



Diocese of Marquette
Office of Catholic Schools

Science Biographies



Rev Msgr Georges Lemaitre
Founder of the Big Bang Theory

for
Grades 1 - 8



The Value of Our Catholic Schools

I want to begin by thanking everyone who is involved in our Catholic Schools in the Diocese of Marquette. The work all of us are engaged in through supporting and operating our Catholic Schools is a very important mission of our diocesan Church.

A primary mission of our Church is evangelization: bringing all people into friendship with Jesus and his Church. For our young people and their families, our Catholic Schools are one of the best places where this evangelization takes place.

Another strength of our Catholic Schools is that we promote the formation of the whole person. This means that we work to develop all the human faculties of our students, including a strong and deep intellectual formation that results in a young person who possesses the habits of a lifelong learner, the formation of ethical and social virtues, a religious education and growth in personal faith in Jesus Christ.

One way to think about this formation of the whole person is in light of our Catholic liberal arts curriculum, which I fully support. Our curriculum goes beyond purely educational content to the formation of the character of the student. To begin with, a liberal arts curriculum teaches rich subject content knowledge. However, a Catholic liberal arts curriculum goes beyond this content knowledge to the level of personal formation. This kind of formation really reaches into the being of a student and helps develop the student's character of mind. I'm speaking here of the formation of intellectual, moral and spiritual virtues.

The liberal arts curriculum fosters many important habits that become skills. Intellectual virtue involves a sense of *wonder* about reality. It helps us recognize the truth that stands at the root of all being, of all that is real. And so we approach learning with a sense of *wonder* and we inculcate a *reverence* before being. To penetrate the mystery of what is, and Who ultimately is behind all that is, leads us to our ultimate goal of entering into personal relationship with Jesus Christ, who is the source of all being and truth. These aren't things that can really be measured in standardized tests or other kinds of standards-based education. It's not that we don't have rigorous academic content goals – we do – but true education involves far more than that, and so we go beyond the academics to the formation of the whole person: humanly, intellectually, morally and spiritually.

I close by thanking in a special way our teachers and principals for the sacrifices they make as Catholic educators. Your daily examples of love for our children and their families make up the backbone of our schools and their Christian mission. Please know that you are all in my prayers...

Most Reverend John F. Doerfler, Bishop of Marquette





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They may be reassigned to meet student and/or curriculum needs.*

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How to Use Science Biographies in the Classroom, Grades 1 - 8

Socratic Dialogue: Foster a Culture of Faith & Science

Questions to discuss are part of the science biography lessons below. Include your own questions and invite students to wonder as well. Science biography resources provide excellent content from which to practice Socratic dialogue that the teacher is working to incorporate per each grade level classroom.

Science Biography Content as Part of the Integrated Timeline

Each student in every grade level should construct an Integrated Timeline to plot persons and events of interest across all subject areas, including science. (See the emphasis on timelines in the diocesan history curriculum.) While all teachers assist and guide students in developing the habit of plotting points on this map as they arise, the goal is that the student is encouraged and comes to see the timeline as personal and uses it to orient whatever comes up that is of interest to the student.

Intellectual habits developed: Self-learner. Life-long learner. Habit of reflection. Habit of seeing the particular in light of the larger whole. Habit of making relations in a variety of ways: across time; between subject areas; between significant discoveries and/or events, persons, etc. The student's continued use of a timeline in Grades 1-8 allows the student to reflect on personal growth in knowledge through time and come to understand the relatedness of all things as an integrated whole.

Guided reflection: Teachers should take time periodically to lead students individually in the examination of their timelines as a whole and reflect on relations as mentioned above, then discuss student discoveries and reflections about their timelines together as a group.

Timeline construction: Timelines may be constructed of a continuous, folded strip of paper on which dates, names, events and illustrations may be plotted. Brief diary-type entries may be made in a timeline notebook kept alongside the timeline strip for older grades. Additional related assignments and artwork may be attached within the timeline notebook. Younger students may wish to use various colored stars to plot points of interest on the timeline strip, such as green star = science-related point, red=art-related entry, blue=history-related point, etc., with date and name of person or event.

Timelines per student should be preserved from grade level to grade level for student reflection and so students may begin each new grade's timeline with previously learned information and reflections attached, then continued in a more sophisticated manner. An oversized zip bag may serve as a file.

Faith & Science Websites

Please utilize these websites that offer a plethora of additional information on scientists and faith:

<https://www.catholicscientists.org/catholic-scientists-of-the-past>

<https://www.vofoundation.org/faith-and-science/religious-scientists/>



Grades 1 - 8

Anna Botsford Comstock, Naturalist Educator

Across grade levels 1 - 8, teachers are encouraged to rely on Anna Comstock's *The Handbook of Nature Study* provided free online at the following link for fruitful nature walks and general nature study:

<https://archive.org/details/handbookofnature002506mbp/page/n6>

A brief background video about Anna Comstock's life and accomplishments (1:38 minutes):

https://www.youtube.com/watch?v=0_CfKXa-Qs0

While the following illustrated biography is recommended for grades 1 - 3, the Anna Comstock biography lesson that follows is provided for Grade 3 as part of the Diocese of Marquette Science Curriculum.

View the children's book read aloud: *Out of School and Into Nature: The Anna Comstock Story* by Suzanne Slade, Illustrated by Jessica Lanan (8 minutes):

<https://www.youtube.com/watch?v=umHVgwzlzM4>

Discuss the Great Scientist/Artist Who Studied Nature: Anna Comstock

Learn about **Anna Comstock** (1 September 1854 - 24 August 1930), a great American naturalist, scientific illustrator, educator, conservationist and leader of the nature study movement. Anna Comstock completed a degree in nature studies at Cornell University and went on to become the first woman faculty member at Cornell. She fostered a deep love for the study of nature, which she shared warmly and generously with others.

As an artist, Anna Comstock produced over 600 insect illustrations for her husband's projects and publications.

Here are pictures of Comstock's drawings:

https://www.google.com/search?q=anna+botsford+comstock+drawings&tbm=isch&rlz=1C1GCE_A_enUS847US847&hl=en&ved=2ahUKEwj96fW2-sLqAhXPTqwKHfbpC_sQrNwCKAJ6BQgBEN8B&biw=1519&bih=754

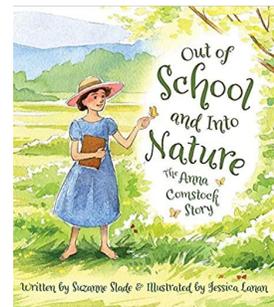
Click your mouse on particular drawings to use the magnifying capability and see drawing detail: https://upload.wikimedia.org/wikipedia/commons/2/29/Insect_life_%28Plate_V%29_%288495326320%29.jpg

Anna Comstock quote: "Nature-study cultivates in the child a love of the beautiful . . . a perception of color, form and music . . . But more than all, nature-study gives the child a sense of companionship with life out-of-doors and an abiding love of nature."

Ask students: ***Shut your eyes and think about what you have seen in nature. What have you heard? What have you smelled? How was it beautiful? How did it make you feel?***



Anna Comstock
1854 - 1930



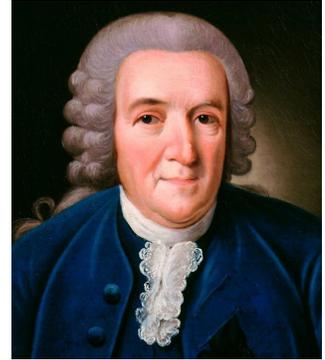


Grades 1 - 8

Carl Linnaeus, Botanist & Founder of Taxonomy

TAXONOMY is the organizing and classifying of living things:
How we name the order found in nature.

All grades learn about Carl Linnaeus's system of classification of organisms as part of the diocesan science curriculum, per grade level. The biography of Carl Linnaeus is specifically studied in Grade 3 as follows. The Grade 5 discussion on the science of taxonomy that follows is included as a sample.



Carl Linnaeus
1707 - 1778

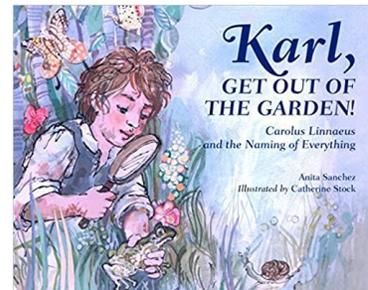
Discuss the Great Scientist Who Founded the Science of Taxonomy: Carl Linnaeus (Grade 3)

Carl Linnaeus

Learn about **Carl Linnaeus** (23 May 1707 – 10 January 1778), a Swedish botanist, zoologist, and physician who founded a system to name all living organisms.

Here is a book to read to learn about **Carl Linnaeus**, the first scientist to develop a classification system for living organisms:

Karl, Get Out of the Garden!: Carolus Linnaeus and the Naming of Everything by Anita Sanchez, Illus Catherine Stock



Study this poster to help students learn more about Linnaeus:
<https://www.linnean.org/learning/teaching/primary/posters>

Here is a short video on Linnaeus's life and impact (3:57 minutes):
https://www.youtube.com/watch?v=Gb_IO-SzLgk

Linnaeus is most famous for revolutionizing the way we name living organisms. In his book *Systema Naturae* he introduced his new system of **taxonomy**, and gave organisms a two-part name, one for the **genus** and another for the **species**.

Carl's system is called BINOMIAL naming (bye-nome-al). Binomial means "two words"—every plant and animal that he knew about was given a two word name with a GENUS name and a SPECIES name, in Latin.

Linnaeus's system has made it easier for scientists all over the world to communicate about life on Earth.

All grades discuss Linnaeus's system of classification of organisms as part of the diocesan science curriculum. Here is the Grade 5 discussion:



Grade 5 - Discussion About Taxonomy

“There is a branch of science that helps us to organize **living things**. It is called the science of **taxonomy** developed by Carl Linnaeus.

“**Taxonomy** is the branch of science concerned with **classification**, or the organization of living organisms. (Living things are called **organisms**.) Scientists have always tried to organize and classify objects, including **organisms (living things)**, that they discover around them. This organization shows where each living thing fits into all that God has created. When we know where a living thing fits within God’s big plan, we understand it better.

“**CLASSIFICATION** or **taxonomy** helps us to discover the order God made within creation and where each living thing fits **in relation to** every other living thing that he has made. It helps us to learn the general plan that includes the **similarities and differences** between living things.

“Scientists have observed living organisms in nature and have found similarities and differences between their outward structures. These similarities helped scientists to find a way to organize **groups** of living things.

“**Classification of living organisms can be defined as the grouping of organisms according to their structural similarities. This means that organisms that share similar features are placed in the same group.**

“There are **seven** groups of organisms that have names and are arranged from the largest group of organisms to the smallest group of organisms. The **names** of the groups **from largest to smallest** are given and arranged as follows:

*The column on the right shows how we classify **human persons**. Human persons are organisms, too.*

Taxonomic Classification of the Human Person

Kingdom - The largest group of organisms	Kingdom: Animalia
Phylum	Phylum: Chordata
Class	Class: Mammalia
Order	Order: Primata
Family	Family: Hominadae
Genus	Genus: Homo
Species The species is the smallest group of organism.	Species: sapiens



When we name an organism, we usually use just the Genus and species names. For example, the human person's scientific (taxonomic) name is ***Homo sapiens***.

The genus name is uppercase, i.e. "Homo," and the species name is lowercase: "sapiens" -- "Homo sapiens."

Scientists needed to have a common language for naming living things and they chose Latin. Latin is a language that doesn't change. Each living organism is known by its common name and also by its scientific name.

What does the Latin word *Homo* mean? *Homo*, a Latin word, means **man**. ("Man" refers to both men and women, boys and girls -- the human person.)

What does the Latin word *sapiens* mean? *Sapiens*, a Latin word, means **wise**. So ***Homo sapiens*** = "**wise man**."

Of all God's creatures, only angels have a higher intellectual capacity than human persons. (We do not classify angels on our living organism chart because all organisms have physical bodies, and angels do not have physical bodies.)

As we move down the classification hierarchy, members in each group become more and more similar. The number of species slowly decreases until there is just one. It is the species, ***sapiens***.

Man, the human person, differs from all other organisms, including other animals, because the human person is made in the image of God and has **rational capacities** called **reason** and **free will** (here called ***sapiens***, "wisdom"). This is also why the genus *Homo* (man) has only one species (*sapiens*). (The gorilla, for example, belongs to a genus different from man called *Gorilla*, which contains two species with two subspecies, each.)

Two large kingdoms are plants and animals. What's the difference between plants and animals?

Plants have either a very basic ability to sense or none. They have what we call a **VEGETATIVE form**.

Animals have much more highly developed sensory and nervous systems. They have a **SENSITIVE form**.
Animals generally have local motion (they can move from place to place); plants don't.

Some higher animals, like dogs, have a higher SENSITIVE form that includes imagination and memory. Dogs can dream! They also know how to react appropriately to danger or to fun things like playing ball. But only human persons have the capacities to reason, freely choose and will. Human persons have what is called a **RATIONAL form**. (Each **form** here is higher than the last.)



Grades 1 - 2

John Chapman “Johnny Appleseed,” Pioneer Nurseryman

Learn About the Pioneer Nurseryman: John Chapman

John Chapman

Discuss “Johnny Appleseed,” someone who planted many, many trees long ago.

John Chapman, better known as Johnny Appleseed, was an American pioneer nurseryman who introduced apple trees to large sections of Pennsylvania, Ohio, Indiana, Illinois and Ontario, as well as the northern counties of present-day West Virginia, with apple seeds and young trees that he planted or gave for planting.

- Find this rhymed book by Reeve Lindbergh with beautiful illustrations by Kathy Jakobsen: *Johnny Appleseed* for your classroom library.

- Watch this same book read aloud (5:37 minutes):

https://www.youtube.com/watch?time_continue=18&v=za-jpJ_qMgA&feature=emb_title

- Watch the Johnny Appleseed song by Pete Lounsbury, sung by Dennis Day (1:08 minutes):

https://www.youtube.com/watch?v=3_OO4-XUIA8

- Here is a version of the written lyrics (Traditional) to help learn the Johnny Appleseed song:

<https://www.kididdles.com/lyrics/johnny-appleseed.html>

Johnny Appleseed Grace: You may wish to use the first stanza of the Johnny Appleseed song as a before- or after-meal grace.

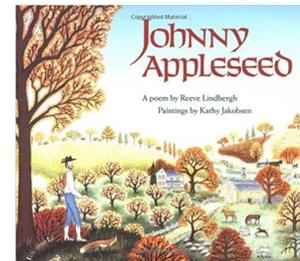
Discuss the Johnny Appleseed Grace: ***Did Johnny Appleseed think the Lord was good to him? What does Johnny do in response to God’s goodness? He thanks the Lord. What was Johnny thankful to God for? For giving him the things he needs, the sun, ... etc. How is God good to us? (Responses.) Should we thank God too? When should we thank him?***

Apple seed: The apple seed contains cyanide (a poison) to protect it against being eaten by birds and other creatures so that it can be successfully planted and have the chance to sprout and grow into an apple tree.

The Fruit of the Apple Tree: Bring in two or three types of apples to class. Explain to students that every type of tree produces a “fruit,” which is where the tree’s seeds are found. Cut open the apples and show the seeds. Eat apple slices! Count each apple’s seeds. Plant them and see if they will sprout.



John Chapman
“Johnny Appleseed”
1774 - 1845





Grades 1 - 3

Jean-Henri Fabre, Entomologist & Artist

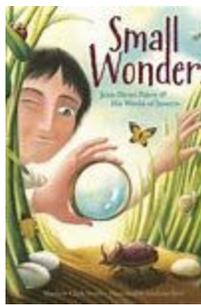
Learn about a scientist who loved and studied insects.

Jean-Henri Fabre

Discuss **Jean-Henri Fabre** (21 December 1823 - 11 October 1915), a great French entomologist. An entomologist is a person who studies insects.



Jean-Henri Fabre
1823 - 1915



Watch this story of Henri Fabre’s life, *Small Wonders: Jean-Henri Fabre & His World Of Insects* by Matthew Clark Smith, being read out loud. (12:47 minutes):

https://www.youtube.com/watch?v=JH_I0liuNLE

Try to locate it in your school library.

Here is a 2-minute story about one of the books Fabre wrote about insects:

https://www.youtube.com/watch?time_continue=1&v=iTLMQSeOi4I&feature=emb_title

Look at this page from one of Fabre’s books about insects. It’s written in French. (Jean-Henri Fabre was French -- he was from the country of France.) Jean-Henri Fabre was an artist. He used his talent in art to record his careful observations about insects:

https://upload.wikimedia.org/wikipedia/commons/thumb/0/06/Les_Ravageurs%2C_Jean-Henri_Fabre.djvu/page139-1659px-Les_Ravageurs%2C_Jean-Henri_Fabre.djvu.jpg

Quote by Fabre: “What matters in learning is not to be taught, but to wake up!”

When we go out in nature, how do we pay attention? Discuss the careful use of the five senses.

Grades 1 - 2

William Kirby, “Father of Entomology”

Art, Science and Beauty

Learn about a scientist who loved and studied insects.

William Kirby

Discuss **William Kirby** (19 September 1759 – 4 July 1850), called the "Father of Entomology." (Entomology is a branch of science that studies insects.) He lived in England and was probably one of the most





famous entomologists of all time. He was a Christian minister for 58 years and studied insects extensively during that time.

Here are some of his drawings from his famous insect book:

<https://www.alamy.com/stock-photo/entomology-kirby.html>

More of Kirby’s drawings:

<https://ccsearch.creativecommons.org/photos/ed8d0fc4-5a3a-4fad-915b-969a37a71ce6>

Quote by William Kirby: “In no part of creation are the POWER, WISDOM, and GOODNESS of its beneficent and almighty Author more signally conspicuous than in the various animals that inhabit and enliven our globe.” -William Kirby

Did William Kirby think about the power, wisdom and goodness of God when he studied animals? Why? God created the animals. Are insects animals? Yes, they are. Did Kirby love animals/insects?

There’s a Bug on My Book! by John Himmelman can be taken outside to motivate the students to search for insects after listening to the critters in the book hopping, flying, wiggling, and sliding.

Grades 1 - 2

John James Audubon, Ornithologist & Painter

Art, Science and Beauty

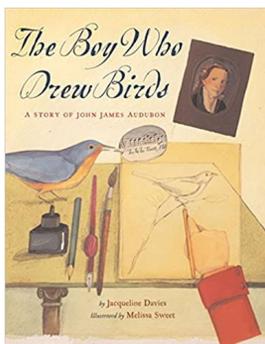
Learn about a scientist who found birds beautiful. He enjoyed, studied and drew birds.

John James Audubon

Discuss **John James Audubon** (26 April, 1785 - 27 January, 1851), a French-American **ornithologist** (scientist who studies birds), naturalist and painter.



John James Audubon
1785 - 1851



Watch this video of the book read aloud, *The Boy Who Drew Birds: A Story of John James Audubon* by Jacqueline Davies (13:24 minutes): <https://www.youtube.com/watch?v=NQevGPNyNsE>

See if you can locate this book for your classroom library.

Watch this video on Audubon’s book, *The Birds of America* (2 mins):

https://www.youtube.com/watch?time_continue=1&v=7gozLgMAq38&feature=emb_title



Discussion:

Why is this book worth such careful handling and attention?

How did Audubon learn so much about birds?

What makes Audubon's drawings so beautiful?

View these paintings by Audubon:

https://www.google.com/search?q=john+james+audubon+paintings&rlz=1C1GCEA_enUS847US847&sxsrf=ALeKk01TK7pySboapKwosXuBC4iH8X4JAw:1594736198397&source=lnms&tbm=isch&sa=X&ved=2ahUKEwj8pfak98zqAhUYQ80KHdPmDTsQ_AUoAXoECB4QAw&biw=1536&bih=754

Grades 1 - 2

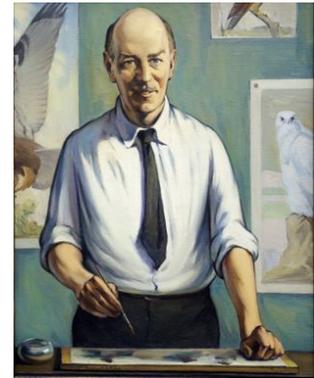
Louis Agassiz Fuertes, Ornithologist & Illustrator

Art, Science and Beauty

Learn about another scientist who found birds beautiful. Like John James Audubon, he enjoyed, studied and drew birds.

Louis Agassiz Fuertes

Discuss **Louis Agassiz Fuertes** (7 February, 1874 Ithaca, New York – 22 August, 1927 Unadilla, New York), an American **ornithologist** (person who studies birds) and illustrator who is considered one of the most prolific American bird artists. As a child he had been influenced by John James Audubon's *Birds of America* book, above.



Louis Agassiz Fuertes
1874 - 1927

Some bird drawing by Fuertes:

https://commons.wikimedia.org/wiki/Category:Louis_Agassiz_Fuertes

Take some time to view and enjoy the beauty and accurate detail in Fuertes's drawings:

https://commons.wikimedia.org/wiki/Category:Works_by_Louis_Agassiz_Fuertes



Read this children's book about Fuertes's life: *The Sky Painter: Louis Fuertes, Bird Artist* by Margarita Engle and illustrated by Aliona Bereghici.

Video book trailer here:

<https://www.youtube.com/watch?v=aFiuMkimCU>



Grade 2

Jean Léon Foucault, Physicist

Who experimented to prove that Earth rotates on an axis? Learn about Jean Léon Foucault, the scientist who discovered the earth’s rotation.

Jean Léon Foucault

Discuss **Jean Léon Foucault** (1819-1868) a French physicist (a scientist who studies motion and force) who came up with an experiment using a pendulum made to swing continuously back and forth for a whole day in order to prove that the earth rotates as around an axis. The experiment (and pendulum) are called “Foucault’s pendulum.”

Here are some photos of the pendulum and more information:

https://kids.kiddle.co/Foucault_pendulum



Watch this video showing the pendulum working. If the pendulum were located at the poles or equator (which it is not here), the swinging of the pendulum would take place all in the same plane. This means the markers shown in this video would not knock down. (36 seconds):

<https://www.youtube.com/watch?v=us7r4Fk2AW4>



Jean Léon Foucault
1819 - 1868

Grade 3

George Washington Carver, Agricultural Scientist

George Washington Carver

Discuss a great scientist who studied agriculture:

George Washington Carver (12 July 1864 - 05 January 1943).

Here is a video on Dr. Carver’s life:

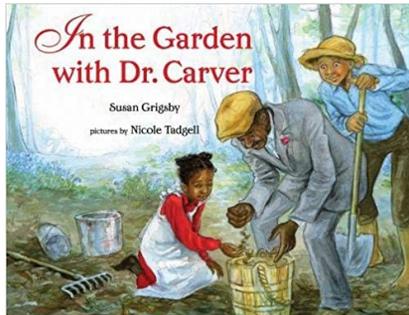
<https://vimeo.com/5423963>

Here is more information about Dr. Carver:

https://kids.kiddle.co/George_Washington_Carver



George Washington Carver
1864 - 1943



Watch the children's book, *In the Garden With Dr. Carver* by Susan Grigsby, read out loud at the following link:

<https://www.bing.com/videos/search?q=George+Washington+Carver+for+children&docid=608028675796110990&mid=FC41715013C7704270FAFC41715013C7704270FA&view=detail&FORM=VIRE>

Read these quotes from Dr. Carver and discuss them:

We should view nature as “unlimited broadcasting stations through which God speaks to us” every moment of our day. “We just have to tune in to God to hear him,” Carver explained.

What is a broadcasting station? Radio was a common means of transmitting news at the time.

How is creation/nature like a “broadcasting station” that God uses to speak to us through?

How can we “tune in to God” when we are in nature?

“All my life, I have risen regularly at four o’clock a.m. and have gone into the woods and talked with God. There he gives me my orders for the day. Alone there with things I love most, I gather specimens and study the great lessons nature is so eager to teach us all. When people are still asleep, I hear God best and learn my plan.” -George Washington Carver

Have we ever spent time alone with God in nature? Where could we do this?

Can nature help us think about God and feel close to him? How?

Do we listen to God early in the morning to learn God’s plan for us each day? Can we? How?

Discuss how Dr. Carver used his knowledge of science to serve others.



Grade 3

Galileo Galilei, Physicist & Astronomer

Galileo Galilei

Discuss **Galileo Galilei** (15 February, 1564 - 8 January, 1642), an Italian astronomer, physicist and engineer.

Galileo is one of the greatest figures of the Scientific Revolution. His discoveries in astronomy and physics played a central role in creating modern science.

In 1609, only a year after the telescope was invented, Galileo constructed his own telescope and began using it to make astronomical observations --- the first person to do so. His most famous telescopic discoveries were that Jupiter has moons (the first moons of another planet to be discovered), that Venus has phases, that Earth's own moon has mountains on it, and that there are spots on the sun. Galileo's discovery of the phases of Venus was crucial because these showed that sometimes Venus was on the other side of the sun, which contradicted and refuted Ptolemy's geocentric model of astronomy.

Learn about some of Galileo's discoveries here:

<https://www.rmg.co.uk/discover/explore/what-was-galileos-contribution-astronomy>

Galileo remained a devout Catholic throughout his life. ***Like virtually all the great figures of the Scientific Revolution, Galileo saw scientific discoveries as revealing the magnificence of God's creation.*** One of Galileo's favorite ideas was that God reveals himself in two books, the "book of nature" and the Holy Scriptures, and that if properly interpreted these can never be in conflict.

Discuss the following quotes from Galileo:

"The laws of nature are written by God in the language of Mathematics." -Galileo

What did Galileo mean when he said that mathematics is God's language about the laws of nature?

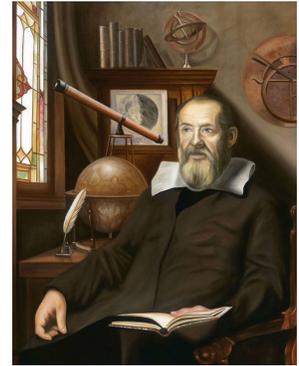
Does mathematics help us understand what is true about the measurement of real things?

Does everything that is true come from God?

"The prohibition of science would be contrary to the bible, which in hundreds of places the bible teaches us how the greatness and the glory of God shines forth marvelously in all His works, and is to be read above all in the open book of the heavens." -Galileo

Did Galileo teach that the bible and science go together?

Did Galileo say that getting rid of science, the study of God's creation in nature and outer space, would be against what is taught in the bible? Why?



Galileo Galilei
1564 - 1642



Grade 3

Giovanni Domenico Cassini, Mathematician & Astronomer

Giovanni Domenico Cassini

Learn about **Giovanni Domenico Cassini** (8 June 1625 – 14 September 1712), a Catholic French-Italian astronomer, mathematician and engineer.

Cassini is considered the greatest observational astronomer of the 17th century after Kepler and Galileo, with many discoveries to his credit. He was the first person to show what the size of the solar system was. He also studied planets and found new moons on Saturn and discovered and named the craters on our moon which are still used today.

<https://www.bing.com/videos/search?q=Giovanni+Domenico+Cassini&docid=608021185403357111&mid=E96C524BFDE024225E73E96C524BFDE024225E73&view=detail&FORM=VIRE>



Giovanni Domenico Cassini
1625 - 1712

Grade 4

Maria Sibylla Merian: Entomologist & Botanical Illustrator

Maria Sibylla Merian

Maria Sibylla Merian (1647-1717) was a naturalist, an entomologist and a botanical illustrator rated as one of the greatest botanical artists ever.

One of her principal claims to fame is that she is one of the first naturalists to have studied insects. She recorded and illustrated the life cycles of 186 insect species.

Her evidence **documented the nature of metamorphosis** and contradicted contemporary ideas about how insects developed.

Her classification of butterflies and moths is still used today.

Find this book and read it aloud: *The Girl Who Drew Butterflies, How Maria Merian's Art Changed Science* by Joyce Sidman

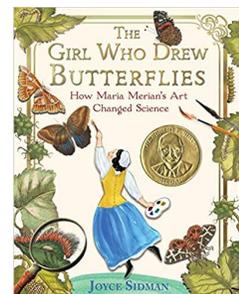
Watch this video of of Maria Merian's life (4 minutes):

<https://www.bing.com/videos/search?q=maria+merian&ru=%2fvideos%2fsearch%3fq%3dmaria%2bmerian%26FORM%3dHDRSC4&view=detail&mid=346484A80B9D48BBC527346484A80B9D48BBC527&&FORM=VDRVRV>

View some of Maria Merian's beautiful drawings, which she painted:



Maria Sibylla Merian
1647 - 1717





<https://www.bing.com/images/search?q=Maria+Sibylla+Merian+Art&form=RESTAB&first=1&scenario=ImageBasicHover>

Prepare students to relax and enjoy this video of Maria Meriams' nature art, set to beautiful music (8 minutes):

https://www.youtube.com/watch?v=sU3aQveRQCw&feature=emb_rel_pause

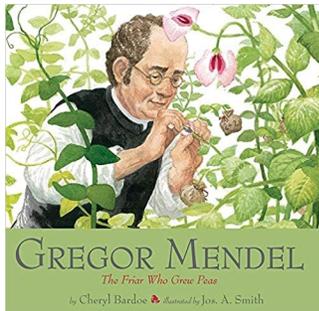
Take an artists' nature walk. Take along drawing pencils, brushes and watercolors. Have students quickly locate an object of interest in nature and capture it in their nature journals or on watercolor-appropriate paper. Fasten it in the nature journal when dry. Have students caption their illustrations with words about what they discovered about their object while they worked to illustrate it. What was easy to illustrate? What was difficult? Why?

Grade 4

Fr. Gregor Mendel: Pioneer Geneticist

Father Gregor Mendel

Heredity - An Expression of Order and Patterns in Nature



Fr. Gregor Mendel was a Franciscan Friar who avidly studied many subjects including botany, mathematics, astronomy and physics at the Franciscan Abbey, an intellectual center, and the University of Vienna. He developed pioneering experiments in genetics, working to express scientifically the order and patterns found in nature.

Read aloud the book, *Gregor Mendel, The Friar Who Grew Peas* by Cheryl Bardoe, or read his brief biography, here:

http://archive.fieldmuseum.org/mendel/story_life.asp



Fr. Gregor Mendel
1822 - 1884

"In an abbey garden Gregor Mendel planted the seeds for the science of heredity.

Born to poor tenant farmers in the Austro-Hungarian Empire, Gregor Mendel joined the Abbey of St. Thomas in 1843, at age 21. The Abbey was a dream come true for a budding scientist. A vibrant center of research, its friars were active in the sciences, linguistics, literature and philosophy. The Abbey made it possible for Mendel to attend the University of Vienna and to read widely in a library that contained 30,000 books.

Mendel had diverse interests—astronomy, meteorology, physics, botany, and mathematics. He was one of the first scientists to use rigorous experiments and mathematical analysis as a means to study biology.



*In 1856, Mendel launched an ambitious series of experiments with *Pisum sativum*—the garden pea. Eight years and approximately 28,000 pea plants later, Mendel published the results of his grand experiment. His methods were so advanced and his results so groundbreaking that no one realized how his discovery would eventually revolutionize science.*

After being elected Abbot in 1868, Mendel had little time for science. He may have been disheartened by the lack of reaction to his pea paper, but he knew that his discovery was important. Not long before his death in 1884 he told a scientific colleague, “My time will come.”

Mendel was right. In 1900 three European botanists rediscovered his work and set off a scientific explosion. The field of genetics was born and Mendel is considered its founding father.”

Here is a beautiful, short video of the life of Gregor Mendel:

<https://vimeo.com/8854352>

This video explains Mendel’s pea experiments:

<https://www.youtube.com/watch?v=cWt1RFnWNzk>

These activities help students better understand the concept of heredity:

<https://teach.genetics.utah.edu/content/heredity/>

<https://teach.genetics.utah.edu/content/heredity/files/InventoryOfTraits.pdf>

<https://www.mensaforkids.org/teach/lesson-plans/peas-in-a-pod-genetics/>

Grade 4

Discuss Great Scientists Who Studied Electricity

André-Marie Ampère

Learn about **André-Marie Ampère** (20 January 1775 – 10 June 1836), who discovered the relationship between magnetism and electricity:

https://kids.kiddle.co/Andr%C3%A9-Marie_Amp%C3%A8re

Ampère is most known for establishing the relationship between electricity and magnetism, and combining them into a new field called [electromagnetism](#), or electrodynamics. In 1823, he discovered the law that describes the magnetic force between two pieces of wire that are carrying electrical current, which became known as Ampère’s Law. In honor of his epoch-making discovery, the most commonly used unit of electrical current is called the ampere (or “amp” for short). Ampère was a sincere and devout Catholic believer.

“On the day of his wife’s death he wrote two verses from the Psalms, and the prayer ‘O Lord, God of Mercy, unite me in heaven with those whom you have permitted me to love on earth.’”



André-Marie Ampère
1775 –1836



Grade 4

Discuss Great Scientists Who Studied Electricity (cont.)

Alessandro Volta

Learn about the inventor of the **electrical battery**.

Alessandro Volta (18 Feb 1745 - 5 Mar 1827) is perhaps best known as the inventor of the electrical battery, a key part of electrical technology. The electrical unit of the Volt is named for him.

<https://www.famousscientists.org/alessandro-volta/>

https://kids.kiddle.co/Alessandro_Volta

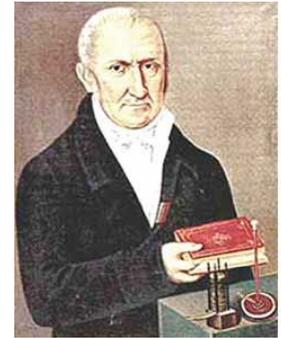
Volta was a Catholic, a great scientist who loved God.

Here's a quote from Alessandro Volta:

"I confess the holy, apostolic, and Roman Catholic faith. I thank God who has given me this faith, in which I have the firm intention to live and die."
-Alessandro Volta

Discuss the importance of Volta's faith in God. Did Volta evangelize simply by stating his own faith in God? How does this help us?

Has Volta's evangelization come down through time? Why is this important?



Alessandro Volta
1745 - 1827

Luigi Galvani

Another important Catholic Scientist who studied electricity was **Luigi Galvani** (9 Sept 1737 to 4 Dec 1798).

https://kids.kiddle.co/Luigi_Galvani

Luigi Galvani Galvani was a pioneer in bioelectricity and is famous for discovering what he termed "animal electricity." He wrote a book entitled, *On the Power of Electricity in Muscular Movement* published in 1791. This was the beginning of the fields of bioelectricity and electrophysiology. He became a member of the Third Order of St. Francis.



Luigi Galvani
1737 - 1798

Electromagnetism is the science of charge and of the forces and fields associated with charge. Electricity and magnetism are two aspects of electromagnetism.



Grade 4

Discuss Great Scientists Who Studied Electricity (cont.)

Michael Faraday

Learn about **Michael Faraday** (22 Sept 1791 - 26 Aug 1867), who was a pioneer in the study of electromagnetism.

Read and discuss this short biography of life of Faraday:

https://kids.kiddle.co/Michael_Faraday

Video (4 minutes) - Discuss the experiment found within the video showing a relationship between magnetism and electricity:

<https://www.bing.com/videos/search?q=michael+faraday&&view=detail&mid=6ADFB96E9AA7CB4189E36ADFB96E9AA7CB4189E3&&FORM=VRD GAR&ru=%2Fvideos%2Fsearch%3Fq%3Dmichael%2Bfaraday%26FORM%3DHDRSC3>

Read and discuss this quote from Michael Faraday:

“The book of nature which we have to read is written by the finger of God.” -Michael Faraday

Who is reading the book of nature?

What does Faraday mean that the book of nature is written by the finger of God?



Michael Faraday
1791 - 1867

Grade 4

Discuss Great Scientists Who Studied the Earth

Blessed Bishop Nicolaus Steno, Founder of Geology

Learn about **Nicolaus Steno** (01 Jan 1638 - 25 Nov 1686), the founder of the science of geology.

Nicolaus Steno was a Danish scientist who became both the founder of the science of geology and a bishop in the Catholic Church. On October 23, 1988, Bishop Steno was beatified by Pope St. John Paul II.

Read this brief biography about Blessed Bishop Steno:

<https://www.famousscientists.org/nicolas-steno/>

Watch this video about Steno’s three geology laws:

<https://www.bing.com/videos/search?q=nicolaus+steno&docid=608010568291452945&mid=401DF36FFAFFB0B9C8D6401DF36FFAFFB0B9C8D6&view=detail&FORM=VIRE>



Bl. Nicolaus Steno
1638 - 1686



Discuss this quote from Blessed Nicolaus Steno:

“Beautiful is what we see, more beautiful is what we comprehend, most beautiful is what we do not comprehend.” -Blessed Nicolas Steno

Does Blessed Nicolaus Steno say that it is more beautiful to see or to understand?

What does Blessed Nicolaus Steno say is most beautiful of all? What we do not comprehend -- God.

Grade 4

Discuss Great Scientists Who Studied the Earth (cont.)

Mary Anning, Paleontologist

Learn about **Mary Anning** (21 May 1799 - 09 March, 1847), a famous paleontologist.

Read this brief biography about Mary Anning:

https://www.youtube.com/watch?v=u4EiClPd2dw&feature=emb_rel_pause

This simple narrative of Anning’s life includes her strong Christian faith:

<http://www.neverofftopic.com/primary/mary-anning-fossil-hunter/>

Here is a helpful video on Mary Anning’s life and impact:

<https://www.bing.com/videos/search?q=mary+anning+&&view=detail&mid=33DE5CD6BCECBD6F66BE33DE5CD6BCECBD6F66BE&&FORM=VRD GAR&ru=%2Fvideos%2Fsearch%3Fq%3Dmary%2520anning%2520%26qs%3Dn%26form%3DQBVR%26sp%3D-1%26pq%3Dmary%2520anning%2520%26sc%3D8-12%26sk%3D%26cvid%3D8523E7CB6EED4C6295507D50C3154670>



Mary Anning
1799 - 1847

Grade 4

Discuss Great Scientists Who Studied Astronomy

Nicolaus Copernicus

Learn about **Nicolaus Copernicus** (19 Feb 1473 - 24 May 1543), a Polish Catholic astronomer and doctor.

Copernicus proposed the theory that the Earth revolves around the sun. Prior to him, people thought that the earth was the center of the



Nicolaus Copernicus
1473 - 1543



solar system and the universe.

See these links:

https://kids.kiddle.co/History_of_astronomy

https://kids.kiddle.co/Nicolaus_Copernicus

Copernicus's heliocentric theory helped set in motion the Scientific Revolution from which modern science was born.

Watch this video that explains Copernicus's model:

<https://www.bing.com/videos/search?q=copernicus+for+kids&ru=%2fvideos%2fsearch%3fq%3dcopernicus%2bfor%2bkids%26FORM%3dHDRSC4&view=detail&mid=B163D505C2E2E29EA626B163D505C2E2E29EA626&&FORM=VDRVRV>

Quotes from Copernicus to discuss with your class:

"It is my loving duty to seek the truth in all things, insofar as God has granted that to human reason." -Nicolaus Copernicus

Why did Copernicus connect love with truth?

Where does Copernicus say to seek truth? (In all things.)

Where does Copernicus say we get our ability to reason?

Why is seeking truth a duty?

"To know the mighty works of God, to comprehend His wisdom and majesty and power; to appreciate, in degree, the wonderful workings of His laws, surely all this must be a pleasing and acceptable mode of worship to the Most High, to whom ignorance cannot be more grateful than knowledge." -Copernicus

In Copernicus's words above, how does he say we worship God?

Which makes us more grateful to God, ignorance or knowledge of his works?

Grade 4

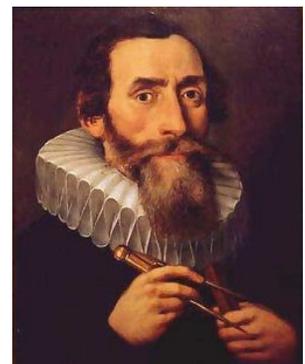
Discuss Great Scientists Who Studied Astronomy (cont.)

Johannes Kepler

Learn about **Johannes Kepler** (27 Dec 1571 - 15 Nov 1630), another important scientist who supported and expanded the Copernicus theory.

https://kids.kiddle.co/Johannes_Kepler

Kepler developed three laws to describe the movement of planets around the sun. The first law states that a planet's orbit around the sun is



Johannes Kepler
1571 - 1630



not circular but elliptical or in an oval pattern:

https://kids.kiddle.co/Kepler%27s_Laws

Here's a two-minute video on these laws (watch the first law):

<https://www.bing.com/videos/search?q=kepler+johannes+for+children&ru=%2fvideos%2fsearch%3fq%3dkepler%2bjohannes%2bfor%2bchildren%26FORM%3dHDRSC4&view=detail&mid=00D11532008DAFA4AF9B00D11532008DAFA4AF9B&&FORM=VDRVRV>

Quotes from Kepler to discuss:

“The diversity of the phenomena of nature is so great, and the treasures hidden in the heavens so rich, precisely in order that the human mind shall never be lacking in fresh nourishment.”

-Johannes Kepler

Does Kepler think it is important for our minds to be fed by “treasures?” How?

“I wanted to become a theologian; for a long time I was unhappy. Now, behold, God is praised by my work even in astronomy.” -Kepler

Did Kepler become happy when he realized something about his work in astronomy? What?

Grade 4

Discuss Great Scientists Who Studied Astronomy (cont.)

Nicholas Cardinal Cusa

Learn about **Cardinal Nicholas of Cusa** (1401 to August 11, 1464), a German Cardinal and astronomer who died nine years before Copernicus was born.

Cardinal Cusa suggested that the universe is infinitely large and has no center and that all bodies in the universe, including both the earth and the sun, are in motion in infinite space. He also speculated about the existence of intelligent life on other planets and celestial bodies and thought it was probable due to God’s creativity. Even before Copernicus, Nicholas Cardinal Cusa had proposed even bolder and more modern ideas.



Nicholas Cardinal Cusa
1401 - 1464

Discuss a quote from Nicholas Cardinal Cusa:

“For reason's measurements, which attain unto temporal things, do not attain unto things that are free from time—just as hearing does not attain unto whatever is not-audible, even though these things exist and are unattainable by hearing.” - Nicholas Cardinal Cusa

Does Cardinal Cusa point out that important things exist that are beyond our ability to reason about? Which of the five senses does he use to compare this idea with?



Grade 4

Discuss Great Scientists Who Studied Astronomy (cont.)

Edwin Powell Hubble

Learn about **Edwin Powell Hubble** (20 Nov 1889 - 28 Sept 1953), the inventor of the Hubble space telescope in 1929 that was launched into space by NASA in 1990 to help determine the age of the universe.

American astronomer Edwin Powell Hubble is considered the founder of extragalactic (happening outside the milky way) astronomy and observational cosmology (the study of the origin and development of the universe) and is regarded as one of the most important astronomers of all time. He provided the first evidence of the expansion of the universe.

https://www.spacetelescope.org/about/history/the_man_behind_the_name/

Here's a good video on Hubble's life and discoveries:

<https://www.bing.com/videos/search?q=Edwin+Powell+Hubble&&view=detail&mid=52DF7D1487B4C54AA9F652DF7D1487B4C54AA9F6&&FORM=VRDGAR&ru=%2Fvideos%2Fsearch%3Fq%3DEdwin%2BPowell%2BHubble%26FORM%3DHDRSC4>

Quote from Edwin Powell Hubble to discuss:

"Equipped with his five senses, man explores the universe around him and calls the adventure Science." -Edwin Powell Hubble

Every nature walk and study of the earth and sky is an adventure we go on with our five senses. The word Science comes from the Latin word Scientia. It means knowledge. Gaining knowledge (learning) is an exciting adventure.



Edwin Powell Hubble
1889 - 1953

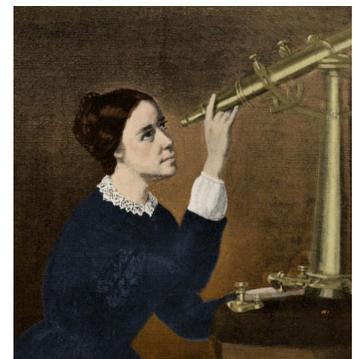
Grade 4

Discuss Great Scientists Who Studied Astronomy (cont.)

Maria Mitchell

Learn about **Maria Mitchell** (01 Aug 1818 - 28 June 1889), American astronomer, naturalist, librarian and educator who discovered a comet in 1847, for which she received a gold medal from the King of Denmark.

Maria Mitchell was the first internationally known woman astronomer. She became professor of astronomy at Vassar College in 1865. Her father taught her to use a telescope when she was a child in Nantucket.



Maria Mitchell
1818 - 1889



A good biography to read about America's first woman astronomer:

Maria Mitchell - The Soul of an Astronomer by Beatrice Gormley

A quote from Maria Mitchell to discuss:

"We especially need imagination in science. It is not all mathematics, nor all logic, but it is somewhat beauty and poetry." -Maria Mitchell

The Vatican and Its Interest in Astronomy Over Time

The Vatican is the chief residence of the pope and the place he leads the Catholic Church from.

Here is a video about the Vatican's history in astronomy through the Vatican space observatory.

What is the Vatican Observatory, and why does the Vatican have a modern telescope in southern Arizona?

https://www.youtube.com/watch?v=IDz9rFVtzaQ&feature=emb_title

Discuss this quote from the end of the video:

"If you believe in a universe that God so loved that he sent his Son, then, not only are you going to want to study the universe because it is kind of cool, [but] it's an act of worship, it's an act of getting closer to the Creator and getting closer to the universe that is cleansed and quickened by the Incarnation. Then doing science is an act of worship."

Grade 5

Discuss Great Scientists Who Studied Nature

John Muir

Learn about **John Muir** (21 April 1838 - 24 December 1914), a great Scottish-American naturalist, author, environmental philosopher and "father" of the U.S. national parks system.

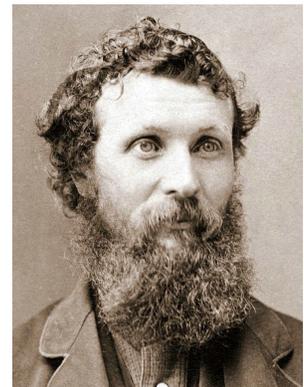
Watch this 10-minute video of John Muir's life:

<https://www.youtube.com/watch?v=-CDzhlvugw8&feature=youtu.be>

Watch this re-creation of a famous camping trip with John Muir and President Teddy Roosevelt to establish our national park system, *The Camping Trip That Changed the Nation* (1:49 minutes):

<https://nationalparksadventure.com/the-camping-trip-that-changed-the-nation/>

Here is a comprehensive web site containing more John Muir information:



John Muir
1838 - 1914



https://vault.sierraclub.org/john_muir_exhibit/bibliographic_resources/john_muir_bibliography/film_and_video.aspx

From the Sierra Club "John Muir" exhibit. A brief biography of John Muir:

https://vault.sierraclub.org/john_muir_exhibit/about/default.aspx

Discuss these John Muir quotes with your class:

"Everybody needs beauty as well as bread, places to play in and pray in, where nature may heal and give strength to body and soul." -John Muir

What do you think John Muir means when he says that we need beauty as well as bread?

What is it about nature that makes it a good place to pray in?

Are there places you like to go in nature that help refresh you in body and soul? Where?

"The grand show is eternal. It is always sunrise somewhere; the dew is never all dried at once; a shower is forever falling; vapor is ever rising. Eternal sunrise, eternal sunset, eternal dawn and gloaming, on seas and continents and islands, each in its turn, as the round earth rolls." -Muir

How is nature like a "grand eternal show?"

All of these ongoing patterns: sunshine, sunset, dawn, evaporation, rain, snow, speak to grand order and a kind of relationship. Have you thought about the wonder of nature like this?

"Keep close to Nature's heart . . . and break clear away, once in a while, and climb a mountain or spend a week in the woods. Wash your spirit clean." -Muir

How does Muir say we can help our spirit to be washed clean?

God created all of nature, so it makes sense that we experience closeness and rest with him there. How can we experience closeness and renewal with God that is even more personal, even more real, than when we experience the beauty of his creation? Can our time alone with God in nature help prepare us for this encounter?

Perhaps Muir's greatest legacy is not even wilderness preservation or national parks as such, but his teaching us the essential characteristic of the science of ecology, the interrelatedness of all living things. Muir summed it up nicely:

"When we try to pick out anything by itself, we find it hitched to everything else in the Universe." -Muir

God has created great order in the universe and everything is "hitched to everything else" because everything relates back to God -- he created each thing. God is the Father of everything, and so each thing in creation is related to God and to each other. We relate more or less to each thing in creation depending on how more or less each thing resembles God. (Rocks are like God in that they exist; plants are like God in that they have life; animals are like God in that they have a type of knowledge; persons are like God, even "made in his image," in that we have



understanding and free will and are capable of receiving God’s gifts of wisdom, faith, and grace, a share in God’s own life.)

Grade 5

Discuss Great Scientists Who Studied Nature (cont.)

Leonardo Fibonacci

In 1202, **Leonardo Fibonacci** (1175 - 1250) introduced the **Fibonacci sequence** to the Western world through his book, *Liber Abaci*.



Leonardo Fibonacci
1175 - 1250

Books About Fibonacci to Read and Discuss

Growing Patterns: Fibonacci Numbers in Nature by Sarah Campbell

Blockhead: The Life of Fibonacci by Joseph D'Agnese

Mysterious Patterns: Finding Fractals in Nature by Sarah Campbell

Watch this video that explains the Fibonacci number sequence (3:55 minutes):

<https://www.youtube.com/watch?v=ihxJN6ZC9HE>

See these common examples in nature that show the fibonacci sequence:

<http://gofiguremath.org/natures-favorite-math/fibonacci-numbers/fibonacci-in-nature/>

Here are two lessons on the Fibonacci sequence.

<https://www.mensaforkids.org/teach/lesson-plans/fabulous-fibonacci/>

Fibonacci Activity: Go outside and look for pine cones, lilies, and leaves and bring them into class and mark the fibonacci spirals and patterns you find. Record in your nature journal.

Wilson Alwyn Bentley

The Beauty and Order Found in Snowflakes

The American photographer **Wilson Bentley** (February 9, 1865 – December 23, 1931) took the first micrograph (a photograph taken by means of a microscope) of a **snowflake** in 1885.

Please read this children's tradebook about his life: *Snowflake Bentley* by Jackeuline Briggs Martin.

Here is a video of some of Bentley’s photos of snowflakes (2:08 minutes). Notice the beauty and order in the patterns:

https://www.youtube.com/watch?v=UdAK_kiFVaY



Wilson Alwyn Bentley
1865 - 1931





A quote from Mr. Bentley: “Under the microscope, I found that snowflakes were miracles of beauty; and it seemed a shame that this beauty should not be seen and appreciated by others. Every crystal was a masterpiece of design and no one design was ever repeated. When a snowflake melted, that design was forever lost. Just that much beauty was gone, without leaving any record behind.” -Wilson “Snowflake” Bentley, 1925

Snowflakes have six-fold symmetry. What does this mean?

Symmetry in Nature

Symmetry in everyday language refers to a sense of harmonious and beautiful proportion and balance. Science denotes specific characteristics of symmetry. For example, **mirror symmetry** denotes a mirror-like image: if an imaginary line is drawn down the center, aspects of the image on each side of the line must mirror one another exactly.

Symmetry is pervasive in living things. Animals mainly have bilateral or **mirror symmetry**, as do the leaves of plants and some flowers such as **orchids**. Plants often have radial or **rotational symmetry**, as do many flowers and some groups of animals such as **sea anemones**. Fivefold symmetry is found in the **echinoderms**, the group that includes **starfish**, **sea urchins**, and **sea lilies**.

Among non-living things, **snowflakes** have striking **sixfold symmetry**. **Crystals** in general have a variety of symmetries. Rotational symmetry is found at different scales among non-living things, including the crown-shaped **splash** pattern formed when a drop falls into a pond.



Animals often show mirror or **bilateral symmetry**, like this **tiger**.



Echinoderms like this **starfish** have **five fold symmetry**.



Fluorite showing cubic **crystal habit**.



Water **splash** approximates **radial symmetry**.

Here is a video of 10 examples of symmetry in nature (50 seconds):

<https://www.youtube.com/watch?v=J-ykLPy9Un8>



Symmetry Walk: Can you think of any other kinds of symmetry in nature? Go outside and take a nature walk and look for examples of symmetry. Journal your findings.

Grade 5

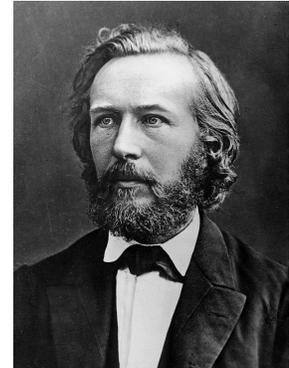
Discuss Great Scientists Who Studied Nature (cont.)

Ernst Haeckel

Ernst Haeckel (1834–1919) painted beautiful illustrations of marine organisms, in particular **Radiolaria** (Radiolarians are microscopic zooplankton and the mineralized skeletons can be found in marine sediments) emphasizing their **symmetry**.

Here is a video with music to enjoy paintings from Haeckel’s book on marine organisms that demonstrate symmetry. It is 8 minutes long and would probably best work if you watched 2 minutes or so with students:

<https://www.youtube.com/watch?v=GNQB8WnQe9Q>



Ernst Haeckel
1834 - 1919

Sir D’Arcy Wentworth Thompson

Sir D’Arcy Wentworth Thompson (1860 – 1948) was a Scottish **biologist, mathematician** and **classics scholar**. Thompson is remembered as the author of the 1917 book, *On Growth and Form*, which helped lead the way for the scientific explanation of **morphogenesis**, the process by which **patterns** and body structures are formed in plants and animals.

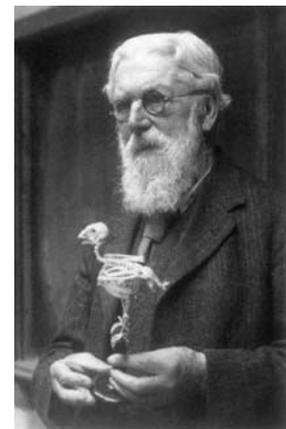
Thompson observes there are many **spirals in nature**.

Examples include:



Halved shell of *Nautilus* showing chambers in a logarithmic spiral

The spiral horns of a male bighorn sheep



Sir D’Arcy Wentworth Thompson
1860 - 1948



Here is a web site helpful to exploring spirals more with your class:

<https://thesmarthappyproject.com/spirals-in-nature/>

Spiral walk: Go outside and see if you can find and observe spirals in nature. (Hint: pine cones, fir cones and other evergreen cones, sunflowers, roses, daisies... What else?)

Thompson quoted Scripture at the end of his book, *On Form and Order*:

“Who has measured with his palm the waters, marked off the heavens with a span, held in his fingers the dust of the earth, weighed the mountains in scales and the hills in a balance?”

- **Isaiah** 40:12

Discuss this quote. What does it mean?

Quantity, measurement, has to do with material things like water, dirt, and earth as mentioned in the Scripture passage. An understanding of the measurement of patterns over time can help us describe change in matter, as Thompson helped recognize through his work in the beginning of the science of **morphology**.

The poetic expression of quantity (measurement) used here in Scripture helps us reflect that we cannot understand exactly *how* God has created things from matter, how he has given each thing its *form*, which makes it what it is.

It is also important to recognize with students that many things cannot be measured by material quantity or mathematics -- such as the things that are not material, not made up of matter, such as freedom, truth, and other spiritual realities like eternal life. These are some of the most important realities of all. (Things like light and nuclear particles, however, *are* made up of matter, which is why they *can* be measured by mathematics.)

Perhaps it is best to leave this section with a quote from **Blessed Nicolas Steno** (1 January 1638 – 25 November 1686), a great Danish pioneer anatomist, geologist, and Catholic bishop, studied in Grade 4:

“Beautiful is what we see, more beautiful is what we comprehend, most beautiful is what we do not comprehend.” -Blessed Nicolas Steno (*What is most beautiful? God.*)

Grade 5

Discuss the Great Scientist Who Founded Biogeography - Relations of Life in Nature

Alexander Von Humboldt

Alexander Von Humboldt (1769 – 1859) helped us better understand the interconnectedness of all of nature.



Alexander von Humboldt
1769 - 1859



Humboldt was the founder of the field of Biogeography. Biogeography is the branch of biology that deals with the geographical distribution of plants and animals.

Humboldt's major scientific contribution was realizing the interconnectedness of climate, geography, nature, and human societies. His ideas were revolutionary for the 19th century, and they remain relevant today for scientists studying the effects of climate change.

Alexander von Humboldt was a geographer, naturalist and explorer. He was certainly one of the most famous scientists of the 19th century. **Watch this brief but important video** about his life and travels as a scientist and his understanding of the interconnectedness of all life and nature (4:21 minutes):

<https://www.youtube.com/watch?v=EzakQuKqBeQ>

Discuss with your students how Von Humboldt blended different branches of science to come to his understanding that there is interconnectedness in nature.

Here are some samples of amazing maps Von Humboldt drew from his travels:

<https://www.smithsonianmag.com/history/pioneering-maps-alexander-von-humboldt-180973342/>

Humboldt's theory of the unity of nature, connected in a global web of life, required an interdisciplinary approach of which few of his contemporaries were capable. He drew equally from his fund of knowledge about astronomy, botany, geology, and meteorology. Sadly, as human knowledge has expanded since his time, an interdisciplinary approach to science is more and more rare. Scientific inquiry has become increasingly narrowly specialized, preventing the global view that informed Humboldt's studies. The "big picture" is lost in the compartmentalization of science into isolated, specialized scientific disciplines.

Grade 5

Discuss Great Human Life Scientists

BEAUTY, SCIENCE & ART: *Beauty in the Science and Art of Healing*

Medicine is both a **science** and an **art**: speculative knowledge is involved (*scientia*: knowledge) as well as the practical aspects of healing (*practicus*: to do, perform), which is an art. Healing is a beautiful work.

We will now learn about some great scientists in history who have studied the human body and medicine. All of these medical experts are in some real ways connected to each other through history. Each person today who is working on new breakthroughs in medicine has depended upon the work of others before them to develop this area of science to where it is today.

Plot these scientists on your timeline, or make a timeline of medicine as you learn about these scientists and others you might study.



Discuss a Great Scientist: The “Father of Medicine”

Hippocrates

Hippocrates of Kos (c. 460 – c. 370 BCE) was a Greek physician. He is a towering figure in the history of medicine, considered the "father of modern medicine." Most famously, Hippocrates and his followers came up with the [Hippocratic Oath](#) for physicians. Contemporary physicians swear an oath of office which includes aspects found in early editions of the Hippocratic Oath.

Here are a couple of quotes from Hippocrates:

"First, do no harm" ([Latin](#): *Primum non nocere*) is a part of the original Hippocratic oath.

What does this mean? Many ancient medical treatments did more harm than good to their patients. Even today, the first thing medical workers must consider when determining a treatment is whether the treatment will help their patients rather than cause harm.

“For where there is love of man, there is also love of medicine.” -Hippocrates

What does this mean?



Hippocrates of Kos
460 - 370 BCE

Discuss a Great Scientist: The Founder of Modern Human Anatomy

Andreas Vesalius

Andreas Vesalius (1514 to 1564) was a Catholic anatomist (an expert in the structure of the human body), often called the founder of modern human anatomy.

Since ancient times, the scientific prestige of Galen, a 2nd century Greek anatomist and physician, had been so great that many of his statements were accepted without question. Vesalius demonstrated that there were numerous errors in Galen’s descriptions of human anatomy.

Vesalius carried out his own dissections of human cadavers and encouraged his students to do the same. His hands-on approach and careful observation enabled him to make many anatomical discoveries. In 1543, he published his epoch-making multi-volume work, *On the Fabric of the Human Body*, which was filled with richly detailed illustrations of every part of the human body that were far superior to those of earlier books. This work is regarded as a major advance in the history of anatomy.

Here's a couple of pictures of drawings from this 1543 book:

https://upload.wikimedia.org/wikipedia/commons/3/35/Vesalius_Fabrica_p174.jpg



Andreas Vesalius
1514 - 1564



Here is a drawing of Vesalius holding a class of a public dissection of a human cadaver:

https://upload.wikimedia.org/wikipedia/commons/e/ee/Vesalius_Fabrica_fronticepiece.jpg

Here is a seven minute video on Vesalius. Notice the reference about 5 minutes in where the professor explains that Vesalius believed that knowledge of the human body leads to knowledge of God, the creator:

https://www.youtube.com/watch?time_continue=2&v=ZhnDcPdS4NA&feature=emb_title

Discuss a Great Scientist: The Founder of Microbiology

Antonie van Leeuwenhoek

Antonie van Leeuwenhoek (1632 - 1723) was born in Delft, Netherlands. He is known as "the father of **microbiology**" and is best known for his work to improve the **microscope**. Using his handcrafted microscopes, he was the first to see and describe single **celled organisms**.

Antonie van Leeuwenhoek was an unlikely scientist. A tradesman of Delft, Holland, he came from a family of tradesmen, had no fortune, received no higher education or university degrees, and knew no languages other than his native Dutch. This would have been enough to exclude him from the scientific community of his time completely. Yet with skill, diligence, an endless curiosity, and an open mind free of the scientific dogma of his day, van Leeuwenhoek succeeded in making some of the most important discoveries in the history of biology. It was he who discovered bacteria, free-living and parasitic microscopic protists, blood cells, and other microscopic cells, and much more. His research, which was widely circulated, opened up an entire world of microscopic life to the awareness of scientists.

Watch this two-minute video on van Leeuwenhoek's life:

https://www.youtube.com/watch?v=c_BiLl2v6OE

Here is some bacteria, which van Leeuwenhoek was the first person ever to see:

https://www.researchgate.net/figure/Oral-bacteria-observed-by-Anton-van-Leeuwenhoek-and-their-contemporary-equivalents-a_fig2_5784039

Here is a picture of van Leeuwenhoek's microscope:

https://commons.wikimedia.org/wiki/File:Leeuwenhoek_Microscope.png#/media/File:Leeuwenhoek_Microscope.png

A quote from van Leeuwenhoek to discuss with your class:

"We cannot in any better manner, glorify the Lord and Creator of the Universe, than that, in all things, however small soever they appear to our naked eyes, but which yet have received the gift of life, and power of increase, we contemplate the display of his Omniscience and Perfections with the utmost admiration." -Antonie van Leeuwenhoek



Antonie van Leeuwenhoek
1632 - 1753



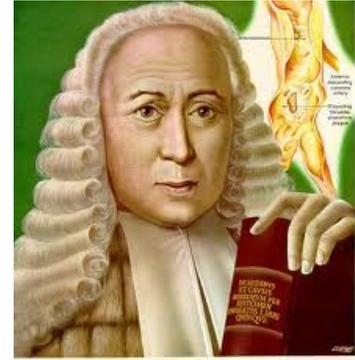
What does this passage mean in total?

How does van Leeuwenhoek contemplate the display of God's "Omniscience and perfections with the utmost admiration?"

Discuss a Great Scientist: The Founder of Anatomical Pathology (Causes and effects of diseases)

Giovanni Battista Morgagni

Giovanni Battista Morgagni (1682 to 1771) was an Italian anatomist and pathologist who is considered the founder of anatomical pathology (the science of the causes and effects of diseases). Before Morgagni, anatomical knowledge had reached a high level as the result of the research of [Vesalius](#) and many others but it was mainly knowledge about healthy human bodies. Morgagni undertook to study diseased organs and parts of the human body with the goal of understanding the origins of illnesses. In 1761, he published his monumental treatise, *On the Causes of Diseases Investigated Through Anatomy*, based on 646 dissections, many of which are described with great precision and detail.



Giovanni Battista Morgagni
1682 - 1771

Morgagni was one of the most respected scientists of his time and was elected a fellow of the Royal Society of London in 1724, the *Académie des Sciences* of Paris in 1731, and other scientific societies throughout Europe.

Here is a drawing of Morgagni:

<https://link.springer.com/article/10.1007/s12565-016-0373-7/figures/3>

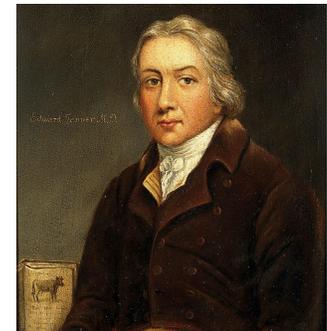
Morgagni had ten children who survived to adulthood, of whom eight became Catholic religious sisters, one became a priest, and one entered the medical profession.

Discuss a Great Scientist: The Father of Immunology

Edward Jenner

Edward Jenner (1749 – 1823) was an English [physician](#) who was a contributor to the development of the [smallpox vaccine](#). The practice of vaccination was popularized by Jenner, and since then has been used widely to prevent several diseases. He is one of the most famous scientists in medical history and is called the "Father of Immunology."

150 years after Jenner's death in 1823, smallpox was drawing to an end. It would eventually be eradicated after a massive surveillance



Edward Jenner
1749 - 1823



and vaccination program, thanks largely to the initial efforts of the Father of Immunology, Jenner.

Here's a video about how Jenner did it:

<https://www.youtube.com/watch?v=yqUFy-t4MIQ>

Discuss a Great Scientist: The Developer of the Germ Theory of Disease

Louis Pasteur

Louis Pasteur (1822 – 1895) was a French microbiologist and chemist. He and his wife, Marie, are best known for their experiments supporting the germ theory of disease, and he is also known for his vaccinations, most notably the first vaccine against rabies. He is the person who came up with how to keep milk from spoiling; it's named after him and is called pasteurization.

https://kids.kiddle.co/Louis_Pasteur

Watch this good video to learn of Pasteur's impact:

https://www.youtube.com/watch?time_continue=1&v=OXdbQ1JkX7c&feature=emb_title

Here are a couple of quotes by Pasteur to discuss with your class:

"Happy the man who bears within him a divinity, an ideal of beauty and obeys it; an ideal of science, an ideal of country, and an ideal of the virtues of the gospel." -Louis Pasteur

"These are the living springs of great thoughts and great actions. Everything grows clear in the reflections from the Infinite." -Pasteur

How is this first quote a well rounded description of someone we would like to know and be friends with ?

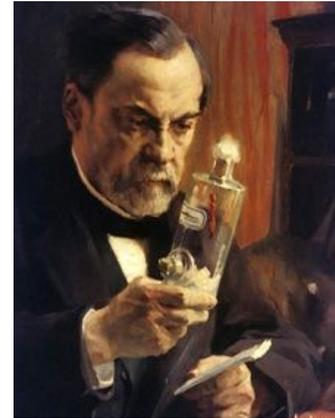
Pasteur seems to say in his second quote that great thoughts and actions stem from where?

- Here's a story of Pasteur's encounter with a proud student on a train:

More than a century ago a proud university student boarded a train in France and sat next to an older man who seemed to be a peasant of comfortable means. The brash student noticed that the older gentleman was slipping beads through his fingers. He was praying the rosary.

"Sir, do you still believe in such outdated things?" the student inquired.

"Yes, I do. Don't you?" the man responded. The student laughed and admitted, "I do not believe in such silly things. Take my advice. Throw the rosary out the window and learn what science has to say about it."



Louis Pasteur
1822 - 1895



"Science? I do not understand this science. Perhaps you can explain it to me," the man said humbly, tears welling in his eyes.

The university student noticed that the man was deeply moved. To avoid further hurting the older person's feelings, he said, "Please give me your address and I will send you some literature to explain the matter to you." The man fumbled in the inside pocket of his coat and pulled out his business card. On reading the card, the student lowered his head in shame and was speechless. The card read: "Louis Pasteur, Director of the Institute of Scientific Research, Paris." The science student had encountered his country's leading chemist and bacteriologist.

Discuss a Great Scientist: The Founder of the Science and Art of Modern Nursing

Florence Nightingale

Florence Nightingale (1820-1910) changed the way that hospitals cared for their patients. Before her great work, hospitals were overcrowded and dirty places filled with rats. This meant that germs and diseases were easily spread and the environment often made it impossible for healing to occur. Nurses were badly trained or not educated at all, so people did not often get the care they needed. Often a majority died.

Florence changed all of this by making hospitals cleaner and healthier places. She made sure patients received the care necessary for healing to occur, which included having good food to eat among many other factors. She taught that the environment is of prime importance in aiding the process of natural healing, and she developed standards for setting up that environment in hospitals and places where sick people were cared for. She developed the education and training of nurses through both science and art so patients could be cared for in the most educated and professional manner.

Nightingale's founding of the science and art of modern nursing changed the care of the ill forever, and this has saved countless lives. Florence Nightingale recognized that the care of the ill is not only a science and art, but a beautiful and noble vocation.

On a very normal day in 1837, Florence felt as though she was called by God to go into the field of nursing:

https://www.youtube.com/watch?time_continue=3&v=ZowcEM-K1QU&feature=emb_title

Quotes by Florence Nightingale to discuss:

"Live your life while you have it. Life is a splendid gift. There is nothing small in it. For the greatest things grow by God's Law..." -Florence Nightingale

"How little can be done under the spirit of fear." -Nightingale



Florence Nightingale
1820 - 1910



"Nursing is an art; and if it is to be made an art, it requires an exclusive devotion as hard a preparation as any painter's or sculptor's work..." -Nightingale

What did Florence Nightingale say about life?

Did Florence Nightingale believe that great things grow by God's Law?

What did Florence Nightingale say about the spirit of fear?

What did Florence Nightingale mean by "exclusive devotion" and "hard preparation?"

Discuss a Great Scientist: Founder of the Science & Techniques to Prevent Infection and Death

Joseph Lister

Joseph Lister (5 April 1827 – 10 February 1912) was a British surgeon and a pioneer of antiseptic surgery. Lister promoted the idea of sterile surgery while working at the Glasgow Royal Infirmary.

Before he was 16 years old, Lister learned by making dissections under the microscope given to him by his father. He published a pamphlet called "The Use of the Microscope in Medicine" while still in college.

Joseph Lister was a Christian who lived out what he believed. People witnessed that he was never known to raise his voice in anger, and if he thought he had offended anyone, he apologized immediately and asked their pardon.

Here are some facts about Lister's life:

https://kids.kiddle.co/Joseph_Lister

Here's a two-minute video on Lister's life:

https://www.youtube.com/watch?v=lkzX4ty_jPO

Quotes from Joseph Lister:

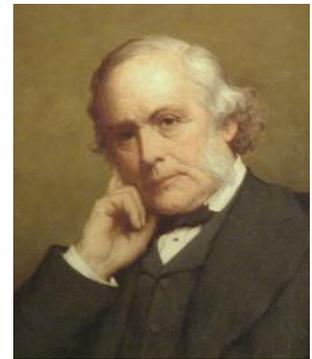
"I am a believer in the fundamental doctrines of Christianity." -Joseph Lister

Lister told a graduating medical class: "It is our proud office to tend the fleshly tabernacle of the immortal spirit, and our path, if rightly followed, will be guided by unfettered truth and love unfeigned. In pursuit of this noble and holy calling I wish you all God-speed." -Lister

Did Dr. Lister state that "unfettered" truth and love are important and right parts of the science of medicine? What does "unfettered" mean?

Did Joseph Lister value life?

Like Florence Nightingale, did Joseph Lister view work in medicine as a holy vocation (calling)? Where do holy vocations come from? Have you talked with God about what your calling might be? What do you like? What do you feel drawn toward?



Joseph Lister
1827 - 1912



When Dr. Lister wished the graduating medical class “God-speed,” what did he mean? Was this a prayer that they be guided by God in their noble work as new doctors?

Discuss a Great Scientist: Nobel Prize Winner and Pioneer in Radiology

Marie Curie

Marie Curie (1867 – 1934) was a Polish-French physicist and chemist. She did research on radioactivity with her husband, Pierre. When Pierre died suddenly, Marie took over his professorship at the University of Paris and became the first woman professor there.

Just before World War I, radium institutes were established for Marie in France and in Poland so she could pursue the scientific and medical uses of radioactivity. During the war, Curie organized a field system of portable X-ray machines to help in treating wounded French soldiers.

https://www.youtube.com/watch?v=w6JFRi0Qm_s

Marie became the first woman to win a Nobel Prize. She received the prize in physics for her research on uncontrolled radiation, which was first discovered by Henri Becquerel. Marie then became the first person to win two Nobel Prizes. In addition, she is the only Nobel Prize winner who is also the mother of a Nobel Prize winner. Marie and Pierre’s daughter, Irène Joliot-Curie, won the Nobel Prize in Chemistry in 1935 jointly with her husband, Frederic Joliot-Curie, for the discovery of artificial radioactivity.

Books About Marie Curie to Read and Discuss

Marie Curie by Kathleen Krull ISBN 978-0-670-05894-5

Marie Curie by Philip Steele ISBN 978-1-4263-0249-7

A quote by Marie Curie to discuss:

"I am among those who think that science has great beauty. A scientist in his laboratory is not only a technician: he is also a child placed before natural phenomena which impress him like a fairy tale." -Marie Curie

Have you experienced the wonder of examining phenomena of nature? How was this beautiful?

A quote by Marie Curie’s daughter, Irène Joliot-Curie:

"That one must do some work seriously and must be independent and not merely amuse oneself in life—this our mother has told us always, but never that science was the only career worth following." -Irène Joliot-Curie



Marie Curie
1867 - 1934



Discuss a Great Scientist: Geneticist and Pediatrician Who Cherished Life Through His Work

Servant of God Jérôme Lejeune

Jérôme Jean Louis Marie Lejeune (1926 - 1994) Lejeune was a French geneticist and pediatrician most famous for discovering in 1958, in collaboration with Raymond Turpin and Marthe Gautier, that Down Syndrome is caused by an extra copy of chromosome 21. This was the first time that an intellectual disability was shown to be the result of a chromosomal abnormality. Lejeune went on to discover the connection between several other diseases and chromosomal abnormalities.



Jerome Lejeune
1926 - 1994

Dr. Lejeune was a Catholic and father of five. His discoveries led him to think in terms of improving the lives of those with trisomy 21 or Down Syndrome. Thousands of families corresponded with him and came from all over the world to seek his counsel. Dr. Lejeune offered them a different perspective than the world's, encouraging them to see that their children were created in God's image and made for eternity, like all of us. He assured them their children possessed special gifts of love and affection.

Lejeune was very outspoken in defense of the unborn and was named the first President of the Pontifical Academy for Life. He has been named a "Servant of God" by the Catholic Church, the first stage in the process of canonization.

Discuss these quotes from Dr. Lejeune:

"Human genetics can be summarized in this basic creed: **In the beginning is the message, and the message is in life, and the message is life. And if the message is a human message, then the life is a human life.**" -Dr. Jerome Lejeune

"We need to be clear: **The quality of a civilization can be measured by the respect it has for its weakest members.** There is no other criterion." -Lejeune

"The absolute superiority, the complete novelty of humanity, is that no other creature can experience a kind of complicity between the laws of nature and its awareness of its own existence. The **ability to admire exists only in human beings. Never in the history of gardening have we seen a dog smell the scent of a rose.** Nor has a chimpanzee ever gazed at the sunset or the splendor of a starry sky." -Lejeune

How does the first quote explain that all human life is valuable and has dignity?

In the second quote, what determines the quality of a civilization?

In the third quote, Lejeune is arguing for the uniqueness of the human person. What are his examples to show this uniqueness of the human person? What are some other examples?



Grade 5

Discuss Great Scientists Who Studied Matter & Energy

Anders Celsius

Anders Celsius (1701 - 1744) was an astronomer who became famous for discovering a temperature scale that is named after him: the Celsius scale.

Anders Celsius based his scale upon the boiling and melting points of water. Celsius's fixed scale for measuring temperature defines zero degrees as the temperature at which water freezes, and 100 degrees as the temperature at which water boils. This scale, an inverted form of Celsius's original design, was adopted as the standard and is used in almost all scientific work.

Here is a brief video about Anders Celsius and his work:

<https://www.youtube.com/watch?v=XKB99pFnYII>



Anders Celsius
1701 - 1744

James Clerk Maxwell

James Clerk Maxwell (1831 - 1879) was a brilliant Scottish mathematical physicist. He made great advances in electromagnetism and the kinetic theory of gases in particular.

Here's a video briefly explaining his discovery of the relationship between magnetism and electricity:

<https://www.youtube.com/watch?v=44SI1D5UGrg>

“Maxwell is generally considered the greatest theoretical physicist of the 1800s, if not the century's most important scientist. He combined a rigorous mathematical ability with great insight into the nature of science. This ability enabled him to make brilliant advances in the two most important areas of physics at that time (electromagnetism and a kinetic theory of gases), in astronomy, and in biology as well.”

<https://www.eia.gov/kids/history-of-energy/famous-people/maxwell.php>

Quotes from Maxwell to discuss:

“Almighty God, Who hast created man in your own image, and made him a living soul that he might seek after Thee, and have dominion over Thy creatures, teach us to study the works of Thy hands, that we may subdue the earth to our use, and strengthen the reason for Thy service.” -James Maxwell



James Clerk Maxwell
1831 - 1879



Does Maxwell think that working hard in science is a way to seek after God?

Why does Maxwell pray to God before he tries to understand things of science?

Was Maxwell successful by combining his faith with his work to make important scientific discoveries?

“Happy is the man who can recognize in the work of to-day a connected portion of the work of life and an embodiment of the work of Eternity. The foundations of his confidence are unchangeable, for he has been made a partaker of Infinity.” -James Maxwell

What does Maxwell think happiness is?

Does Maxwell see his own work in science each day as a participation in “the work of life,” in God’s work of creation? Does this give Maxwell great confidence? Why?

Do you know people today who see their work as a participation in the larger “work of life,” in God’s work, and ask God to help them accomplish it however God would like them to? Who?

James Prescott Joule

James Prescott Joule (1818 - 1889) was an English physicist and mathematician who studied the nature of heat and its relationship to mechanical work (energy).

James Joule's experiments with chemical properties, heat, and electricity led to the field of science called "thermo-dynamics." Joule determined that heat is a form of energy and that energy can be changed from one form to another. He shares credit for discovering the law of the conservation of energy, which says that energy used in one form will reappear in another and will never be lost. In 1840, he declared another law of science that says that heat is produced in an electrical conductor and is now called Joule's Law. The international unit of energy, the joule, is named in his honor.



James Prescott Joule
1818 - 1889

Here is a brief biography of James Joule:

<https://www.youtube.com/watch?v=e-LIAgs3GP8>

Quotes by James Joule:

“Order is manifestly maintained in the universe... governed by the sovereign will of God.”
-James Prescott Joule

Did James Joule study order in the universe? How? Through laws of energy.

“After the knowledge of, and obedience to, the will of God, the next aim must be to know something of His attributes of wisdom, power, and goodness as evidenced by His handiwork.”
-Joule

What is God’s “handiwork” that Joule speaks of? Creation. Our discoveries about nature.



Does Joule view discoveries in science as coming to “know something of [God’s] attributes?”

“Believing that the power to destroy belongs to the Creator alone I affirm... that any theory which, when carried out, demands the annihilation of force, is necessarily erroneous.” -Joule

Is Joule talking about a scientific law here? Can you guess which one? The conservation of energy, the first law of thermodynamics.

Does Joule’s study of the conservation of energy help him reflect on the attribute of God alone as all-powerful?

Max Planck

Max Planck (1858 - 1947) was a German theoretical physicist who developed the **quantum theory**, which gave important understandings about atomic and subatomic processes. He won the Nobel Prize.

https://kids.kiddle.co/Max_Planck

Discuss these quotes from Max Planck:

“While both religion and natural science require a belief in God for their activities, to the former He is the starting point, to the latter the goal of every thought process. To the former He is the foundation, to the latter the crown of the edifice of every generalized world view.” -Max Planck

Planck says that both religion and science require a belief in God for their activities. What role does Planck say God plays in religion? The starting point.

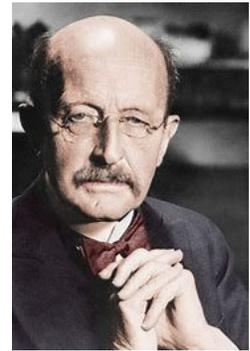
What place does Planck say God plays in science? The goal of every thought process.

What does Planck mean by this? 1. God is the subject of religion and we begin the study of religion with the truths that God has revealed to us.

2. Science starts with the matter of the world that God has created, and its goal is always to seek further through. God is truth, and the goal of every scientific though process is to seek the truth yet unknown, which is always of God.

“No matter where and how far we look, nowhere do we find a contradiction between religion and natural science. On the contrary, we find a complete concordance in the very points of decisive importance. Religion and natural science do not exclude each other, as many contemporaries of ours would believe or fear; they mutually supplement and condition each other. The most immediate proof of the compatibility of religion and natural science, even under the most thorough scrutiny, is the historic fact that the very greatest natural scientists of all times -- men such as Kepler, Newton, Leibnitz -- were permeated by a most profound religious attitude.” -Planck

Planck does not see a contradiction between religion and science. What’s his “immediate proof” of this claim?



Max Planck
1858 - 1947



Cosmology: the science of the origin and development of the universe

The term “cosmology” comes from the Greek word “kosmos,” which means “world.” It is the study of the origin, evolution, and eventual fate of the universe; the study of the large scale properties of the universe as a whole. Like any field of science, cosmology involves the formation of theories or hypotheses about the universe, theories which make specific predictions for phenomena that should be testable with observations. The observations may cause the theories to be abandoned or to be revised to accommodate the data. For much of science’s history, the prevailing theory about the origin and evolution of the universe was the theory, dating back to Aristotle, that the universe was eternal, unchanging, not evolving, with neither beginning nor end. Observations in the 20th century caused that theory to be abandoned, and currently the prevailing theory about the origin and evolution of our Universe is the so-called Big Bang theory, first developed by [Fr. Georges Lemaître](#) in the 1920s.

View this two-minute video on cosmology:

<https://www.bing.com/videos/search?q=what+is+cosmology&docid=608010448027585141&mid=4292F61DFB610B8FA9C44292F61DFB610B8FA9C4&view=detail&FORM=VIRE>

What is the current prevailing theory about the origin and development of the universe ?

The Big Bang Theory

View these facts about the Big Bang theory: https://kids.kiddle.co/Big_Bang

The scientist who developed the Big Bang theory was a Catholic Priest named **Rev. Msgr. Georges Lemaître**.

Rev. Msgr. Georges Lemaître

Msgr. Georges Lemaître (1894 - 1966) was a Belgian Catholic priest, mathematician, astronomer and professor of physics at the Catholic University of Louvain. He developed the Big Bang theory and the theory of an expanding universe.

Learn about Msgr. Lemaître’s work here:

https://kids.kiddle.co/Georges_Lemaître

Read this quote from Lemaître and discuss with students. He is speaking about how the world began.

“The question if it was really a beginning or rather a creation, something started from nothing, is a philosophical question which cannot be settled by physical or astronomical considerations.” -Msgr. Georges Lemaître

Discussion:

Msgr. Lemaître, a great physicist, is making the distinction between what we can know about material things, like the world and energy, and what we can know about things that are not



Rev Msgr Georges Lemaître
1894 - 1966



material, like how something is created out of nothing, which is beyond the laws of material things.

We can have modern scientific understanding about material things, but we can't have physically scientific understanding about things beyond material things because physical science deals only with what is material.

We can have philosophical understanding about things that are not material, however, through the philosophical science called metaphysics. (Science is actually a word that means "knowledge." We often use it in place of "physical science" and this leads to confusion. We can begin to think that all science, all knowledge, is only about material, physical things. This is certainly not the case.)

Msgr. Lemaitre recognizes both material and nonmaterial things, because reality is made up of both. He could see this clearly because the data he collected through his scientific observations of retracting and expanding galaxies offered the physically scientific, or material, explanation for something that went beyond what material explanation could account for. He understood that both physical science and philosophical science are necessary to give a full explanation of reality. The philosophy that goes beyond material science is called metaphysics. Meta is the Greek word for "beyond" or "after." It means "what comes after the physical or material." Metaphysics is the intellectual science that studies the realities that go beyond physical, material realities.

What are the limits of the Big Bang theory?

The Big Bang theory doesn't explain how something could be created from nothing. This is a question that is beyond physical science, which concerns itself only with the study of physical realities. The question of creating something from nothing is a question for philosophy (the science of metaphysics) and the science of theology.

A distinctly Christian approach to science is expressed by Lemaître in his original work on the primeval atom, or his Big Bang theory.

"We cannot end this rapid review which we have made together of the most magnificent subject that the human mind may be tempted to explore without being proud of these splendid endeavors of Science in the conquest of the Earth, and also without expressing our gratitude to One Who has said: "I am the Truth," One Who gave us the mind to understand him and to recognize a glimpse of his glory in our universe which he has so wonderfully adjusted to the mental power with which he has endowed us." -Msgr Georges Lemaitre

What does Msgr Lemaitre say his explorations in physical science have given him a glimpse of?

Lemaitre celebrates that we can understand our universe. To whom does he give the credit for this? How?



Appendices

Biographies of Scientists

Read out loud at least one biography of a naturalist/scientist per month and discuss the wonder, reverence, and beauty these scientists and naturalists found in God's creation, nature. Also, discuss how these scientists and naturalists have served others through their work. This list is not comprehensive.

Out of School and Into Nature by Suzanne Slade (The Anna Comstock Story/Nature study)

Planting the Trees of Kenya: The Story of Wangari Maathai by Claire Nivola

A Weed Is a Flower: The Life of George Washington Carver by Alik

John Muir: America's Naturalist by Thomas Locker

The Girl Who Drew Butterflies, How Maria Merian's Art Changed Science by Joyce Sidman

The Tree Lady: The True Story of How One Tree Loving Woman Changed a City Forever by H. Joseph Hopkins

Small Wonders by Matthew Clark Smith (about Jean Henri Fabre/Insects)

Blockhead: The Life of Fibonacci by Joseph D'Agnese, Hardcover

The Friar Who Grew Peas, Fr. Gregor Mendel by Cheryl Bardoe

Rachel Carson: Preserving a Sense of Wonder by Thomas Locker (about Rachel Carson/Environment)

Rachel Carson and Her Book That Changed the World by Laurie Lawlor

Seeds of Change: Wangari's Gift to the World by Jen Fullerton Johnson

Into the Woods: John James Audubon by Robert Burleigh

The Boy Who Drew Birds: A Story of John James Audubon by Jacqueline Davies

Uncovering Plate Tectonics by Greg Young (Alfred Wegener) ISBN 978-0-7439-0560-2

The Girl Who Could Dance in Outer Space by Maya Cointreau (Mae Jemison/Space Flight)

Maria Mitchell - The Soul of an Astronomer by Beatrice Gormley

Neo Leo: The Ageless Ideas of Leonardo da Vinci by Gene Baretta

Black Pioneers of Science and Invention by Louis Haber ISBN 0152085661

Five Brilliant Scientists by Lynda Jones ISBN 0590480316

Great Scientists by Jacqueline Fortey ISBN 978-0-7566-2974-8

Snowflake Bentley by Jacqueline Briggs Martin

Shark Lady: The True Story of How Eugenie Clark Became the Ocean's Most Fearless Scientist by Jess Keating



Swimming with Sharks: The Daring Discoveries of Eugenie Clark by Heather Lang

The Brilliant Deep: Rebuilding the World's Coral Reefs by Kate Messner

Life in the Ocean: The Story of Oceanographer Sylvia Earle by Claire A. Nivola

The Fantastic Undersea Life of Jacques Cousteau by Dan Yaccarino

Marie Curie by Kathleen Krull ISBN 978-0-670-05894-5

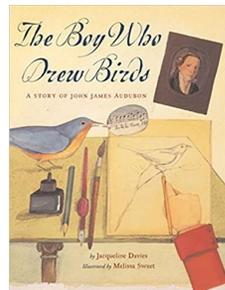
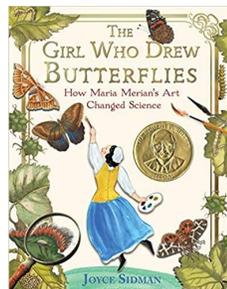
Marie Curie by Philip Steele ISBN 978-1-4263-0249-7

Recommended Classroom Poetry Books

Diocese of Marquette Anthology of Poetry and Prose, Volumes 1-3

Sing a Song of Seasons: A Nature Poem for Each Day of the Year selected by Fiona Waters, illustrated by Frann Preston-Gannon

In addition, a supplemental poetry list has been included in your binder.



“Ever since the beginning of the world, his invisible nature, namely his eternal power and deity, has been clearly perceived in the things that have been made.” Romans 1:20

“For from the greatness and beauty of created things comes a corresponding perception of their Creator.” Wisdom 13:5



Four General Areas: Background of the Grades 1 - 5 Science Curriculum

The following four general areas of the elementary science curriculum: General Objectives, General Skills, Integration of Studies, and Nature Study Teacher Orientation provide the background for the Diocese of Marquette elementary science curriculum.

1) General Objectives in elementary science classes, Grades 1-5

The overall objective of instruction is that the student come to know, wonder about and understand nature as real and as a gift to reverence.

We begin by discovering things in nature that really exist, that have real being, and we come to know them through our senses. We take time to really “see” these beings; we observe closely with all our senses and we wonder (ask questions) and reflect on relations.

We teach about real living organisms in nature and learn about their structures and functions, life cycles, offspring, habitats and ecosystems by beginning with each organism itself as a whole.

Success in our approach results from field work that takes place outdoors in nature; we observe real organisms outside. While indoors, we continue observing real organisms by using terrariums, aquariums, ant farms, plant boxes, etc. With an attitude of reverence (considering other beings as gifts to receive) we observe, wonder, ask questions, record, analyze, see connections, classify and order.

The abilities to understand, classify and order involve seeing relations between beings.

We recognize that “relation” includes such things as connectedness (“It reminds me of...”), time (dates, times of day, seasons, sequences), place (geography, habitat, environment), relations that exist between organisms (ecosystems, symbiosis, generation -i.e. parent/offspring), relations that exist within organisms (body parts and body systems; the body and the body’s soul as its life-giving principle, etc.), and the relation of “knowing” that simple existence gives: when a being exists, it is able to be known by another.

We understand the distinction between living and non-living things; we recognize the “form” (also called the “soul”) of a living being to be its “animating principle” -- what gives a living thing its life and makes it a whole. Living things include plants, non-rational animals and human persons.

We learn to value nature as a gift from God and be a steward of natural resources. Learning to reverence nature, both living and nonliving, prepares one to become a steward of nature.

Every effort is to be made to incorporate cross curricular touchpoints between science and all subjects including religion, math, Latin, literature, geography, health, history, art, music, etc.

We learn that the Catholic Church has engaged in and supported the study of science throughout history.

We learn about great experiments, inventions, and scientists’ lives throughout history.



We learn about the basic properties and utilizations of various substances and materials.

We learn about basic definitions and principles of energy through experience with common phenomena and materials.

We learn a basic understanding of climate, soil, rocks and minerals, the water cycle and patterns in the earth's physical features.

We learn a basic understanding of the solar system and the universe.

We learn to know and understand our human bodies according to our reality as persons, made in the image of God and in relation with him at all times and with others.

We understand our place in relation with God and with all of creation both in humility as one creature among a multitude and according to our great dignity as beloved person.

2) General Skills in elementary science classes, Grades 1- 5

The student will:

Learn to observe with all senses through nature walks. (Nature “walks” include planned, focused activities while outside.)

Learn to appreciate, wonder and ask questions about living organisms and nonliving things in nature as much as possible.

Distinguish easily through experience the differences between living and nonliving things (include technology in relation to nonliving things for older students).

Learn to classify and identify organisms. Regarding classification in biology, we present the classical Linnaean taxonomic categories (Kingdom, Phylum, Class, Order, Family, Genus and Species).

Use scientific nature journals while studying natural organisms. Each journal entry is to have a clear structure.

Learn various means of recording, quantifying, analyzing and interpreting data.

Learn to know the natural and built environments in their neighborhood, to observe the changes happening therein, and to know about their home region.

Learn to obtain information about nature and the environment by observing, investigating and using a variety of source materials such as field guides and excellent nonfiction trade books.

Learn to use simple research tools and to describe, quantify, compare and classify their observations.

Learn to perform simple scientific investigations and experiments.

Learn to represent information about the natural environment and its phenomena by different means, including models.



Through observation, learn about the features of the changing of seasons and know how to describe how organisms adapt to the different seasons.

Through experience, understand the transformation of a substance into another substance.

Learn to care for living things.

3) Integration of science study with other learning areas

Nature, Creation, God, Scripture, Poetry and Literature, History, Beauty, Goodness and Truth

Frequently read poetry with nature themes out loud to your students, if possible related to the organism you are studying at the time. Memorize simple stanzas, then recite them while on nature walks.

Read passages from scripture that relate to nature to help children see creation as good and beautiful and a gift from God. (See list in your binder.) Again, simple memorization with recitation while outdoors is encouraged.

Share beautiful paintings, art and video of nature scenes and particular organisms with students.

Choose science trade books that have the highest quality illustrations.

Look for aspects of order and symmetry in the beauty of nature to point out to students.

Explain how creation is an outward sign of God's love and goodness.

Help students understand connections between what we learn in nature study and other areas (i.e. care for ourselves and care for nature is inseparable from care for our neighbor).

Connect the *Ruah Woods Theology of the Body* material you are studying with the study of all nature and creation in science to better understand the human person's unique role in nature and creation as child of God.

Teach your students through the lives of scientists that scientific knowledge is a call to serve others.

Teach topics in science from a historical point of view when you are able, such as the development of man's efforts at flight, advent of the microscope and other key experiments and discoveries. Plot these on your timelines. (Each student should keep a comprehensive working timeline to plot points of interest across all subject areas, including those of science.)

Be comfortable using the term "creation" interchangeably for the term "nature" when appropriate.

4) Teacher Orientation: Prepare for Nature Studies

***Students should take frequent nature walks and learn as much as possible through a real experience of nature. Nature itself should be teaching the children. **Plan to take a nature walk outside at least every other week during the fall and the spring; weekly is optimal.** Nature walks in winter are also encouraged. Winter walks bring a fascination all their own and some areas of exploration, such as animal tracking and the hunt for the snowshoe hare, are at their best.



(Resources follow to assist with teacher preparation for fruitful student nature studies. Please see the Diocese of Marquette Science Curriculum, Grades 1 - 5, posted on the diocesan website at www.dioceseofmarquette.org to access the full science curriculum.)