



***Living Memorials to Spectacular  
Scientists, Engineers, and Mathematicians***

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Devonshire Elementary School

This curriculum unit is recommended for:  
Third, fourth and fifth grade

**Keywords:** memorials, biographies, third grade, wax museum, project based learning, scientists, engineers, mathematicians, African-American scientists, Hispanic scientists, female scientists, science careers, STEM education, gender differences, GEMS, Newsela

**Teaching Standards:** See [Appendix 1](#) for teaching standards addressed in this unit.

**Synopsis:** This curriculum unit is designed to offer upper elementary students the opportunity to read, research, and complete a poster project as well as design a memorial to a noted scientist, mathematician, or engineer. I will collaborate with third grade teachers in this curriculum unit because biographies are a major literacy focus in third grade. The unit is appropriate for fourth and fifth grade as well. Care will be taken to include scientists, mathematicians, and engineers from a wide variety of backgrounds in order to highlight scientific contributions from a broad cross-section of American society including female and minority scientists, engineers, and mathematicians. This is particularly important at Devonshire Elementary because of the demographics of the school.

*I plan to teach this unit during the coming year to 110 students in third grade.*

*I give permission for Charlotte Teachers Institute to publish my curriculum unit in print and online. I understand that I will be credited as the author of my work.*

## **Introduction**

Most students in American schools tend to think scientists are mostly white males such as Albert Einstein, Thomas Edison, and Bill Nye. This includes females and students from minority backgrounds such as African-Americans and Hispanics (1). These tendencies have been shown in a number of studies.

A study of 206 elementary students of varying gender, ethnicity, and grade asked students to draw teachers, scientists, and veterinarians in 2008. The students were in grades 1, 3, and 5. The drawings of teachers tended to be attractive females. The drawings of scientists were overwhelmingly unattractive white males. As a consequence, female and minority students could get the message that being a scientist is not for children like them (2).

Although science organizations are recruiting more women and minorities for science and engineering fields, the way scientists are typically portrayed in children's trade books reinforce that science and engineering fields are typically for white males. A study of 1,656 images of scientists in children's nonfiction trade books in 2014 show that role models in terms of gender and race for scientists and engineers are still lacking (3).

Students at Ridgecrest Intermediate School in Palo Verdes, California were asked in 2011 to name scientists. Their examples were people who were mostly white, male, or dead. These attitude and perceptions have resulted in a lack of scientists and engineers who can serve as role models for women and minorities (1).

It is important for the future of our country and its students to change prevailing attitudes about who can become a scientist or an engineer. Attitudes need to expand to fully include females and minorities. African Americans, Latinos and American Indians make up about 28 percent of the population of the United States, but they only account for about 9 percent of college-educated Americans in science and engineering careers. Of that 9 percent, there are twice as many males as females (4).

According to a survey conducted at Bayer Corporation, over 75 percent of respondents said girls and minorities are not encouraged to consider STEM careers. Women comprise less than 25 percent of the STEM workforce. Female college students who are qualified to enroll in science, math, and engineering courses of study often opt to not do so. For example, women account for about 11 percent of bachelor's degrees in computer engineering (4). Corporations, teachers and schools need to do more to encourage all students that they can become scientists and engineers.

Women and minorities are underrepresented in tech firms as well. Google is one of the few tech companies to release the demographic data of its employees. In 2017, over 91 percent of Google's employees were white or Asian. About 4 percent of the work force is two or more races, about 4 percent are Hispanic or Latinx, and about 2

percent are Black. About 20 percent of the tech workers are women. With percentages like this, the importance of giving females, Hispanics, and Blacks role models who have defied these trends is necessary (5).

Female and minority students who are employed in STEM fields tend to earn more money than those who are employed in other fields. One study states minorities in STEM careers earn 26-40 percent more than minorities who are not employed in STEM careers (6). One can conclude the underrepresentation of females and minorities in science, technology, and math careers results in less earning power.

The Association for the Study of Higher Education completed a special report in 2011 about minority students in STEM education. While much of the report was about minority representation in higher education, there was a chapter about K-12 science and math education for racial and ethnic minority students. The report noted a lack of representation from minorities in the STEM workforce and in colleges and universities. The report noted the increase of racial and ethnic diversity in the United States. Increasing minority representation in the STEM workforce is important for the financial well-being of minorities because workers in STEM fields tend to earn higher wages and having a well-educated STEM workforce is important for the United States to maintain global economic competitiveness (7).

It is critical for schools to provide teachers who can develop students academically, including offering Advanced Placement classes to students. Factors that support K-12 STEM education include parental involvement, bilingual education, culturally relevant teaching, early exposure to STEM careers, promoting interest in STEM subjects, and building self-efficacy in STEM domains for students. The report suggests exposing students to individuals who model minority success in STEM helps students build their self-efficacy in regard to believing they can be successful in math and science. This self-efficacy, when combined with excellent teaching, will prepare more minority students to be successful in college or STEM careers (7).

Schools can take steps to improve science, technology and math for minority students. A computing program used in fourth and fifth grades at 12 schools in a district in the southeastern United States had a positive effect on the attitudes of the students. The district student population was 95 percent African-American and 89 percent free and reduced lunch. Teachers received special training during the summer and the school year. Students took a science, math and technology survey in the fall and again in the spring to gauge student attitudes. The study recommends STEM interventions should be interesting, fun and useful to students to increase positive attitudes towards STEM disciplines. This, in turn, could result in increasing the number of students in the “STEM pipeline” that may hold position in the STEM workforce in the future (8).

## The Future of STEM Careers

According to the United States Bureau of Labor Statistics, there will be a 13 percent increase in the number of STEM related jobs in the United States between 2012 and 2022. The American job sector is expected to increase about 11 percent in other fields. STEM jobs will require proficiency in some mix of science, technology, mathematics, and engineering. Categories in this report included mathematics, computers, architecture, engineering, life, and social sciences. This report excluded health care. The projection is for over 9 million jobs to be STEM related by 2022. Many of these new jobs will be related to changes in technology. Examples include software developers and computer analysts. Workers in STEM fields earned twice as much as the average earner in 2013. Employees in STEM fields earned an average of about \$76,000 per year as compared to \$35,080 for the average American worker. (9)

The need to increase representation of minorities and females in STEM fields has been a goal of both Republican and Democratic presidential administrations in recent years. President Donald Trump wants to direct 200 million dollars in federal grants for technology education for women and minorities. A key reason for the grant program is to help young Americans develop their skills for future jobs. The White House cited the current limits to STEM and computer science education for women, minorities, and rural students (10, 11). President Obama also made STEM education a priority. President Obama said “One of the things I’ve been focused on as President is how we create an all-hands-on-deck approach to science, technology, engineering, and math” at the 2013 White House Science Fair. In 2016, the Obama administration touted securing over \$1 billion in private investment for STEM education as part of the Educate to Innovate campaign, the inclusion of STEM in Race to the Top grants, and over \$3 billion across 14 Federal agencies for STEM programs (12). Our two most recent Presidents are from opposite parties. Both administrations have seen the need for developing minority and female scientists, engineers, and mathematicians. Although the actual spending may differ from the proposals made by President Obama and President Trump, it is interesting that both of them touted the need for spending federal tax dollars to support the development of female and minority scientists, engineers, and mathematicians.

As was previously noted, employees in STEM fields tend to earn higher wages than the average worker and this is very likely to continue to occur in the future (10). Therefore, providing minorities and females increased access to employment in STEM fields would most likely improve their upward economic mobility. This would benefit students in the Charlotte area. A 2014 report by researchers at Harvard and the University of California at Berkeley about upward mobility in fifty American cities rated Charlotte dead last at number 50 out of 50. Families with students born between 1980-1982 were tracked until the children were 30-year-old adults. A child in the lowest quintile in Charlotte had only a 4.4 percent chance of rising to the top quintile. The highest city in this part of the rankings was San Jose, California with 12.9 percent of

children going from the lowest to highest quintile. The cities with the lowest mobility rankings tended to be in parts of the Midwestern rust belt or southeast. Atlanta ranked number 49 and Raleigh number 48. This is somewhat surprising because all of these cities are generally regarded as places of good opportunity. (13, 14)

If one role of schools is to develop students to be prepared for future job opportunities, then it is important for students in schools like Devonshire to be exposed to great leaders in STEM who are like them. This is especially true in light of the lack of representation in STEM careers for females and minorities and the historically low prospects of upward mobility in Charlotte.

### Devonshire Elementary School Demographic Data

I am the science lab facilitator at Devonshire Elementary. The science lab facilitator position is a new position at the school in 2017-18. Devonshire has an entirely new administrative team for the 2017-18 school year. Every student in the school will attend science lab classes as one of the special area classes. Every student in the school will receive science instruction in the classroom. An instructional block for science and social studies has been created for kindergarten through fourth grade. Teachers will alternate between the two subjects. Science and social studies were not taught as a lesson block in prior years in grades K-4. Science and social studies were integrated into literacy classes. Fifth graders will have a science block each day. This has been the case for many years. In 2016, 28 percent of fifth graders scored a 4 or a 5 on the science end-of-grade test. Scoring a 4 or a 5 shows a student is college or career ready. A school improvement plan goal for this year is for at least 38 percent of fifth graders to score a 4 or a 5 on the science end-of-grade test in 2018.

Devonshire is a Title I school in east Charlotte. The school grades are kindergarten through fifth grade. The school has a 100 percent poverty rate. This means every student qualifies for free and reduced meals. 613 students currently attend Devonshire. The school population is almost evenly divided between males and females. The racial makeup is about 56 percent Hispanic, 34 percent African-American, 2 percent white, 2 percent Asian, and less than 2 percent American Indian, Pacific Islander, and Multiracial.

## **Curriculum Unit Rationale**

A goal of teaching science in kindergarten through fifth grade is to build the science capacity of students. The teaching of science in the classroom and science lab for all students should increase the vision of students to see themselves as scientists. Exposing students to great scientists, engineers, and math can get students excited about STEM subjects such as science, math, and technology.

Students need to envision themselves as scientists. This is critical at Devonshire because the vast majority of the student body comes from demographic groups that are traditionally underrepresented in STEM fields. Promoting role models for these students who look like them should help these students see the possibilities of them becoming scientists, engineers, and mathematicians. In turn, this would have the potential of helping more of these students have successful, high paying STEM careers that increase their odds of upward economic mobility. The self-efficacy of students at Devonshire will benefit from exposure to female and minority scientists, engineers, and mathematicians.

### **Student Memorials to Spectacular Scientists, Engineers, and Mathematicians**

The title of the CTI seminar is Memorials, Memories, and American Identity. A cornerstone of the curriculum unit will be the student creation of a poster project and a memorial to an outstanding scientist, engineer, or mathematician. Many students will learn about minority and female STEM contributors. Outstanding white and Asian scientists, engineers, and mathematicians certainly will be included, but the need to include minority and female STEM contributors is great because approximately 98% of the students at my school are from a minority group and approximately 50% of the students at my school are female.

The curriculum unit contains a series of lessons in which students learn there are great scientists from many backgrounds, read a biography about a noted scientist, engineer, or mathematician, create a poster project, and create a memorial to the scientist, engineer, or mathematician they are studying. The activities are developmentally appropriate, integrate well with literacy standards, and have the potential to inspire students to become a scientist, engineer, or mathematician.

I see each class once every six school days for 55 minutes in this year's schedule. I will work with classroom teachers to implement portions of the student project. Collaborating with teachers will be necessary because my time with each class is limited, but collaborating with teachers is good pedagogical practice and will create opportunities for building staff capacity.

Third graders are a great audience for this curriculum unit. Third graders study biographies in literacy class. This fact, combined with the well-documented underrepresentation of females and minorities in STEM, make studying notable female

and minority scientists, engineers, and mathematicians a good idea. The purpose is to help students see that they can be scientists, engineers, and mathematicians if they choose to do so.

The curriculum unit also works within the framework of fourth and fifth grade literacy. Fourth and fifth grade does not study biographies, but they do have non-fiction units. A worthy topic of inclusion into fourth and fifth grade non-fiction units would be to take note of the years and eras in history when the STEM figures lived.

The first activity will be to demonstrate for students the need to study scientists, engineers, and mathematicians from more demographics than just white males. The activity is inspired by research that shows young students often envision white males as scientists. I will show students photographs of several notable scientists including males, females, and people of various racial and ethnic backgrounds. I will include Bill Nye, Albert Einstein, Benjamin Franklin, Thomas Edison, Nikolai Tesla, Jane Goodall, Marie Curie, Grace Hopper, Ellen Ochoa, Luis Alvarez, Mario Molina, Katherine Johnson, Mae Jemison, Neil deGrasse Tyson, George Washington Carver, and Benjamin Banneker. I will ask students to name as many of the people as possible. I will tell students I think it is important for them to learn about a lot of great scientists from many different backgrounds, not just white men like Albert Einstein and Bill Nye.

The second student activity will be for students to read a biography about a famous scientist, engineer, or mathematician. I want a great number of those biographies to be about females and minorities so our students can relate to them.

For the reading, students will be assigned a biography by their homeroom teacher. There are five third grade classes at Devonshire. Each class currently has 22 students. I want to have at least 25 biographies available per class in order to account for potential increased enrollment and to give teachers some flexibility in assigning biographies based on reading levels and student interest. Information about the biographies that will be used is included in a separate section of the curriculum unit.

For the poster project, students will include a picture of their subject, a timeline of key events in their lives, a short story that explains why the person was famous, and a list of at least three to five reasons why the student admires their subject. Sentence stems may be used to help students with writing well-developed statements about why their scientist, engineer, or mathematician is spectacular. Students may copy the sentence stem to help them with writing their statements about the person they are studying. The information for the poster project will be drawn from the biography the student reads. The picture will most likely be printed from a computer. Classroom teachers will assist students in selecting a biography that is appropriate for their reading level or assign a biography to each student. The biography could be from an online resource such as Newsela or a book.

I will work with third grade teachers to create one or two model poster projects that fit the parameters of the student project. Students may use the model posters to guide their work. This type of scaffolding will assist students with creating a project that meets criteria. The model posters will need to avoid people the students may choose for their memorials.

Projects will be judged on a rubric. This would allow the homeroom teacher to use the project as a grade. Assigning a grade to the poster project is not a must, but it may be helpful to third grade teachers to apply a level of accountability to the quality of project. The rubric will give students the ability to evaluate their own work and compare it to a set of guidelines. Students may apply the rubric as they create and edit their work.

I will provide time in science lab for students to work on their poster projects. I believe students will need two science lab sessions to complete the poster project. I have Chromebooks in my classroom, so students can refer to their Newsela biography while making the poster.

I will explore whether or not the poster project can be done as a Discovery Education board. All Charlotte-Mecklenburg elementary teachers currently have access to the Discovery Education website. The board builder on Discovery Education can be assigned to students by the homeroom teacher. The Discovery Education board looks very similar to a poster board. Pictures can be posted on a board and content can be typed into templates. Outstanding boards can be placed on the Discovery Education website.

For the final activity, students will draw a memorial including what the memorial would say about their scientist. I will talk to students about how we build memorials to famous people. I will show students pictures of several memorials and discuss why those people got a memorial. Students will be asked to respond to a prompt. "Imagine you have been told you can build a memorial to your scientist. You want your memorial to teach people about your scientist. What would you build? What would you say?" Students would be required to plan what they would write and what they would build before getting an 11" x 17" piece of paper to draw the memorial and write what be on the memorial.

### Biographies about Scientists, Engineers, and Mathematicians

One limitation I will face is the low number of available biographies at developmentally appropriate reading levels at Devonshire. I searched the biography section of the Devonshire media center to find biographies of scientists, engineers, and mathematicians. I found 21 biographies of scientists.



Seven of the biographies I found were published by Pebble and were designed for first and second graders. These could be good choices for students in grades three, four and five who are at a very low reading level. All of them are either females or minorities, but none of them are Hispanic. Black males include Benjamin Banneker (15), George Washington Carver (16), and Matthew Henson (17). There is one black female, Mae Jemison (18). Three white female scientists are Clara Barton (19), Elizabeth Blackwell (20), and Jane Goodall (21).

Other biographies in the Devonshire media center are more appropriate for upper elementary students. Two of them are biographies about Mae Jemison (22, 23). This is the only female African-American scientist to have a biography in the media center. There are three African-American males who have biographies appropriate for students in grades 3-5. They are Benjamin Banneker (24), George Washington Carver (25), and Neil Degrasse Tyson (26). There are five biographies of five white female scientists. They are Ava Lovelace (27), Rachel Carson (28), Marie Curie (29), Jane Goodall (30, 31), and Clara Barton (32). There are biographies of white male scientists John James Audubon (33), Alexander Graham Bell (34), and Albert Einstein (35).

#### Charlotte Mecklenburg Public Library Trade Book Resources

The Public Library of Charlotte and Mecklenburg County offers assistance in regard to obtaining biographies about scientists. Students may use their public library cards at school. This gives students another way to get these books. It is something most students will need help and encouragement to do because the books have to be placed on hold and sent to Devonshire or students have to go to a public library to check out the books. Teachers who want to use public library books in the classroom can check them out.

Many of the titles available from the Mecklenburg County Public Library system are books I would love to obtain for the Devonshire library. I checked out a sample of biographies of famous female and minority scientists, engineers, and mathematicians. Examples of available children's biographies include Mae Jemison (36, 37), Marie Curie (38, 39, 40), Benjamin Banneker (41), Ellen Ochoa (42), Rachel Carson (43), George Washington Carver (44), Ada Lovelace (27), Grace Hopper (45), Matthew Henson (46), and Bessie Coleman (47). Another book is an anthology called *Women in Science: 50 Fearless Pioneers Who Changed the World* (48). There are many more biographies of scientists at the public library that would be great to add to the Devonshire collection.

#### Online Resources for Biographies

The lack of biographies in the Devonshire media center will require using online resources. Several online resources have been considered for student research use. They

include BrainPOP, Newsela, and online encyclopedias Wikipedia and Encyclopedia Britannica Kids.

Encyclopedia Britannica Kids requires a subscription. It has a number of biographies. Some of them are scientists, engineers, and mathematicians. Like some other resources, it lacks content on Hispanics. There is only one Hispanic scientist, Ellen Ochoa, on the website. Encyclopedia Britannica Kids is not a good choice because it requires a subscription that the school does not have and few, if any, teachers will have and has too few biographies for this project.

Wikipedia is a free online encyclopedia. Searching the names of individual scientists shows Wikipedia does have entries for a significant number of scientists, engineers, and mathematicians that are applicable for the student project. Wikipedia could be used as a place to find facts about scientists, engineers, and mathematicians from a broad spectrum of backgrounds, but it may not be a highly useful resource partly because the text is not written at an elementary reading level. This would require teachers to provide lots of support for students.

BrainPOP is a website designed for elementary students. It uses videos as text. BrainPOP is found at [www.brainpop.com](http://www.brainpop.com). It requires a paid subscription, but many teachers have a Brainpop account. I believe I can advocate the principal purchase BrainPOP subscriptions or advocate teachers who do not have a Brainpop account write a grant proposal at [www.donorschoose.com](http://www.donorschoose.com) for a BrainPOP subscription. A classroom subscription is \$230 per year. A school site license is \$1,795 per year.

BrainPOP captures the attention of students very well. It would be helpful for students are reading below grade level by serving as a text students could use to get facts for their projects. BrainPOP could also be useful in conjunction with a written text.

BrainPOP has a section for “Famous Scientists”. There are 16 scientists on the website. They are Ada Lovelace, Alan Turing, Albert Einstein, Benjamin Franklin, Charles Darwin, Copernicus, Galileo Galelei, George Washington Carver, Isaac Newton, Jane Goodall, Leonardo Da Vinci, Marie Curie, Nikola Tesla, Rachel Carson, Sally Ride, and Thomas Edison. Only one of these scientists, George Washington Carver, is African-American. There are five white females in the list. There are no Hispanics in the list. The lack of Hispanics and low number of African-American scientists limits the usefulness of BrainPOP for this curriculum unit.

The website [www.newsela.com](http://www.newsela.com) offers one solution to the lack of appropriate biographies in the Devonshire media center (49). All teachers at Devonshire are familiar with Newsela and have Newsela accounts. Teachers can assign reading selections from Newsela to students.

Newsela offers many types of reading selections including biographies. Newsela content is leveled, so students can be matched with texts that are appropriate for their reading levels. The articles are brief enough to be easily digested by students. One challenge for third grade teachers using Newsela is there are 15 articles about scientists, engineers and mathematicians on third grade level and 27 articles on fourth grade level. This will allow teachers to differentiate and give above grade level readers articles that correlate to their reading ability, but it limits the number of third grade level biographies. Teachers using Newsela biographies with third graders will have to provide extra support for those who read below grade level because none of the biographies are written below a third grade level.

Newsela has 40 biographies that are about 41 different scientists, engineers, or mathematicians. All of the biographies are written at a third or fourth grade reading level. They include three biographies about two African-American females, four African-American males, and ten females. Nineteen of the biographies are about white males. One of the biographies is that of a disabled person who is pictured in a wheelchair. None of the biographies are about a Hispanic person.

The Newsela biographies represent a broad spectrum of historical time periods. There are biographies about scientists, engineers, and mathematicians who lived many centuries ago, such as Ptolemy and Eratosthenese. There are also biographies of many scientists, engineers, and mathematicians from the late 20<sup>th</sup> century and early 21<sup>st</sup> century such as Neil Degrasse Tyson, Katherine Johnson, Mae Jemison, and Stephen Hawking.

A weakness of the Newsela biographies is the lack of Hispanic representation. No Hispanics have biographies for scientists, inventors, mathematicians, or explorers on the Newsela website. A list of the people who have biographies on the Newsela website are in Appendix 3.

### Building the Devonshire Media Center Biography Collection

Devonshire needs to add biographies about scientists, engineers, and mathematicians to our classroom libraries and school media center. Bolstering classroom libraries is a part of our school improvement plan. I think it is extremely important to add books about Hispanic, African-American, and females because of the school demographics and their general underrepresentation in scientific fields. Adding these books will also support our school improvement plan goal of improving classroom libraries.

As of November 13, 2017, the Devonshire principal has invited me to work with the literacy facilitator and math facilitator to help select books for the Devonshire media center. I will advocate for adding books to the media center that are about outstanding scientists, engineers, and mathematicians. I will use the Library of Congress list of books

about Latino scientists and the list of books about outstanding female scientists from the A Mighty Girl website to make a list of suggested books. I will add books about great African-American scientists, engineers, and mathematicians that I have found and will continue to identify.

I will seek out grants and other funding sources to purchase additional books for the media center and teacher classroom libraries. I believe there will be organizations and agencies that will see merit in providing books that can inspire Devonshire students to learn more about scientists who are like them and to be involved with STEM in the future. I firmly believe the Devonshire media center will be much more useful in future years when students learn about a broad cross-section of scientists, engineers, and mathematicians.

Potential Books for the Devonshire Media Center

There are ten books on the Library of Congress list of kid's books about Hispanic scientists. These books were all written in the past 25 years and can be found at <https://www.loc.gov/rr/scitech/SciRefGuides/latinos.html#kids>.

These books are at an appropriate reading level for upper elementary students. Books about individual scientists include Ellen Ochoa, Luis Alvarez, Antonio Novello, Mario Molina, and Carlos Finlay. Three of the books are about Ellen Ochoa. Two of the books are about Luis Alvarez. Another book is about women explorers and includes Ellen Ochoa. There is one book that contains five short biographies about Hispanic scientists. They are Ellen Ochoa, Carlos A. Ramirez, Eloy Rodriguez, Lydia Villa-Komaroff, and Maria Elena Zavala.

An Amazon search for books about Hispanic scientists came up with some of the same books as the Library of Congress list. Some of the books about Hispanic scientists also came up in an Amazon search for Hispanic inventors and mathematicians. No additional books came up in an Amazon search for books about Hispanic engineers.

A search on the Amazon website for Hispanic inventors yielded three books, but only one of them is at an elementary school reading level. It is a Scholastic book written in 2016 about a Hispanic NASA Mars science lab engineer named Diana Trujillo. This biography was designed for students in fourth grade and up.

An Amazon search for Hispanic mathematicians yielded two books. One that is out of print is called *Latinos in Science, Math, and Professions*. There are used copies available for slightly under \$20. This book contains 177 profiles. It was published in 2007. I read a portion of the book online. Each profile is about one page long. I like the large number of profiles, but the book is written above grade level. An elementary teacher using this book would need to provide a lot of support to readers.

The second book is called *Paths to Discovery: Autobiographies from Chicanas with Careers in Science, Mathematics, and Engineering*. Norma Cantu edited this book. This book was published in 2011. It includes ten autobiographies from female scientists, mathematicians, and engineers. A description of the book says it will “encourage young Chicanas to enter the fields of mathematics, science, and engineering.” I believe a teacher would need to support elementary readers in comprehending this book. I believe it would be a great book for Devonshire to add to our media center primarily as a classroom resource rather than an addition for students in the media center.

I found an excellent resource for identifying books about female scientists, engineers, and mathematicians. The website [www.amightygirl.com](http://www.amightygirl.com) promotes materials for “smart, confident, and courageous girls. (50)” It lists 97 books that are biographies about female scientists. This is an outstanding resource for identifying biographies to add to classroom libraries and school libraries. The description for each book lists suggested ages for the book. The lists would need to be filtered in order to ensure books are at appropriate reading levels for elementary students. For example, a listed book that I found at the public library called *Women in Science: 50 Fearless Pioneers Who Changed the World* is recommended for ages 9 and up. This would make it a good choice for upper elementary students. Another book in the list that is available from the public library, *You Should Meet Mae Jemison*, is suggested for ages 6-8. That would make it a great choice for many third graders (36).

### Ideas for Promoting STEM for Minorities and Females

There are other ideas for students to create memorials to scientists, engineers, and mathematicians. In the future, Devonshire may be able to include some of these as ways to encourage female and minority interest in STEM. These would include GEMS club and wax museum.

Several schools in the Charlotte area have a GEMS club. GEMS means Girls Excelling in Math and Science. GEMS was created in 1994 as an after school club (51). At Devonshire, such a club could provide an excellent outlet for studying and creating memorials for outstanding female scientists, engineers, and mathematicians. This would include studying those who are both female and minority.

I would welcome the opportunity to work with classroom teachers want to offer a more in-depth and interactive temporary memorial, the wax museum. Wax museum is a project based learning strategy that would meld the goal of having students at Devonshire see themselves as scientists, mathematicians, and engineers with the seminar theme. Wax museum can accomplish this by having each student research and create a living memorial to an influential STEM person. Wax museums can be done at any grade level, but a good choice for them is third grade. This is true because biographies are part of the third grade literacy curriculum. It would be very difficult for me to do a wax museum

project by myself because students only come to science lab once every six days. However, I could certainly work with teachers by allowing them to practice their wax museum routines in science lab.

There are many ideas for wax museum projects on websites such as Pinterest and Teachers Pay Teachers. A wax museum project typically entails a student portraying a historical figure. The student will learn key facts about the person they are portraying. A wax museum project can include writing, speaking, dressing in character, making props and drawings, using pictures, citing quotes, and making timelines. Students are like a figure in a wax museum until someone approaches them and asks them to tell about themselves.

It would be a great challenge for me to have students complete a wax museum project in science lab because students only come once every six weeks for 55 minutes per class. Homeroom teachers would have to partner with me to do a wax museum that features a great number of minority and female scientists, engineers and mathematicians. My hope is that third grade teachers will incorporate the reading of biographies about scientists, engineers and mathematicians into a biography unit. Third grade literacy standards call for teaching biographies, so it is a natural connection to incorporate the study of biographies into the concept of learning about minority and female STEM leaders.

## Conclusion

I believe this curriculum unit has the potential to change the life of some of the students at Devonshire Elementary. I believe it can inspire students to believe they can be a scientist, engineer, or mathematician. Students will get the chance to read about great STEM leaders who are more like them than the routine image of scientists being white males. While students can certainly be inspired by Einstein, Newton, Edison, and other great white male scientists, it stands to reason they will enjoy learning about women and minorities who are spectacular scientists, engineers, and mathematicians.

## *Appendix 1: Implementing Teaching Standards*

### Reading Informational Text

Reading Standard 3: Describe the relationship between a series of historical events and/or scientific concepts.

Reading Standard 7: Use information gained from illustrations (e.g., maps and photographs) and the words in a text to demonstrate understanding of the text (e.g., when, where, why, and how key events occur.)

Reading Standard 10: By the end of the year, read and comprehend information texts, including social studies and science.

### Research to Build and Present Knowledge

Writing Standard 2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly. These include introducing a topic, using an illustration to aid comprehension, develop the topic with facts and details, and providing a concluding section or statement.

Writing Standard 4: With guidance and support from peers and adults, produce writing in which the organization and development are appropriate to a task.

Writing Standard 6: Create readable documents with legible handwriting.

Writing Standard 7: Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

Writing Standard 8: Gather relevant information from print and digital resources; take brief notes on sources and sort evidence into provided categories.

Writing Standard 10: Write routinely over an extended time frame for a discipline-specific task.

*Appendix 2: Rubric for Evaluating Poster Project about a Spectacular Scientist,  
Engineer, or Mathematician*

Student \_\_\_\_\_ Homeroom \_\_\_\_\_

There are six things that will be graded. Each one is worth up to 10 points.  
The final grade will be the percentage out of 60 points.

- Outstanding (done very well, no errors, lots of great details, very neat): 10 points
- Excellent (all parts done, excellent details, very few errors, very neat): 9 points
- Very Good (all parts done, a few errors or lack of details, neat): 8 points
- Satisfactory (most things done correctly, some lack of details, neat): 7 points
- Unsatisfactory (some parts are missing or done incorrectly, not neat): 6 points
- Poor (almost all parts are missing or are done incorrectly, not neat): 5 points
- Not Done (no parts done, no effort was made): 0 points

Is there a <b>TITLE</b> at the top of the poster that includes the name of the person the project is about? (5 points)	
Is the <b>STUDENT'S FIRST AND LAST NAME</b> and <b>HOMEROOM TEACHER'S NAME</b> clearly written on the project? (5 points)	
Is there a <b>PHOTOGRAPH</b> of the person the project is about?	
Is there a <b>TIMELINE</b> of the person's life that includes when they were born, when they died (if this applies), and key events?	
Is there a list of 3 or more <b>INTERESTING FACTS</b> about the person written in complete sentences?	
Is there a brief paragraph written in complete sentences that tells why this person was a <b>SPECTACULAR</b> scientist, engineer, or mathematician?	
Is the poster well organized, neat, has correct spelling, and has good handwriting?	
<b>TOTAL NUMBER OF POINTS OUT OF 60</b>	
<b>FINAL GRADE</b>	



*Appendix 3: Newsela Biographies of Scientists, Engineers, and Mathematicians*

Person	Gender	Race	Gr	Lexile	Fountas & Pinnel Rdg Level
Banneker, Benjamin	Male	African-American	4	710	Q
Barton, Clara	Female	White	3	590	M
Bell, Alexander Graham	Male	White	4	700	Q
Braille, Louis	Male	White	4	680	P
Carson, Rachel	Female	White	3	550	M
Carver, George Washington	Male	African-American	4	660	O
Copernicus, Nicolaus	Male	White	4	750	R
Curie, Marie	Female	White	4	700	Q
Da Vinci, Leonardo	Male	White	3	500	L
Darwin, Charles	Male	White	4	600	N
deGrasse Tyson, Neil	Male	African-American	4	730	Q
Earhart, Amelia	Female	White	3	580	M
Edison, Thomas	Male	White	4	740	R
Einstein, Albert	Male	White	4	700	Q
Eratosthenese	Male	White	4	680	P
Franklin, Ben	Male	White	4	710	Q
Galilei, Galileo	Male	White	4	660	O
Gates, Bill	Male	White	3	530	L
Gates, Jim	Male	African-American	4	680	P
Goodall, Jane	Female	White	4	750	R
Gutenberg, Johannes	Male	White	4	700	Q
Hawking, Stephen	Male	White	4	710	Q
Hess, Harry*	Male	White	4	670	P
Hubble, Edwin	Male	White	3	590	N
Jemison, Mae	Female	African-American	3	610	O
Johnson, Katherine	Female	African-American	3	590	O
Johnson, Katherine**	Female	African-American	3	540	N
Khayyam, Omar	Male	White	3	570	O
Leavitt, Henrietta	Female	White	4	630	O
Lovelace, Ava	Female	White	4	700	Q
Mendeleev, Demitri	Male	White	4	770	S
Mitchell, Maria	Female	White	3	580	O
Muir, John	Male	White	3	550	N
Newton, Isaac	Male	White	4	660	P
Pasteur, Louis	Male	White	4	750	R
Ptolemy, Claudius	Male	White	3	620	O

Pythagoras	Male	White	4	680	P
Tesla, Nikola	Male	White	3	650	P
Wegener, Alfred*	Male	White	4	670	P
Whitney, Eli	Male	White	4	700	Q
Wright, Orville and Wilbur	Male	White	3	530	L

\*Combined biography for Alfred Wegener and Harry Hess

\*\*News article about Katherine Johnson

*Appendix 4: Library of Congress List of Children's Books About Latino Scientists*

Person(s)	Title	Author
Alvarez, Luis	Luis W. Alvarez	Corrin Codye
Alvarez, Luis	Luis Alvarez: Wild Idea Man	Mike Venezia
Anthology	Women Explorers in North and South America: Nellie Cashman, Violet Cressy-Marcks, Ynes Mexia, Mary Blair Niles, Annie Peck	Margo McLoone
Anthology	Hispanic Scientists: Ellen Ochoa, Carlos A. Ramirez, Eloy Rodriguez, Lydia Villa-Komaroff, Maria Elena Zavala	Jetty St. John
Finlay, Carlos	Carlos Finlay	Christine Sumpton and Kathleen Thompson
Molina, Mario	Mario Molina: Chemist and Nobel Prize Winner	Deborah Kent
Novello, Antonia	Antonia Novello: U.S. Surgeon General	Joan Hawxhurst
Ochoa, Ellen	Ellen Ochoa	Annie Buckley
Ochoa, Ellen	Ellen Ochoa: First Latina Astronaut	Lila Guzman and Rick Guzman
Ochoa, Ellen	Ellen Ochoa	Jayne Keedle

## Annotated Bibliography

- (1) Hua, Vanessa. "Planting Seeds, Growing Diversity." *Teaching Tolerance* 39, 2011. This article showed most students, including females and minorities, think of white males when they imagine how a scientist looks.
- (2) Losh, Susan, Ryan Wilke, and Margareta Pop. "Some Methodological Issues with 'Draw a Scientist' Tests Among Young Children." *International Journal of Science Education* 30(6): 773-792, 2008. This article researched how children drew scientists. It found children tend to draw white males as scientists. There was a lack of female and minority representation in the drawings.
- (3) Rawson, Casey and Megan McCool. "Just Like All the Other Humans? Analyzing Images of Scientists in Children's Trade Books." *School Science and Mathematics* 114(1): 10-18, 2014. This article was about a research project that looked at the images of scientists in children's trade books. It found the images are mostly white males.
- (4) White, Jeffry and G.H. Massiha. "The Retention of Women in Science, Technology, Engineering, and Mathematics: A Framework for Persistence." *International Journal of Evaluation and Research in Education* 5(1): 1-8, 2016. This article was about 9% of the population in STEM jobs being African-American, Latino and Native American even though they represent about 28% of the U. S. population.
- (5) Donnelly, Grace. "Google's 2017 Diversity Report Shows Progress Hiring Women, Little Change for Minority Workers." *Fortune*. [Retrieved September 9, 2017].  
[www.fortune.com/2017/06/29/google-2017-diversity-report/](http://www.fortune.com/2017/06/29/google-2017-diversity-report/). This article cited statistics from Google that show the percentage of female and minority employees at Google is much lower than their numbers in the general population.
- (6) Melguigo, Tatiana and Gregory Wolniak. "The Earnings Benefits of Majoring in STEM Fields Among High Achieving Minority Students." *Research in Higher Education* 53(4): 383-405, 2012. This article says minority STEM workers earn up to 40% more on average than minorities who are not employed in a STEM field.
- (7) Museus, Samuel, Robert Palmer, Ryan Davis, and Dina Maramba. "Racial and Ethnic Minority Students' Success in STEM Education." *ASHE Higher Education Report* 36(6): 1-140, 2011. This special report contained a chapter on

what K-12 schools should do to increase minority and female representation in STEM subject and prepare them for STEM in college and STEM jobs.

- (8) Ball, Christopher, Kuo-Ting Huang, Shelia Cotten, and R.V. Rikard. "Pressurizing the STEM Pipeline: An Expectancy-Value Theory Analysis of Youths' STEM Attitudes." *Journal of Science Education and Technology* 26(4): 372-382, 2017. This article was about a study done in a district in the southeastern United States in which students received special computer instruction and completed surveys. It found the perceptions of students towards science, engineering, and technology was significantly improved after the computer instruction was completed.
- (9) Bureau of Labor Statistics. *STEM 101: Intro to Tomorrow's Jobs*. [www.bls.gov/careeroutlook/2014/spring/art01.pdf](http://www.bls.gov/careeroutlook/2014/spring/art01.pdf), 2014. This report discussed anticipated potential wages for American workers in STEM fields. It found that the average workers in STEM fields would made over \$76,000 dollars a year while those who did not made a little over \$35,000 dollars a year in 2013.
- (10) Kullgren, Ian and Caitlin Emma. "Trump Directs \$200 Million to Tech Education for Women and Minorities," [Retrieved October 19, 2017]. <https://www.politico.com/story/2017/09/25/trump-stem-technology-grants-women-minorities-243115>, 2017. This article is about how President Trump proposing spending \$200 million for females and minorities in STEM education.
- (11) White House. "President Trump Signs Memorandum for STEM Education Funding." <https://whitehouse.gov/blog/2017/09/26/president-trump-signs-memorandum-stem-education-funding>., [Retrieved October 19, 2017]. This article is about how President Trump proposes increasing STEM education funding for females and minorities.
- (12) White House. February 11, 2016. *STEM for All*. <https://obamawhitehouse.archives.gov/blog/2016/02/11/stem-all>, [Retrieved October 19, 2017]. This article is about how President Obama addressed STEM education, including STEM for females and minorities, during his administration.
- (13) Semuels, Alana. "Why It's So Hard to Get Ahead in the South." *Atlantic*. <https://theatlantic.com/business/archive/2017/04/south-mobility-charlotte/521763/>, 2017. This article is about upward mobility in cities in southern United States. It cites a research study done by Harvard and the University of California at Berkeley. In this study, Charlotte finished last out of 50 cities from across the United States and other southern cities also fared poorly.

- (14) Chetty, Raj, Nathaniel Hendren, Patrick Kline, and Emmanuel Saez. *Where is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States*. [www.equality-of-opportunity.org/assets/documents/mobility\\_geo.pdf](http://www.equality-of-opportunity.org/assets/documents/mobility_geo.pdf), 2014. This research article written by researchers from the University of California at Berkeley and Harvard studied the upward mobility of people in the lowest economic quintile to the highest quintile from 1982-2012 in 50 U. S. cities. Charlotte ranked last in upward mobility in this study.
- (15) Braun, Eric. Benjamin Banneker. Capstone Press: Mankato, MN, 2006. This biography is designed for students in first and second grade. He was a surveyor and astronomer in the late 1700s.
- (16) Rustad, Martha. George Washington Carver. Capstone Press: Mankato, MN, 2002. This biography is designed for students in first and second grade. He is known for studying plants, especially peanuts and sweet potatoes, and being a biology professor at Tuskegee Institute in the late 1800s and early 1900s.
- (17) Hoena, B. A. Matthew Henson. Capstone Press: Mankato, MN, 2006. This biography is designed for students in first and second grade. He explored the Arctic in the late 1800s and early 1900s and going to the North Pole in 1909.
- (18) Braun, Eric. Mae Jemison. Capstone Press: Mankato, MN, 2006. This biography is designed for first and second grade readers. She was a NASA astronaut and was the first African-American woman to fly into space in 1992.
- (19) Schaefer, Lola. Clara Barton. Capstone Press: Mankato, MN, 2003. This biography is designed for first and second grade readers. She nursed soldiers during the Civil War and founded the Red Cross.
- (20) Mader, Jan. Elizabeth Blackwell. Capstone Press: Mankato, MN, 2007. This biography is designed for first and second grade readers. She is known as the first female doctor and was a physician from 1849-1910.
- (21) Schaefer, Lola and Wyatt Schaefer. Jane Goodall. Capstone Press: Mankato, MN, 2005. This biography is designed for first and second grade readers. She is known for her research on wild chimpanzees in Africa.
- (22) Naden, Corrine and Rose Blue. Mae Jemison. Millbrook Press: Brookfield, CT, 2003. This 48-page book is about Mae Jemison, the first African-American woman to travel in space.

- (23) Kraske, Robert. Mae Jemison: Space Pioneer. Capstone Press: Mankato, MN, 2007. This 32-page book about Mae Jemison is from the same publisher as the Pebble book series for younger readers. It would be a good choice for third or fourth grade readers.
- (24) Wadsworth, Ginger. Benjamin Banneker: Pioneering Scientist. Carolrhoda Books: Minneapolis, MN, 2003. This is a 48-page book. It is appropriate for grades 3-5. Benjamin Banneker was an astronomer and surveyor in the late 1700s and early 1800s.
- (25) McLoone, Margo. George Washington Carver. Capstone Press: Mankato, MN, 1997. This is a 24-page book. It has a photograph on every other page. Carver was a noted biologist who is well-known for his study of peanuts and sweet potatoes in the late 1800s and early 1900s and for his work as a professor at Tuskegee Institute.
- (26) Ventura, Marne. Astrophysicist and Space Advocate Neil Degrasse Tyson. Lerner Publications Company: Minneapolis, MN, 2014. This 32-page book is one of the newest biographies of a scientist in the media center collection. This book has a more modern look than most of the other biographies in the school collection. Tyson is a noted astrophysicist.
- (27) Stanley, Diane. Ada Lovelace Poet of Science: The First Computer Programmer. Simon & Schuster: New York, 2016. This lovely picture book is about Ada Lovelace. It would be a good book for grades 3-5, especially for a struggling reader. It is available at the Charlotte Mecklenburg Public Library and at the Devonshire media center because a copy was donated to media centers from the Charlotte-Mecklenburg Schools Humanities Department in the summer of 2017.
- (28) Ehrlich, Amy. Rachel: The Story of Rachel Carson. Harcourt: New York, 2003. Rachel Carson is a noted conservationist from the mid-1900s. This is a picture book with higher level text that makes it appropriate for students in grades 3-5.
- (29) Linder, Greg. Marie Curie. Capstone Press: Mankato, MN, 1999. Marie Curie is a noted chemist who lived in the late 1800s and early 1900s. This 24-page book has a photograph on every other page.
- (30) Briscoe, Diana. Jane Goodall: Finding Hope in the Wilds of Africa. Red Brick

- Learning: Bloomington, MN, 2005. This is a 64-page book. Jane Goodall studied chimpanzees in Africa in the 1900s. This book would be appropriate for higher level readers.
- (31) Goodall, Jane. *The Chimpanzees I Love: Saving Their World and Ours*. Scholastic Press: New York, 2001. This is an 80-page autobiography about Jane Goodall's research on chimpanzees. It is appropriate for a higher level reader.
- (32) Francis, Dorothy. *Clara Barton: Founder of the Red Cross*. Millbrook Press: Brookfield, CT, 2002. This is a 48-page biography about the founder of the Red Cross. Barton was a nurse during the Civil War.
- (33) Davies, Jacqueline. *The Boy Who Drew Birds: A Story of John James Audubon*. Houghton Mifflin: Boston, 2004. This is a very artistic book. Audubon was a naturalist who drew illustrations of many types of wildlife in the 1800s. He was known for his bird drawings.
- (34) Joseph, Paul. *Alexander Graham Bell*. Abdo & Daughters: Edina, MN, 1997. This is a 32-page book about the inventor of the telephone, Alexander Graham Bell.
- (35) Slade, Suzanne. *Albert Einstein: Scientist and Genius*. Picture Window Books: Minneapolis, MN, 2008. This is a picture book about Albert Einstein, the physicist who did his most noted work in the mid-1900s.
- (36) Culkhoven, Laurie. *You Should Meet Mae Jemison*. Simon & Schuster: New York, 2016. This biography is designed for children ages 6-8. It is about the first African-American woman to become an astronaut, Mae Jemison. It is available from the Charlotte Mecklenburg Public Library.
- (37) Strand, Jennifer. *Mae Jemison*. Abdo Zoom: Minneapolis, MN, 2017. This book is 24 pages in length. It would be for students ages 6-8. It would also be appropriate for students in grades 3-4 who are struggling readers. It is available from the Charlotte Mecklenburg Public Library.
- (38) Sanchez Vegara, Isabel. *Marie Curie*. Francis Lincoln Children's Books: London, 2017. This book is part of a series called Little People, Big Dreams. It is a picture book about Marie Curie that would be appropriate for grades 3-5. It is available from the Charlotte Mecklenburg Public Library.
- (39) Cobb, Vicki. *Marie Curie: A Photographic Story of a Life*. DK Publishing:



- London, 2008. This biography is appropriate for advanced upper elementary readers. It is 128 pages in length. It is available from the Charlotte Mecklenburg Public Library.
- (40) Rowell, Rebecca. Marie Curie Advances the Study of Radioactivity. Abdo Publishing: Minneapolis, MN, 2016. This biography is designed for grades 3-6. It is 48 pages in length and contains a number of photos and illustrations. It is available from the Charlotte Mecklenburg Public Library.
- (41) Lassieur, Allison. Benjamin Banneker: Astronomer and Mathematician. Capstone Press: Minneapolis, MN, 2006. This biography of Benjamin Banneker is 32 pages in length and would be appropriate for grades 3-5. It is available from the Charlotte Mecklenburg Public Library.
- (42) Romero, Maritza. Ellen Ochoa: The First Hispanic Woman Astronaut. PowerKids Press: New York, 1997. This book is part of a series called Great Hispanics of Our Time. It is 24 pages in length. It would be appropriate for ages 7-9. There are few biographies of Hispanic scientists, engineers, and mathematicians, so this book would be a good one to include at Devonshire because about 65% of our students are Hispanic. It is available from the Charlotte Mecklenburg Public Library.
- (43) Goldberg, Jake. Rachel Carson: Biologist and Author. Chelsea House Publishers, 1992. This biography is 79 pages in length. It has a lot of text and few pictures. It is part of a series called Junior World Biographies. It would be appropriate for an advanced reader in grades 3-5. It is available from the Charlotte Mecklenburg Public Library.
- (44) Bolden, Tonya. George Washington Carver. Abrams Books for Young Readers: New York., 2008 This book was published in association with the Field Museum in Chicago. It is 40 pages in length. It has a great number of interesting photographs mixed with the text. It would be appropriate for grades 3-5. It is available from the Charlotte Mecklenburg Public Library.
- (45) Wallmark, Laurie. Grace Hopper Queen of Computer Code. Sterling Children's Books: New York, 2017. This picture book is appropriate for grades 3-5. It contains a timeline of Grace Hopper's life, her honors, and more books to read about women in STEM. It is available at the Charlotte Mecklenburg Public Library.
- (46) Johnson, Delores. Onward: A Photobiography of African-American Polar

- Explorer Matthew Henson. National Geographic: Washington, D.C., 2006. This 64-page book is suited for advanced readers in grades 3-5. It has a number of outstanding photographs and a compelling story about Matthew Henson. It is available at the Charlotte Mecklenburg Public Library.
- (47) Grimes, Nikki. Talkin' About Bessie: The Story of Aviator Elizabeth Coleman. Orchard Books: New York, 2002. This book has a conversational style from the viewpoints of many people who knew Bessie Coleman. Some of the characters are combinations of people who knew Bessie Coleman. Their words, voices, and styles are imaginary even though the people are real. There is a half-page biography on the final page of the book. It has an illustration on every other page. The book is available from the Charlotte Mecklenburg Public Library.
- (48) Ignatofsky, Rachel. Women in Science: 50 Fearless Pioneers Who Changed the World. Ten Speed Press: Berkeley, CA, 2016. This is an anthology. It is a 126-page book. It contains 50 biographies that are all two-pages in length. There is an illustration of the person and one-page biography of each woman. It contains an introduction, glossary and an index. The audience is children 9 years old and up. It is available from the Charlotte Mecklenburg Public Library.
- (49) Newsela. [www.newsela.com](http://www.newsela.com), 2017. Newsela is an online resource that provides various types of reading articles for classroom use. This includes biographies of famous scientists, engineers, mathematicians, and scientific explorers.
- (50) A Mighty Girl. [www.amightygirl.com](http://www.amightygirl.com), 2017. This website promotes the world's largest collection of books, toys and movies for smart, confident, and courageous girls. It contains an extensive list of biographies about female scientists, inventors, engineers, and mathematicians.
- (51) GEMS: Girls Excelling in Math and Science. 2017. [www.gemsclub.org](http://www.gemsclub.org). This website is about an organization designed to promote STEM for girls. Several Charlotte-Mecklenburg schools have GEMS clubs.