

Finding Wonder: Three Girls Who Changed Science

by Jeannine Atkins

EDUCATION RESOURCE GUIDE: DISCUSSION QUESTIONS AND ACTIVITIES

Discussion Questions:

1. By citing examples from each of the stories, please list the characteristics that the heroines, Maria Sibylla Merian, Mary Anning, and Maria Mitchell, have in common.

Answers:

All found ways to honor their beliefs while pursuing scientific truths.

All fought or found their way around discrimination.

They all explored what was (is) hidden.

All were curious and brave.

They all knew people who were afraid.

All were brought up with a strong religious upbringing.

2. What does it mean to be superstitious?
3. What does it mean to be scientific?
4. What are the superstitions and/or belief systems that Maria, Mary, and Maria needed to overcome?

Answers:

Maria Sibylla Merian – shapeshifters

Mary Anning – curiosities that bring good luck; it was also believed that the curiosities turn people first to snakes and then to stone.

Maria Mitchell – beliefs held by the Quakers

5. What is the significance of the first part of the book's title *Finding Wonders: (Three Girls Who Changed Science)*?
6. Each of the girls' fathers was the greatest influence on their lives. Who has had the greatest influence on your life, so far?
7. What professional inroads did Maria, Mary, and Maria establish for women working in the sciences today?

Activities:

Observation and critical thinking skills are key components in the study and practice of the arts and sciences. In *Finding Wonders: Three Girls Who Changed Science*, the young scientists—Maria Sibylla Merian, Mary Anning, and Maria Mitchell—use all five senses to make keen observations; comparing and contrasting, assessing, evaluating, and drawing insightful conclusions about the subjects each studies. These activities will help your students hone their observational and communications skills.

NATURE STUDIES (MARIA SIBYLLA MERIAN)

NATURE SKETCHBOOKS AND NOTEBOOKS: INCREASING OBSERVATION SKILLS BY COMPARING AND CONTRASTING NATURE SPECIMENS

When students draw nature specimens, they have to take the time to look and then make thoughtful observations. When students make drawings of two specimens, they learn to compare and contrast.

Because the major storytelling agents of our time are predominantly visual and verbal, young people today have difficulty writing descriptive passages. When students are able to take the time to observe nature, reflect on it, and then draw nature specimens, comparing and contrasting one to another—they will then have a more in-depth sensory experience that they can draw upon when writing.

Materials needed:

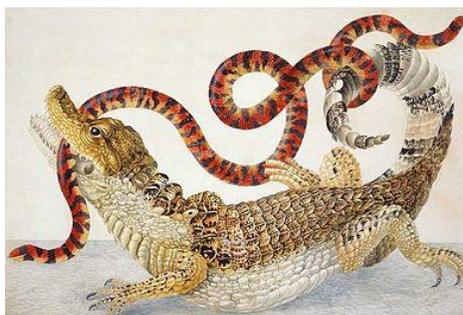
Drawing instruments and painting supplies (personal choice): graphite pencils, colored pencils, markers, erasers, watercolor paints and brushes, etc.

Sketchbooks

Notebooks

Dictionary

Thesaurus



Introduce your students to the nature drawings and paintings of Maria Merian at:

<http://www.botanicalartandartists.com/about-maria-sibylla-merian.html>

https://en.wikipedia.org/wiki/Maria_Sibylla_Merian

<http://gdz.sub.uni-goettingen.de/dms/load/toc/?PPN=PPN477653782>

http://lhldigital.lindahall.org/cdm/ref/collection/nat_hist/id/1049

Discuss Maria Sibylla Merian’s drawings and paintings:

Have students comment on subject matter, the color choices, the details, the placement of the subjects on the page.

Nature Sketchbooks:

Have your students create nature sketch diaries. They may use any drawing utensils they like. Encourage them to do a sketch a day. Ideas for their sketchbooks:

1. Insects are everywhere, in both urban and rural settings. Have your students draw the insect life at home and in school and their neighborhoods, doing detailed drawings based on in-depth observations.
2. Draw pets at home and in the neighborhood. Encourage students to make quick gestural, action sketches of neighborhood pets and detailed drawings of pets while they sleep. Then have them make drawings comparing one dog or cat to another. What are the two dogs’ similarities? What makes them different. They can also use photo references for these sketches.
3. Have your students collect leaves from a wide variety of trees. Ask them to create highly detailed drawings of the leaves. Have them use watercolor paints highlighting the many shades of green in different leaves. Is the green in some leaves more yellow? More blue? Does the green on some leaves seem a more brown-green?
4. Take your students into the school yard or to a park. Have them take a good long look at the trees. When looking at a whole tree, how much of the length of the tree is made up of the seen trunk alone and how much of the length is the branches and leaves? (Students who do not take the time to really look at a tree, often draw a dominantly long tree trunk, when in reality the ratio of trunk to tree is very like the ratio of stem to apple in an upside apple.) What is the overall shape of the foliage on a tree—round? oval? triangular? Have them do drawings of individual trees in their sketchbooks; later, have them draw two different trees on one page showing how each tree is different from the other.
5. Have your students draw animal and insect life, that includes the natural plant and foliage surrounding of each specimen, in full detail, like the nature studies of Maria Merian.

Nature Notebooks:

- After your students have had a few weeks of making nature drawings in their sketchbooks, honing their observation skills, have them write a paragraph describing the weather of the day, and the effect the weather is having on the plants in the school neighborhood, in great detail. You may want to introduce a dictionary and thesaurus as tools to help them write specific details.
- If possible, take your students to a zoo, an aquarium, a farm, a park—anywhere they can see the interaction of animal and plant life. Ask them to write an essay about what they see, so detailed that a person who has never visited that site will be able to see it in his or her mind.

PALEONTOLOGY ACTIVITIES (MARY ANNING)

FIELD TRIP: CREATE FOSSIL BOOKS AT LOCAL NATURAL HISTORY MUSEUM

Take your students on an adventure to a local or big city natural history or science museum where they can see and draw real fossils, adding to their nature sketchbooks.

Plan the Field Trip:

1. Conduct research on the internet to find a natural history museum near you. Most big cities have natural history or science museums that welcome school groups. Also, many universities in big cities, and small towns, have their own natural history or science museums or exhibits that students can attend. If you do not live near a large city or university town, many local communities have small museums that contain fossils found locally.
2. Once you have identified a museum, contact the museum to find out their student group visitation policies. You will need to ask them if your students can have a tour of the fossil sections of the museum and time to draw fossils in their exhibits. You will also need to ask them if a staff person can give an introduction to their fossils on exhibit, and in the case of animal fossils describe the movement of the animals when alive.
3. Check out the NCBLA's field trip guide "[A Teacher's Guide to Planning a School Historical Field Trip](#)" available in the [EDUCATION & LITERACY: FIELD TRIP GUIDES](#) section of the NCBLA's [OurWhiteHouse.org website](#). Although it has been created for historical field trips, many of the suggestions will hold true for a natural science field trip to a museum as well.

Field Trip Day:

1. Have students bring their nature sketch books and simple drawing materials.
2. After your guide has given your group a tour of the fossil section of the museum and shared information with your students about the fossils, allow your students sufficient time to explore the exhibits on their own and choose the fossils they would like to sketch.
3. After your students have made their fossil choice, have them make several sketches of the fossils from various angles. Their sketches should be very detailed. They may want to add written descriptions, too.

Returning to the Classroom:

1. Have your students review their sketches.
2. Ask them to imagine what their animal would have looked like fully fleshed out and alive. Ask them to imagine the natural habitat of their animal. Then ask them to draw what they think their animal fossil looked like alive and in its habitat.
3. Last have them research their animal and its habitat and see how professional scientists envisioned the animal and its habitat, and why the scientists came to those conclusions. Have the students compare and contrast their imagined drawings with those of the scientists and decide who has the best imagined drawings explaining the reasoning of their choice.

Additional Lesson Plans: Making Fossils in the Classroom:

<https://www.homegrownfun.com/how-to-make-homemade-fossils-classroom/>

https://www.mos.org/sites/dev-elvis.mos.org/files/docs/education/mos_dig-into-dinosaurs_make-your-own-fossil.pdf

https://mass.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.lp_funfossils/fun-with-fossils/#.WPAljo61uRs

http://www.michigan.gov/documents/deq/p06create_304664_7.pdf

ASTRONOMY ACTIVITIES (MARIA MITCHELL)

STARRY NIGHT: ART AND SCIENCE EXPLORATIONS



***The Starry Night* (1889), an oil painting by Vincent van Gogh
Museum of Modern Art, New York**

Vincent van Gogh painted *The Starry Night* forty-two years after Maria Mitchell discovered her comet.

Although *The Starry Night* is an interpretive painting of the night sky surrounding the nearby Alpilles Mountains, art historians believe that it is inspired by the actual view van Gogh observed looking out of his cell window at the Saint-Paul asylum in St. Remy, France where he had admitted himself for mental health issues. The oil paint is thick on the canvas; each brush stroke is visible. That thick application of paint is called *impasto*. Van Gogh loved Hans Christian Andersen's stories, and was fascinated by one in particular—"What the Moon Saw" – written from the perspective of the moon looking down on the world. By 1889 the study of astronomy had become popular with scientists and amateurs alike, and the first photographs of the night sky were published in popular astronomy handbooks in Europe and America. Historians believe that van Gogh may have been familiar with these publications as his depiction of the planet Venus in the painting closely resembles photographs of Venus published in those astronomy handbooks. *The Starry Night* is a superb example of the inspirational mix of art and science.

For more information about van Gogh's *The Starry Night*, go to:

https://www.moma.org/learn/moma_learning/vincent-van-gogh-the-starry-night-1889

<https://www.google.com/culturalinstitute/beta/asset/the-starry-night/bgEuwDxeI93-Pg?hl=en>

<http://www.csus.edu/indiv/o/obriene/art1b/research%20paper.pdf>

<https://www.khanacademy.org/humanities/ap-art-history/late-europe-and-americas/modernity-ap/a/van-gogh-the-starry-night>

HAVE STUDENTS CREATE THEIR OWN “STARRY NIGHT!”

Materials needed:

- * Optional: Sky Map at: Fourmilab.ch/YourSky
- * Copy of *The Starry Night* painting to share with students in person or online.
- * Classroom color chart showing analogous and complementary colors.
- * Pencils, and/or colored pencils, markers, or crayons. Also sketchbooks or scrap drawing paper for preliminary sketches.
- * Flashlight or desk lamp to illuminate sketch pad or paper at night while drawing.
- * Watercolors and/or tempera paint and brushes.
- * Thick paper or cardboard for painting.
- * Plastic palette or white dinner plate to serve as palette for mixing paints.
- * Water-filled container for paint mixing and brush cleaning.
- * Paper towels and/or rag for blotting paint and cleaning brushes.

Directions:

- * Optional: The days your students work on their sketches and paintings, you may want to find out what stars and planets that can be seen in your area’s night sky using SKY MAP at: <https://www.fourmilab.ch/yoursky/> You may then want to share that information with your students so that they can look for those stars, constellations, and planets when they create their sketches.
- * Share the *Starry Night* painting with students and discuss painting, its history, and circumstances with students. How much information you share will depend on your students’ ages and abilities. Information about the painting and its history can be found at the Museum of Modern Art website.
- * For homework—have students do a couple of sketches of the night sky that they see from their homes’ windows. They can include the tops of buildings, telephone polls, trees, and bushes if they like—or because these are interpretive drawings based on realistic observations, they can choose to exclude objects, too. The sketches can be as loose or detailed as they like. Students may also want to take written notes on what they see. And they may use color drawing materials to indicate color choices.
- * In class the next day, students will use their sketches as references for their own *Starry Night* paintings.
- * Using their sketches and notes as references, students will lightly pencil in their night views from their homes’ windows.
- * Encourage them to create a sample color chart for their painting by mixing colors on their palettes, then creating sample color squares on a scrap piece of paper for reference. Encourage them to experiment mixing colors together that are analogous on the color chart, as well as mixing colors that are complementary on the color chart. You may want to discuss this scientific color experiment and its result with the class before they create their paintings.
- * After each student’s sketch is okayed by you, the students can create their own *Starry Night* interpretive paintings inspired by the night view from their home window and the color combinations they have experimented with using the color chart.
- * Have a class *Starry Night* exhibit! You may want to invite student family members or younger classmates to a *Starry Night* exhibit reception with punch and cookies for all!

Additional Arts and Sciences Lesson Plans with Strong Astronomy Connections:

- * *Writing poetry inspired by the night sky.* (4th– 9th grades): <http://astroedu.iau.org/en/activities/1414/astropoetry-writing/>
- * *Day and Night Sky.* Help young children identify differences between night and day (Kindergarten): <http://www.cpalms.org/Public/PreviewResourceLesson/Preview/29487>
- * *Watching the Summer Night Sky.* Help students identify and locate celestial objects (Grades K-5): <http://www.nea.org/tools/lessons/summer-night-sky-K-5.html>
- * *Looking at the Night Sky.* Help students understand star patterns (Grades 3-5): <http://sciencenetlinks.com/lessons/looking-night-sky/>
- * *Skygazing.* Teach students to make a simple telescope, planetarium, and moon and star charts (Grades 3-6): <http://nys4h.cce.cornell.edu/Documents/About/Program%20Themes/SET/4-H%20Science%20Toolkit/Astronomy%201.pdf>
- * *Seeing in the Dark/PBS.* A wide variety of videos and lesson plans related to astronomy (Grades 3-and up): <http://www.pbs.org/seeinginthedark/for-teachers/>

Finding Wonders Education Resource Guide Contributors

Discussion Questions:

Marilyn Ludolph, Ed.D, after 35 years of service in public education as a teacher and administrator (elementary and middle school principal), became an assistant professor at Dominican University. Recently retired from her position as Assistant Dean in the School of Education at Dominican University, she now resides in Western Massachusetts. She serves on the Advisory Board of the NCBLA.

Activities:

Author and illustrator **Mary Brigid Barrett** taught high school art in public schools in Ohio early in her career and later, after moving to Massachusetts, taught illustration and writing courses at The Rhode Island School of Design. She is the president and executive director of the NCBLA. Find out more about her books at MaryBrigidBarrett.com.

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