"Teaching" Science at Home

by Dr. Jay L. Wile, Ph.D.

Qualifications

- University Professor From 1990 - 1995
- Helped Develop Indiana's Only Residential High School for Gifted and Talented Students
- NSF-Sponsored Scientist with More Than $200,000 In Research Grants
- Became Interested in Homeschooling Because of Excellent University Students Who Were Homeschooled
- Currently writes junior high school and high school science courses for homeschooled students

Why Do I Need to Teach Science?

- Public schools teach it, and you are trying to give your student a better education.
- Today's society is so technologically-based that you need a basic grounding in the sciences to be successful in most fields.
- All colleges require at least two semesters of science and two semesters of math, regardless of your major.
- Your student may be perfectly suited for a career in the sciences. This is how to find out!

At all levels, homeschoolers are better at science than publicly and privately schooled students

- In the ACT, homeschooled students scored 21.9 in science compared to the national average of 21.1. This is equivalent to a 70 point superiority in the SAT, or about 10 percentage points.
- Several large studies in Montana, Oklahoma, Washington state, Canada and across the USA report homeschoolers (K-12) score from 68 to 88 percent on standardized science tests, compared to the national average of 50%.

MATHEMATICS: A NECESSARY TOOL FOR LEARNING THE SCIENCES

"Diplomacy without arms is like music without instruments"
-Alexander the Great
"Science without math is like music without instruments"
-Jay Wile the Not-So-Great

Especially in the K-6 years, what is covered in math is **more important** for science than what is covered in science itself.

Two BASIC Approaches to Teaching Science

The Spiral Approach: Students are taught a little bit about a wide variety of subjects each year. As time goes on, subjects are revisited in a more detailed fashion.

The Immersion Approach: Students are taught a single subject for a semester or more, allowing them to get a detailed picture. As time goes on, many subjects are covered.

Which Method is Best?

- ✓ **High schools and universities use the immersion approach**
- ✓ **The spiral approach is very repetitive, which many students find boring. However, it does produce high recall.**
- ✓ **Students tend to think they "know all about" a subject they have already covered and thus do not pay attention when the subject is revisited**

The National Science Foundation says:

U.S. science and math teaching "is a mile wide and an inch deep," when compared to our international competitors. "Compared to their counterparts abroad, U.S. science and mathematics teachers are expected to cover a dizzying variety of subjects every school year, and, as result, students seldom get to explore key topics in any depth."

On the other hand, standardized tests are generally written for the spiral approach.

If your goal is to do well on standardized tests, you want the spiral approach. If your goal is the best education, the immersion approach is better.

K-6 Science Education

- Keep it **light**, but not **simple**
- Stress math over science
- Emphasize discovery
- There are **no set topics** to cover. This is a time to gather facts and experience nature.

My experience with students coming out of **elementary school** and into a more rigorous science curriculum has taught me that **enthusiasm for the subject is more important than what the student has covered**.

Great Science Adventures: (Immersion Approach)
http://www.commonsensepress.com/

- Activities and experiments are mostly good for the home.
- Multigrade K-8, but junior high would be a bit "light"
- Resources for Extended study are suggested
- There is a lot of photocopying involved, but many have their children all work together on just one book project

TOPS: (Spiral Approach)
http://topscience.org/

- Activities and experiments are mostly good for the home.
- Multigrade K-8
- There is a wide variety of lessons to choose from, and the progression is not set. The lesson layout is a bit chaotic, too.
- Discovery Oriented

Scott Foresman Science (Spiral Approach)
http://www.pearsonschool.com/index.cfm?locator=PSZ16f

- A different book for each grade
- Tracks very well with Foresman math
- Gorgeous books
- Built-in dependence on a teacher - While parts of each book are very readable, there will be times someone who doesn't know much science will be left confused
- Experiments are mostly not home-friendly

Texts that don't have "home-friendly" experiments are not a big deal. Just supplement with:

Janice Van Cleave's *"_____for Every Kid*." http://www.amazon.com/Janice-VanCleaves-Biology-Every-Kid/dp/0471503819

Developing Critical Thinking Through Science
http://www.criticalthinking.com

Singapore Science (Spiral Approach)
http://www.singaporemath.com

- A different book for each level, K-10
- Tracks very well with Singapore math
- Strong critical thinking component, like Singapore math
- Designed for a classroom, including things like "group projects." This will add to your preparation time.
- More understandable than most school books
- Many home-friendly labs, some not home-friendly

Science in a Nutshell (Mostly Immersion Approach)
http://www.delta-education.com/

- Kits for many home-friendly science experiments
- Lots of subjects, K-8
- Delta Education "modules" are essentially readers that can be used after some kits to give the student more information on a topic
- Content is pretty random, but good
- It gets pricey to cover a lot of subjects

Real Science 4 Kids (Immersion Approach)
http://www.arn.org/realscience/realscience.html

- Best for grades 3-6
- Each major subject has different levels
- Home-friendly Experiments
- More understandable than most school books
- Not a lot of resources for further study

The Young Explorer Series - Christian Worldview - (Immersion Approach)
http://www.apologia.com/

- Multigrade, K-6
- Home-friendly experiments
- Very easy to understand
- Course website that gives a lot more advanced information.
- Free question/answer service

How Do You Choose?

- ☞ Think about your children's personalities. Which interest them the most?
- ☞ Think about the time you have available.
- ☞ Think about what is practical in your environment.

The important thing to remember is that they are ALL GOOD CHOICES.

Movin' On Up…

Once the student is in junior high, it is time to get more deliberate in your science coverage, as the student has been training his or her mind with a lot of math.

- Need to start transitioning to a structured cirriculum
- Many of the elementary options discussed (like Singapore and Great Science Adventures) continue through 8th grade
- Others (like Foresman and Apologia) have a specific junior high school series.

The Rainbow - Grades 7 and 8 - Christian Worldview – (Immersion Approach)
http://www.beginningspublishing.com

- Two courses - one for each year
- Discovery oriented with home-friendly experiments.
- A kit is included - it has pretty much everything
- A bit more understandable than most school books, but not as good as others designed for the home
- The number of topics covered is lower than many courses, but the emphasis is on experimentation, so the student trades breadth for experience.

MATH TOOLS NECESSARY FOR LEARNING THE SCIENCES

BIOLOGY: Metric Units

CHEMISTRY: ARITHMETIC and ALGEBRA: (*Algebra 1*, Saxon)

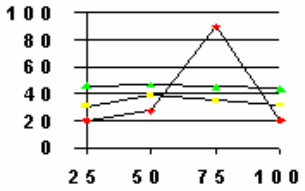
Fraction Manipulation: $\frac{7}{\cancel{64}} \times \frac{\cancel{64}}{13} = \frac{7}{13}$

Positive and Negative Numbers: -122.45 + 567.3 = 454.85

Manipulating exponents: $10^2 \times 10^3 = 10^5$

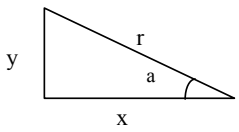
Algebraic Manipulation: $PV = nRT \Rightarrow n = \frac{PV}{RT}$

Reading Graphs and Understanding trends:



PHYSICS : Should have finished Algebra II and be at least starting Trigonometry (*Algebra II*, Saxon)

Using Trig in Triangles:



y = r sina

x = r cosa

y/x = tan a

ADV. CHEMISTRY : Should have finished Algebra II

Logarithms: log(x) = 3 ⇒ x = 1,000

log(xy) = log(x) + log(y)

ADV. PHYSICS: Should have finished Precalculus (*Advanced Math*, Saxon)

	Not Science-Oriented		Science-Oriented		MathPrerequisite
Ninth Grade	Biology	could take all 4 high school years.	Biology (Supplement I)		None
Tenth Grade	Chemistry		Chemistry (Supplement II)		Algebra I
Eleventh Grade	Physics		Physics (Supplement III)	*	Algebra II; At least beginning trig
Twelfth Grade	Supplements		Advanced Biology OR Advanced Chemistry OR Advanced Physics		None Algebra II Precalculus

Your student's math level should drive this time line, especially if the student is science-oriented. When the student *begins* Algebra I, that's when Biology begins.

High School Science Curricula

As before, there are curricula designed for schools and curricula designed for home. The problem is that for most parents, the curricula designed for schools doesn't work very well:

- **The explanations in most school textbooks are not sufficient for someone who has no teacher to explain them**
- **The labs generally don't work at home**
- **Most parents don't know what parts of the book to cover and what to skip.**

High School Science Curricula for the Home

The "At Home" series - http://www.scienceforhighschool.com/

- Research Based
- Lots of experiments that can be done at home, as long as you get the kits.
- Very open-ended
- The average student will not go as deep as most college-prep courses would go, but the interested student will end up going deeper
- Will be frustrating for those who want "pat" answers. Will be exciting for those who like to seek out answers.

The "Exploring Creation" series - http://www.apologia.com/

- **Christian Worldview**
- Lots of experiments that can be done at home, as long as you get the kits. Not all require kits, however.
- Very rigorous – too rigorous for some, mostly because of the emphasis on math.

- Free question/answer service
- Not many pictures – The books concentrate on the explanations, making them easy to follow.