STEAM Success

Utilizing Picturebook Biographies

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STEM tools and picturebook biographies create a teaching tableau.

It can be challenging for children's librarians to see good books sit on the shelves. In many libraries, the biography section gets little use—except when a teacher assigns a book report or maybe during Black History Month.

Yet the value of learning about people who have achieved something extraordinary is immeasurable. Children need to find heroes and role models who can inspire and motivate them. Knowing this, librarians at Carnegie Library of Pittsburgh looked for a way to ignite children's interest in reading picturebook biographies.

STEM/STEAM (**S**cience, **T**echnology, **E**ngineering, **A**rt, **M**ath) learning has been a significant focus for many out-of-school learning organizations since 2005, when a report from the US National Academies of Science, Engineering and Medicine showed that US students were not being prepared for future careers in STEAM fields with the same proficiency and preparedness as students in other countries.[1] Having worked on multiple STEAM learning projects at the library, using STEAM activities to connect children to picturebook biographies seemed like a logical way to take this learning to the next level.

In an interview with Edutopia, Mitch Resnick noted, "Roughly two-thirds of grade school students will end up doing work that hasn't been invented yet."[2] How can we as librarians better prepare children for success?

The library acts as a key player in out-of-school learning time. The informal learning experiences we offer at Carnegie Library of Pittsburgh are intentional, research based, and an important equalizer as we play our part in addressing the achievement gap. In Raj Chetty's research, *Who Becomes an Inventor in America? The Importance of Exposure to Innovation*, he remarks,

> The model implies that increasing exposure to innovation in childhood may have larger impacts on innovation than increasing the financial incentives to innovate, for instance by reducing tax rates. In particular, there are many "lost Einsteins"—individuals who would have had highly impactful inventions had they been exposed to innovation.[3]

Our efforts include increasing access to technology and scientific materials; introducing STEAM thinking skills like

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problem solving, design thinking, and higher-order concepts; addressing the achievement gap through free, high-quality learning opportunities; and exposing children to STEAM professionals by including STEAM biography read-alouds featuring underrepresented individuals in our programs.

We supported and enhanced the STEAM programming offered to children with staff trainings covering topics like connected learning and issues of equity, diversity, and cultural competency. After all, we are asking children to do the impossible—to prepare for skills and professions that we as educators cannot yet define for them. Through inclusive STEAM picturebook biographies, we offer them the opportunity to find the extraordinary heroes who will inspire them to pursue the unknown.

The following are some examples of STEAM activities with a few of our favorite connecting books. We sometimes use the same activity with several books and may use different activities with the same book. Our program planning depends on what skills we are hoping to develop and/or how the book may be relevant to attendees. We love looking at the new picturebook biographies when they arrive to see how they might inspire us to come up with new connecting STEAM activities.

Science

Science activities, experiments, and inquiry are a great way to connect children to reading many types of books, especially picturebook biographies. There are many different types of scientists featured in picturebook biographies, but some of our favorites are scientists who studied animals or the natural world.

There is no better way to grab the attention of a room full of kids than showing them a shark tooth and letting them feel the serrated edge. We chose a few physical characteristics and facts about sharks to look at, study, and discuss. We asked the children, "How does this physical feature or adaptation help a shark survive and thrive in its environment?" They had some creative answers, a few misconceptions, and even a few correct answers.

Examining animal adaptations or the special features that let an animal thrive in its environment opens the door to sharing a book about a scientist who studied an animal and discovered unknown things about them. *Shark Lady: The True Story of How Eugenie Clark Became the Ocean's Most Fearless Scientist* by Jess Keating tells the story of one such scientist who dared to study sharks at a time when many people were terrified of them. She disproved many myths about sharks through her study and research.

We played a game of "Myth or Truth" to ignite children's interest in Eugenie's discoveries. We challenged the kids to guess if

What's under the microscope?

a series of statements were a myth or the truth about sharks, revealing the answers as we read the book.

Reptiles are another type of animal that intrigues children because they have the appeal of the gross, creepy, unknown, and dangerous—beloved topics for many kids. There are a number of options in Pittsburgh that provide opportunities for real animal encounters. But because we serve a diverse urban population, some of whom are living in poverty, many of the children who attend our programs have limited experience with seeing or knowing much about reptiles. This makes the topic of reptiles perfect for building skills of observation and inquiry.

We put a picture of a Komodo dragon on our large-screen TV and asked the kids, "What do you notice about this animal?" We then showed a quick video of the animal in the wild and asked the children more about their observations. Scientific observation is one of the more important skills that scientists develop. One of the best ways for children to notice detail is to ask them to draw something they noticed—like the dragon's forked tongue, the scales of its skin, its curved claws, or powerful jaw.

These large Komodo dragons or monitor lizards were mysterious animals; people knew very little about them at the dawn of the early twentieth century. In 1927, the first live specimens of Komodo dragons were shipped from Indonesia to the London Zoo, which turned to its young, self-taught naturalist/curator named Joan Procter, who had just undertaken the task of designing their innovative new reptile house.

Joan Procter, Dragon Doctor: The Woman Who Loved Reptiles by Patricia Valdez tells the remarkable story of how Joan's observations of reptiles revolutionized the world's understanding of these misunderstood creatures. She also changed the operation of zoos worldwide when she built one of the first animal enclosures that reflected the animals' habitat in place of a barred cage.

Technology

Introducing a new technology should be like introducing a book. Are we asking questions, setting a child up to make predictions, and supporting critical thinking? When we connect the introduction of a new robot with a new book, we are making important relationships between digital and print literacy.

Coding a Cubetto robot to travel an assigned path across the floor is a good anticipatory reason to read the book *Grace Hopper: Queen of Computer Code* by Laurie Wallmark. After spending time working on coding with a robot and struggling with challenges when it doesn't work like they thought it would, children are ready to be asked questions.

"Do you know why we call something that goes wrong on a computer a 'computer bug' or why we say we are 'debugging' a computer when we talk about fixing things that are going wrong?" The story of Hopper can answer this question, and the mystery of "why" should ignite children's interest.

Hopper overcame gender stereotypes and even age discrimination to become a pioneer of computer programming and develop the first computer programming language to use English words, but what part of her story has to do with a "computer bug"?

Another coding robot, DASH, uses a picture-based coding language to make it easy for even very young children to code in behaviors for the DASH robot. Kids can drag and drop picture codes onto an iPad screen and soon have DASH throw a ball, chase a toy, play the xylophone, or go through a maze.

This can lead to a great discussion about how computers get their commands, and the person who wrote the first computer program, Ada Lovelace. *Ada Lovelace, Poet of Science: the First Computer Programmer* by Diane Stanley tells the story of how Ada came to write the first computer program in 1843 for Charles Babbage's Analytical Engine.

A good question to ask children is, "Did you know that computers only understand two values: 0 and 1?" This should spark some wonderment about how to tell a computer to do something using only 0s and 1s, or how to covert our language into a digital language that the computer can understand—what we now call programming.

Engineering

One of the best ways to start to understand how things work is to take something apart and tinker with the parts, or to build something new with scrap materials. The importance of tinkering in building future engineers and innovators has led to the maker movement in public libraries and educational organizations across the United States to encourage youth to use the maker spaces to tinker.[4]

When Lonnie Johnson was growing up, he had no such space. In fact, he grew up in a tiny house with lots of siblings, but he still found a way to take things apart and put them back together or build and invent his own things. *Whoosh! Lonnie Johnson's Super-Soaking Stream of Inventions* by Chris Barton tells his story, especially his most famous invention—the Super Soaker water gun, with its iconic whoosh sound.

Gather a bunch of screwdrivers, fill a room with old toasters, tape or CD players, printers, or other machinery, and let the kids take everything apart and look inside. Can they build something new with the parts? Can they hook up the electronics to a circuit and make it work? Can they create something that moves?

The building of structures requires significant knowledge of engineering and how structures can be built safely and securely. Kids at the library love to build with Magna-Tiles, Keva Planks, Straws & Connectors, wooden blocks, LEGOs, and Zoob BuilderZ (and the loud crashing sound of knocking them over!).

One of our favorite activities is to give the students a building challenge with specific criteria and a set of materials and see what they design and construct. One of the easiest building challenges is having children build the tallest structures they can using only paper or index cards and some kind of fastener. After children build, we use the paper towers to see just how much weight they can support. After this challenge, we might ask children to use magnetic tiles or wooden blocks to build a structure that is both tall and strong.

Using the magnetic tiles in connection with *The World Is Not a Rectangle: A Portrait of Architect Zaha Hadid* by Jeanette Winter introduces the opportunity to talk about art and architecture. How do we design structures beyond the block form of LEGO bricks and square magnetic tiles? Another great book to talk about the intersection of function and design is *Maya Lin: Artist-Architect of Light and Lines* by Jeanne Walker Harvey. Contrast the work of architects like Frank Lloyd Wright and Maya Lin. What do the children notice?

Art

Art and science do not exist in separate realms. Artists practice science regularly, analyzing lighting and color theory and using new technologies to produce their work. Using Javaka Steptoe's Caldecott Medal book *Radiant Child: The Story of Young Artist Jean-Michel Basquiat*, children have the opportunity to learn about pop art and the use of technology in the production of art.

After reading the book and talking about reoccurring symbols, show children some of the artist's self-portraits and photographs. In our STEAM program, we had the children take turns photographing each other. We then printed these images in black and white, making several more copies.

For the first activity, we used chalk and watercolors to draw crowns. The children then made collage work on another edition of their portrait. For the last activity, children used watercolors to create Andy Warhol–inspired portraits, leading to the creation of three personal pop art masterpieces, the iPads long forgotten after our initial photography session.

Susan Wood's biography of Juan Garcia Esquivel, *Esquivel! Space-Age Sound Artist*, offers the perfect opportunity to provide hands-on activities combining science and art. The twentieth-century Mexican musician designed his own instruments to create his "space-age sound."

School-age kids in our libraries often stare in awe at our Teenspace watching their older peers geek out while exploring MIDI equipment, music recording, and other instruments. With a little guidance, kids can learn some of these digital music-making tools.

Borrowing from our teens, we hooked up our Roli Blocks light blocks to create our own Esquivelesque tunes. Using Makey Makeys and Scratch, children can create all sorts of sounds with the conductivity of pencil on paper and some alligator clip wires. This program can easily go tech-free by creating flutes from straws, finger pianos and easy percussion instruments. This STEAM offering is the perfect bridge between children and teen services.

Math

Prepare yourself for rockets blasting through your library with excited screams and predictions of whose design will travel the farthest! Several newer picturebook biographies allow us to introduce the complex science of space travel from computer coding to physics.

What does the word "trajectory" mean and how did the women in *Hidden Figures: The True Story of Four Black Women and the Space Race* by Margot Lee Shetterly plan to guide the astronauts to space and back safely? Children create straw rockets using ordinary straws and strips of paper. After reading this book, we introduced our vocabulary word *trajectory*, and blew into our straws, and measured where they landed. After testing, we asked what makes a rocket travel faster, farther, and higher.

Re-create the solar system using inflatable planets, or even just printed planets. Have children launch their rockets into the system. We paired books about each planet next to the orbs. When the spaceship landed near the planet, children could explore further using the books.

Rather than challenge each of our nineteen library locations to produce their own STEAM programming ideas connected to picturebook biographies, Carnegie Library of Pittsburgh created kits of programming materials that include relevant picturebook biographies. Any librarian in the county can check out the kits, so that a children's librarian can pull out the STEAM hands-on materials, activities, experiments, or lessons and read a relevant picturebook biography.

The STEAM kits contain lesson plans adaptive to a diversity of learning styles and audiences. The grab-and-go format makes them perfect for outreach and visiting school groups on field trips. We provide media connections and app selections using developmentally appropriate and professionally reviewed selections for our tablets while providing tech-free activities for all subjects covered.

We presently cover twenty-five topics in our circulating STEAM program kits—from game design and farming to data journalism. Most kits contain picturebooks and biographies or suggest other relevant titles.

We embrace STEAM programming from the perspective of "let's learn and explore together," not expecting librarians to be experts on STEAM topics but, rather, explorers.

We may be beginners to new technology or science concepts, or lacking in artistic skills, but that doesn't act as barrier to providing STEAM experiences or integrating technology into children's programming in our efforts to support literacy and learning in our community.

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