of the ways of sorting and sifting through the information as you go along.

Believe it or not, there's a straightforward method to doing science. You can't just sit around and argue about how things work, but you actually have to do experiments and be able to measure your results.

And other people have to get be able to get those same results on their own, too!

Learn more about how to do real science with the e-Science Online Program: www.SuperchargedScience.com

TEACHING SCIENCE RIGHT

Hopefully these activities have given you a small taste of how science can be totally cool AND educational.

But teaching homeschool science isn't always easy.

You see, there's a lot more to it than most traditional science books and programs accomplish. If your kid doesn't remember the science they learned last year, you have a problem.

What do kids really need to know when it comes to science?

Kids who have a solid science and technology background are better equipped to go to college, and will have many more choices once they get out into the real world.

Learning science isn't just a matter of memorizing facts and theories. On the contrary, it's developing a deep curiosity about the world around us, AND having a set of tools that let kids explore that curiosity to answer their questions.

Teaching science in this kind of way isn't just a matter of putting together a textbook with a few science experiments and kits.

Science education is a three-step process (and I mean teaching science in a way that your kids will really understand and remember). Here are the steps:

1. Get kids genuinely interested and excited about a topic.
2. Give them hands-on activities and experiments to make the topic meaningful.
3. Teach the supporting academics and theory.

Most science books and programs just focus on the third step and may throw in some experiments as an afterthought. This just isn't how kids learn.

There is a better way. When you provide your kids with these three keys (in order), you can give your kids the kind of science education that not only excites them, but that they remember for many years to come.

Don't let this happen to you… you buy science books that were never really used and now your kids are filling out college applications and realizing they're missing a piece of their education—a REALLY big piece. Now *that's* a setback.

So what do you do?

First, don't worry. It's not something that takes years and years to do. It just takes commitment.

What if you don't have time? What I'm about to describe can take a bit of time as a parent, but it doesn't have to. There is a way to shortcut the process and get the same results! But I'll tell you more about that later.

Putting It Into Action

Step one: Get kids genuinely interested and excited about a topic.

Start by deciding what topic you want your kids to learn. Then, you're going to get them really interested in it.

For example, suppose I want my 10-year old son to learn about aerodynamics. I'll arrange for him to go up in a small plane with a friend who is a pilot. This is the kind of experience that will really excite him.

Step two: Give them hands-on activities and experiments to make the topic meaningful.

This is where I take that excitement and let him explore it. I have him ask my friend for other chances to go flying. I'll also have my friend show him how he plans for a flight. My son will learn about navigation, figuring out how much fuel is needed for the flight, how the weight the plane carries affects the aerodynamics of it, and so much more.

I'll use pilot training videos to help us figure this out (short of a live demo, video is incredibly powerful for learning).

My son is incredibly excited at this point about anything that has to do with airplanes and flying. He's sure he wants to be a pilot someday and is already wanting flying lessons (he's only 10 now).

Step three: Teach the supporting academics and theory.

Now it's time to introduce academics. Honestly, I have my pick of so many topics, because flying includes so many different fields. I mean he's using angles and math in flight planning, mechanics and energy in how the engine works, electricity in all the equipment on board the plane, and of course, aerodynamics in keeping the plane in the air (to name just a few).

I'm going to use this as the foundation to teach the academic side of all the topics that are appropriate.

We start with aerodynamics. He learns about lift and drag, makes his own balsa-wood gliders and experiments by changing different parts. He calculates how big the wings need to be to carry more weight and then tries his model with bigger wings. (By the way, I got a video on model planes so I could understand this well enough to work with him on it).

Then we move on to the geometry used in navigation. Instead of drawing angles on a blank sheet of paper, our workspace is made of airplane maps.

We're actually planning part of the next flight my son and my pilot buddy will take. Suddenly angles are a lot more interesting. In fact, it turns out that we need a bit of trigonometry to figure out some things.

Of course, a 10-year old can't do trigonometry, right? Wrong! He has no idea that it's usually for high school and learns about cosines and tangents.

Throughout this, I'm giving him chances to get together with my pilot friend, share what he's learned, and even use it on real flights. How cool is that to a kid?!

You get the idea. The key is to focus on building interest and excitement first, then the academics are easy to get a kid to learn.

Try starting with the academics and...well, we've all had the experience of trying to get kids do something they don't really want to do.

The Shortcut

Okay, so this might sound like it's time-intensive. If you're thinking "I just don't have the time to do this!" or maybe "I just don't understand science well enough myself to teach it to my kid." If this is you, you're not alone.

The good news is, you don't have to. The shortcut is to find someone who already specializes in the area you want your kids to learn about and expose them to the excitement that persons gets from the field.

Then, instead of you being the one to take them through the hands-on part and the academics, use a solid video-based homeschool science

program or curriculum (live videos, not cartoons).

This will provide them with both the hands-on experiments and the academic background they need. If you use a program that is self-guided (that is, it guides your kinds through it step-by-step), you don't need to be involved unless you want to be.

I'm partial to the "e-Science" program from SuperchargedScience.com (after all, I'm in it), but honestly, as long as a program uses these components and matches your educational goals, it should be fine.

Your next Step should be to take a look at how you're teaching science now and simply ask "Is my kid getting the results I want from his or her science education?"

After this, consider how you can implement the three key steps we just talked about. Either go through the steps yourself, or use a program that does this for you.

If you want to learn more about how to teach science this way, we regularly give free online tele-seminars for parents. To learn more about them, visit:

SuperchargedScience.com/freeteleclass.htm

My hope is that you have some new tools in your homeschool parent toolbox to give your kids the best start you can in life.

Again, I want to thank you for taking the kind of interest in your child that it takes to homeschool. I know it's like a wild roller coaster ride some days, but I also know it's worth it. Have no doubt that the caring and attention you give to your child's education today will pay off many fold in the future.

My best wishes to you and your family.

Warmly,

Aurora