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Greetings from the Board of Directors of the Virginia Children’s Engineering Council. We are so excited to celebrate our 25 years of providing quality children’s engineering instruction for educators. What a year 2020 was! Many of you have probably uttered the expression “20/20 hindsight” before, but I am sure all of us are happy 2020 is now in our hindsight! We, with our students, witnessed scientists and bioengineers from around the world rise to the challenge to identify a new virus and then quickly create a vaccine for the disease. Children and teachers also rose to the challenge of adapting to a virtual school setting that is far different than we have ever experienced at the elementary level. It was a year wrought with challenges and obstacles, but I believe educators across our nation demonstrated ingenuity and perseverance to create new methods of educating our students. Teachers, who did not usually design lessons structured with technology, found themselves downloading new apps and platforms to deliver their curriculum. Many of us faced real-world engineering problems trying to stabilize a webcam and a microphone on our laptops while hiding in our closets because that was the only quiet, child-free location in our house. Let us celebrate our successes and look forward to a future filled with promise and hope for a return to a more normal school environment.

Many of you attended our 25th convention in February. I hope you enjoyed the sessions and were inspired by our three keynote speakers. In the upcoming weeks, we will migrate the prerecorded videos and the screencasts of our live sessions to our website as a member-only resource. Those resources will remain there for you to find new ideas or re-energize yourself. In fact, our conventions are what VCEC is all about – helping our teachers become critical thinkers and problem solvers through the collaboration and communication of their successes and failures. We all learn from each other, and so should our students. I hope you share with us how these sessions affect your classroom or school, so we can learn from you.

In 2021, the VCEC Board of Directors wants more educators actively involved in the organization throughout the year, not just attending our annual convention. In order to continue to provide quality training in the area of children’s engineering, I plan to focus on three goals for this year. I intend to lead our board in:

1. Updating our bylaws.
2. Encouraging more of the membership to participate in the council by being transparent in our actions.
3. Initiating “2 deep in leadership” so responsibilities are more balanced.

I hope you decide to become more actively involved in our council’s goals and endeavors in the months to come. Please reach out to any board member to find out how you can help.

Please remain safe and stay curious!

Lisa A.H. Brown
#VCEC2021 Wrap-Up

by Yvonne Richard

#VCEC2021 kicked off on February 2, 2021, with a welcome from current VCEC President Lisa Brown. This was the silver anniversary of the Virginia Children’s Engineering Convention. While the board would have loved to host an in-person event at the Hotel Roanoke, it was determined that would not be possible. Following the welcome address, Elizabeth Kirk announced the election results for the Virginia Children’s Engineering Council Board of Directors. Barbara Westlund will serve as president-elect, and Joseph Jackson will serve as secretary for the upcoming year. If you are interested in becoming a member of this organization, please visit https://childrensengineering.org/ for information.

Dr. James Lane, Virginia state superintendent, spoke in his keynote address about the importance of innovative thinking and creativity. His presentation was excellent. On Tuesday evening, the VCEC board was excited to offer 10 live sessions presented by people from near and far using Adobe Connect. VCEC board members served as hosts and moderators for our presenters and attendees. In addition to the live sessions, about 20 pre-recorded sessions were available.

VCEC President-Elect Barbara Westlund hosted an amazing awards ceremony Wednesday evening. The teacher of the year award, sponsored by Farm Credit of the Virginias, was Laura Prymack, a teacher at Winterpock Elementary School in Chesterfield County. She received a $1,000 educational scholarship award from Farm Credit of the Virginias to assist with her continued educational goals.

The program of the year, sponsored by the Virginia Aerospace Business Association and presented by Joan Harper-Neely, was awarded to Powhatan County Public Schools. The award was accepted by Libbey Kitten, a science and STEM instructional specialist. Powhatan County Public Schools received a $1,000 educational scholarship award from the Virginia Aerospace Business Association to assist the school division in its continued delivery of STEM-based instruction in grades PreK-5.

Finally, the Dr. Marlene C. Scott Curriculum and Instructional Leadership Award, sponsored by the Virginia Lottery and presented by Eileen Rogers, a Virginia Lottery public relations representative, was awarded to Green Valley Elementary School. Green Valley Elementary received a $1,000 educational scholarship from the Virginia Lottery to assist in the school’s delivery of STEM-based instruction with emphasis on design, engineering, and technology.

Congratulations to all award winners. We wish we could give out awards to everyone for being amazing teachers this year with the burden of COVID-19. Please congratulate yourself on a job well done and keep on doing your best!

On Wednesday evening, our keynote speaker was Chris Woods. Mr. Woods is the host of the STEM Everyday podcast and author of the dailySTEM blog. He shared amazing resources and a lot of ideas that anyone could implement into their classrooms.

Following Mr. Woods’ speech, VCEC again offered 10 amazing live sessions to our attendees.

On Thursday, Dr. John Almarode was our keynote speaker. He talked about student learning communities, the essential component in amplifying student learning. He discussed collaborative versus cooperative educational experiences in the classroom. He also shared ideas on how to make student learning communities and tasks purposeful for our students. Attendees on Thursday had the ability to view an additional session with Mr. Woods, who shared 50 easy resources and ideas for STEM. We closed out VCEC with 10 more live sessions.

With #VCEC 2021 officially in the books, we are making plans for next year’s convention and can’t wait to see what the next 25 years holds for our organization. Please enjoy the photos of the 25th anniversary cake decorating challenge winners. Thank you to all who entered. We hope you enjoyed eating your creations.
VCEC 25TH ANNIVERSARY CAKE CONTEST

The National Institute of Aerospace’s Education and Outreach team voted for their favorite cake. Members were impressed with the cake designs and very, very disappointed they could not taste the cakes.

Kaitlin Childester

VCEC is impressed with this cake totally encompassing the design criteria and spirit! It honored our 25th Anniversary!

Allyson Jamison

Congratulations!

This cake has all of the design criteria! VCEC is impressed by the inclusion of the logo and the party scene!

Susan Mahood

This cake contained all of the design criteria! VCEC is impressed with the student designed moving parts!

Sylvia Anderson
Thank You!

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Oh, the Places We’ve Been: Children’s Engineering in Virginia History with Reflections  
by Patti Fazzi and Linda Harpine

The year 2021 marked the 25th anniversary and our first virtually held Virginia Children’s Engineering Convention. Members of our all-volunteer team have many years of developing and teaching hands-on problem solving, design, technology, and engineering in elementary classrooms. Training for elementary staff and students has taken place in elementary schools across the state of Virginia. We will reflect on some of the highlights of these engineering adventures.

Historical Facts: Long Ago the Adventure Began
The Learning by Doing philosophy of John Dewey, followed by beliefs of Dr. Julian A. Burruss, supports the practice of hands-on learning. Historical research of Virginia’s education records reflects that Dr. Burress implemented what is today called children’s engineering as “hands-on learning” in 1903 in Richmond. He had an amazing career. Dr. Burress served as the president of James Madison University (JMU), originally called The State Normal and Industrial School for Women at Harrisonburg. When Dr. Burruss became president of Virginia Agricultural and Mechanical College and Polytechnic Institute, later called Virginia Tech, he was the first to admit women to the Institute.

Reflections
Wow, more than 100 hundred years ago! Dr. Burress was quite a forward thinker. It is interesting to note that James Madison University and Virginia Tech still play a role in Virginia’s children’s engineering programs.

Historical Facts: The Nineties - Official Workshops
Concurrent with the 1994 Virginia Technology Education Association (VTEA) Summer Conference held in Richmond, the Virginia Department of Education sponsored an Elementary School Technology Education Workshop coordinated through JMU under the leadership of Dr. Arvid VanDyke. Teachers from across the state participated in the workshop led by Cindy Etchison, a technology teacher from Loudoun County. For many years, Dr. VanDyke supported children’s engineering in numerous ways and set up the first children’s engineering graduate credit classes at JMU.

Dr. Sharon Brusic, professor of technology education at Virginia Tech, was instrumental in training teachers in a weeklong class during a VTEA summer conference. She was one of several to promote and help to create the International Technology Education Association’s (ITEA) Elementary Childrens’ Council. Dr. Brusic continues to send college students to present workshops during our convention from Millersville University in Pennsylvania, where she is currently teaching.

Reflections
That first workshop in 1994 was quite an eye-opener to an additional definition of technology. Where were the computers? Teachers were introduced to hands-on problem-solving activities for elementary students, with emphasis to ensure that children developed a degree of technological literacy in grades K-5. Dr. VanDyke, organizer of the workshop, proved to be an expert at the “behind the scenes” logistics of organizing a workshop for teachers on a shoestring budget.

Historical Facts: The Nineties - Design, Technology, and Engineering Initiative
George R. Willcox and Dr. VanDyke collaborated with Dr. Ron Todd on a National Science Foundation project, UPDATE, which incorporated the Design, Technology and Engineering (DT&E) approach to learning. Project UPDATE schools in Virginia were chosen to work with colleagues from five other states at The College of New Jersey for three summer workshops from 1995-1998. The goal was to create learning materials that reflected the DT&E approach and to develop teacher training teams to prepare other teachers in five states to implement the DT&E approach in classrooms. Two Virginia teams were established, one in Rockingham County at Ottobine Elementary School with Dr. David Burchfield and Dr. Bob Grimesey as principals and one at Cooper Elementary School in Hampton with Bill Cawley as principal. The Rockingham team of teachers included Linda Harpine, Jerry Ridgeway, Carole Welch, Susan Pollard, and April Cave. The Hampton team included Patti Fazzi, Kathen Nugent, and Deborah Ballard. Working with teacher teams from New York, New Jersey, Delaware, and Pennsylvania, the Virginia group explored the areas of the design process, tools and materials, drawing and documentation, energy and mechanisms, electricity and control, structures, and authentic assessment. These topics continue to form the core of the Virginia Children’s Engineering program.

Reflections
Participation in the UPDATE classes was a life-changing event for many of us. We had the amazing opportunity to study with educators from the United Kingdom, where design technolo-
gy was part of the regular curriculum. Lead teacher Peter Sellwood shared his knowledge with us in the areas of engineering, architecture, invention, publishing, art, and design. We would attend any class that he taught and then stay after to “learn from the master.” Peter was the inventor of Check-card that we continue to use in our workshops today. He also introduced us to the use of real-world tools in the elementary classroom, including the junior hacksaw, hand drill, and vise. Peter has published a variety of design and technology materials for the elementary classroom. At one of our earliest conventions, Mr. Sellwood came from England to serve as the keynote speaker. He was a wonderful mentor. Sadly he passed away in the fall of 2020.

Dr. Ron Todd has been a long-time proponent of DT&E for elementary students, and in providing teacher training. His programs and connections with UK educators helped build the foundation for children’s engineering in Virginia. He always has a new and innovative idea to explore. Kudos to Dr. Todd!

Historical Facts: Workshops and Graduate Credit Classes - Oh, the Places We’ve Been

Following the 1994 workshop and UPDATE training in New Jersey, the Virginia UPDATE team held workshops across the state for classroom teachers and administrators. Particularly important in this initiative are the teacher participants who moved up through roles as workshop helpers to assistant trainers and eventually became full-fledged DT&E trainers. This practice continues with three new instructors/trainers being added in 2020.

Reflections

VCEC’s goal has been to provide educators training in children’s engineering in Virginia, so that all children can use their creative skills to design, build, and solve challenges. Workshop leaders have packed up their cars with tools and materials and hit the road to make this happen. All workshops are hands-on and engaging for participants; no sitting and listening to lectures! It is so exciting for the class instructors to hear the positive responses from participants.

Historical Facts: The 21st Century - From DT&E to a Virginia Children’s Engineering Council - A First in the Nation

In the 1990s, what first began as a loosely knit group of volunteers from across the state merged into the Virginia Children’s Engineering Council (VCEC) and worked within the VTEA, renamed Virginia Technology and Engineering Education Association (VTEEA) and the International Technology and Engineering Education Association (ITEEA).

While VCEC grew and became an independent 501(c)(3) organization, it still maintains a partnership with VTEEA and ITEEA. The Virginia Children’s Engineering Council, formally titled Virginia Council on Elementary School Technology Education (ESTE), continues to be an entirely volunteer group and focuses on providing teachers in grades PreK-5 professional development experiences that enable them to help children:

- explore how people create, use, and control technology;
- apply knowledge of mathematics, science, English, and history and social studies in solving problems associated with technology;
- use tools and materials to explore personal interest with technology;
- exhibit self-confidence using technology.

The council, composed of approximately 15 members, meets quarterly with its three main objectives: (1) coordination of the annual convention, (2) publication of journals and teacher resources, and (3) organization of teacher workshops and classes. There is a Board of Directors that oversees the general council and its committees.

Reflections

Over the years the council has been made up of a wonderful group of volunteers. Mr. Willcox, one of VCEC’s founders, has many connections through his work for the VDOE and volunteers for VCEC. Without Mr. Willcox’s tenacity and steadfastness, there would not be a Virginia Children’s Engineering Council or convention. He keeps us on track with our mission statement. We, Patti and Linda, have also been members of the council since its inception and are so thankful for the wonderful educators who have given their time and effort to
make children’s engineering a huge success in Virginia. The council members have kept up with technological advances to ensure the council is up to date, even on the cutting edge. We will forever treasure the friendships we have made with this group.

Historical Facts: Virginia Children’s Engineering Conventions

Over time, a professional partnership developed between principal Bill Cawley of Hampton City Schools, Mr. Willcox, Dr. VanDyke, and principals and representatives from Newport News and Norfolk City Schools to create the annual Virginia Children’s Engineering Convention. The first convention was held April 18-19, 1997, in Hampton. That inaugural convention was a huge success with over 200 attendees. Early conventions were held in locations including Williamsburg and the Richmond area. Harvey Dean, owner of Pitsco/Lego in the United States, was enthusiastic about using Legos as a learning tool. He soon became one of our first business partners, providing Legos, door prizes, and monetary support. We began a partnership with NASA/Langley in Hampton. When funding was needed for keynote speakers, NASA came to the rescue. During these growing years Marcia Hickey served as the convention director and Ginger Whiting worked with Mr. Willcox to develop professional development opportunities as part of the convention. Beginning in 2016 and continuing through 2020, the convention was held at the Hotel Roanoke in Roanoke. This amazing facility has provided all the necessary amenities for more than 700 attendees! The convention offers participants from the United States and other countries the opportunity to participate in hands-on workshops, learn from nationally recognized keynote speakers, interact with vendors and network with other educators. In 2021, we marked the 25th anniversary of the convention and a big celebration was in the works. Unfortunately, with the onset of COVID-19 the council made the major decision to move from an in-person convention to a virtual platform. Under the amazing leadership of council members, the 2021 convention was a huge success. Plans are currently underway for the 26th convention in February 2022.

Reflections

From the days of VCEC’s inception to the recent 2021 virtual platform, both seemed to be virtually impossible. Special thanks to council members, keynote speakers, presenters and vendors. You all did an amazing job!

Historical Facts: Publications

In the 2000s the VCEC, in conjunction with VDOE and the Career and Technical Education Resource Center, created and published three teacher resource guides for teachers in grades PreK through fifth grade. The draft of the third edition is currently available for field testing and final editing. The guide, Children’s Engineering: A Teacher Resource Guide for Design, Engineering, and Technology in Grades PK-5, Third Edition, identifies engineering design and technology-based experiences that enhance the content of selected Standards of Learning in English, mathematics, science, history and social science. The experiences enable teachers to introduce children in grades PK-5 to the technological world around them and to develop confidence in their ability to engineer solutions. The document is designed to be a companion to the Standards of Learning and a resource for enhancing locally developed curriculum. It includes design briefs and accompanying resources for each grade level and supports the 5 C’s found in the Profile of a Virginia Graduate.

The Council also publishes The Children’s Engineering
Journal periodically each year. The journal is an avenue for educators to share their engineering experiences and favorite design briefs. It is available online at the VCEC website. A special thanks goes to Dr. Lynn Basham, council member and the VDOE specialist for Technology Education and related clusters, for continued support of publications and other council initiatives.

Reflections

We hope the documents available on our website will get you started in children’s engineering. The documents can be changed to fit your needs in your classroom. Council members will be happy to help you with any questions you may have.

Patricia Fazzi, first president and historian for the Virginia Children’s Engineering Council, Hampton City Schools, retired

Linda Harpine, second president and advisory council to Virginia Children’s Engineering Council, Rockingham County Public Schools, retired

Dr. Ron Todd (right) presents at a Virginia Children’s Engineering Convention in Roanoke. Dr. Todd was instrumental in leading the National Science Foundation’s Project UPDATE.

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Virginia’s Elementary School Teacher of the Year Award
Enhancing the E in STEM

STEM – science, technology, engineering, and mathematics -- has become part of the curriculum in many elementary schools. While the acronym is used everywhere, the educational pedagogy used and content covered varies from district to district, school to school, and classroom to classroom. When we think about engineering in elementary schools, often the “black box” analogy comes to mind. Teachers are unclear about the internal workings of engineering. Many have been filling that “black box” with the engineering design process. The lack of a common language has led to discrepancies in teaching the “E” in STEM. While the engineering design process is a good place to start, it does not provide students with a complete picture of what engineering is. We need a clear direction on how to include the “E” in STEM and to make the “black box” a redesigned “transparent box.”

The Framework for P12 Engineering Learning, a new publication from the American Society for Engineering Education (ASEE) and Advancing Excellence in P12 Engineering Education (AEEE), seeks to provide programs, schools, and teachers with a tool that will help them unlock engineering literacy for all students. This landmark publication constructs engineering learning into three dimensions: Engineering Habits of Mind, Engineering Practices and Engineering Knowledge.

The Framework for P12 Engineering Learning provides fundamental principles on which STEM curriculum should be built: focus on depth over breadth, keep equity at the forefront, strive for authenticity, build on children's natural problem solving, leverage making and doing, connect with students’ interests and cultures, and connect to science and mathematics knowledge.

Within each of the three overlapping dimensions, the engineering framework details core concepts with performance indicators for each. One of three dimensions, Engineering Practices, is laid out into four main practices: Engineering Design, Quantitative Analysis, Materials Processing and Professionalism. Within each of these practices there are core concepts. These core concepts are then broken down into subconcepts. This format allows teachers to dive deeper into what the practices are and how to develop these in their lessons. Currently, the engineering performance matrices (EPMs), which provide performance levels for each subconcept, are targeted to high school. Additional research on EPMs in middle and elementary schools is just beginning. It is imperative that we look at the practices within the EPMs descriptions as we build STEM curriculum within the elementary realm. It is essential for our youngest learners to begin building the habits and practices of engineers alongside science, mathematics, and technical concepts (engineering knowledge) that include the standards of the state (see Proposed Scaffolding of the Dimensions of Engineering Across the Grade Levels).

Through the lens of Engineering Practices and a second-grade Integrative STEM unit, this article will unpack the concepts addressed in Engineering Design and Quantitative Analysis. It is our intent to validate many of the current approaches teachers have been using while also exposing them to new ways of student learning and doing, using the Engineering Practices.

Using an integrative approach to teaching engineering is essential and authentic to actual engineering practice. Integrative STEM and engineering are synonymous. “Keep It Cool” is an integrative STEM design challenge in which second-graders focus on engineering concepts as they explore ways to keep food and other items cool. They build scientific knowledge about matter and phase changes through investigations. Students create containers made from everyday items that will keep an ice pop as cold as
possible for 30 minutes. Students plan, create, and test their design, then share the results with the class.

“Keep it Cool” highlights many Engineering Design practice concepts such as information gathering, problem framing, ideation, prototyping, and decision making. At the beginning of the challenge, during information gathering, students participate in research and investigation and data collection while building background knowledge through team explorations. As part of building understanding, the teacher supports the practice of reverse engineering as the students analyze the layers of a lunch box that has been cut open. They also make the connection to a brown paper bag with no insulation and discuss the benefits of one over the other. Students test different materials and record data (see Quantitative Analysis below).

Once investigations have been conducted and students understand the problem, students can identify design parameters and problem statements through discussing criteria and constraints of building a container to keep their ice pop cold. Problem framing occurs when students write the problem in their own words. Students practice divergent thinking as they brainstorm and share multiple solutions. Listening to others’ ideas and working together to determine the best solution gives opportunities for group decision making. Through this ideation they are practicing decision making by applying engineering knowledge and choosing which materials they think will work best based on their investigations.

Next, students use spatial visualization through drawing and labeling individual designs. Excitement heightens when prototyping begins. Students engage in manufacturing processes for manipulating materials by choosing materials they think will work best for their prototype. Because this is a second-grade unit, materials provided are readily accessible and easy to manipulate. While many elementary school prototypes are low-fidelity, they are still an important step in building the foundation of prototyping. In this unit the teacher sets up the procedures for testing and modification by having students test their prototype in the sun during recess. If the ice pop remains frozen, the design is successful. If not, students can modify and retest.

In the “Keep It Cool” unit, the major focus of Quantitative Analysis rests in computational tools and data collection and analysis. With support, students in the earliest grades can begin to build their understanding of the Quantitative Analysis practice.

For example, students work in teams as they investigate how long it takes ice chips to melt when placed in cups protected by materials such as aluminum foil, plastic wrap, felt, or packing peanuts (while students are waiting, mathematics is integrated as they are given measuring cups and juices to create their own ice pop). The groups share the data they collect with the teacher and the class fills out a data table to record the melting times for each material in the investigation. This helps develop the core concept of Data Collection Techniques and Reporting Data. The teacher then can input the data into a spreadsheet and create a bar graph for the students, or the class can create a graph to display the data in visual form. This supports the subconcept of data visualization within the core concept of data collection, analysis, and communication. An additional teaching activity that supports data analysis can be done, if classes share data with each other to compare data collected.

One of the most important components of this lesson is that students use data in making design decisions which supports the sub-concept data-driven decision making. The earlier investigation exploring which materials kept the ice chips frozen the longest is key. Students should be able to look at the visual representation of the data and connect their investigations to the materials that they chose to build their “Keep It Cool” container. At the end of the unit, after students test their prototype, they share data as they explain their learning to peers. Sentence frames are provided as scaffolding to ensure Engineering Literacy for all.

“My ice pop was a _______. Now it is a _______. I used _______ to keep my ice pop frozen. The experiment was _______ because ___________________________."

The main practices of Material Processing and Professionalism are not as prevalent in “Keep It Cool.” However, the unit still offers foundations that move in the direction of a greater understanding of these two practices. The use of basic tools such as scissors and tape and the opportunity to manipulate familiar materials is a step toward students understanding how to work with more advanced tools and materials later.
This unit strives for authenticity as second-graders are naturally interested in keeping their ice pop from melting. Furthermore, this unit serves as a general engineering connection introducing students to how engineers must use science and mathematics to solve problems. While not every design challenge will cover all of the Engineering Practices, teachers can take steps to build Engineering Literacy at the elementary level. In being strategic about how Engineering Literacy is being developed in classrooms and across grade levels, students can be better prepared as they move toward understanding the “E” in STEM.

References:

Authors:
Amy Sabarre, director of STEM education for Harrisonburg City Public Schools and director of implementation and professional development and for Advancing Excellence In P12 Engineering Education
Diana Ferguson, STEM specialist for Harrisonburg City Public Schools
Courtney Sokolowski, STEM specialist for Harrisonburg City Public Schools

Virginia Lottery is delighted to Sponsor
Dr. Marlene C. Scott Curriculum and Instructional Leadership Award
Using Children’s Literature to Teach Computer Science: Pick a Great Book and Get Started!

by Sheryl L. Roberts and Michelle Dunphy

There is a saying that every elementary teacher is a reading teacher. Strong teachers know that every content area can be enriched by including language arts skills as a core part of a lesson. Children’s literature is ideal for this purpose and has many books that can be used as mentor texts. Mentor texts are books that can be read and reread for different purposes. They can be used to introduce, model, and enrich skills. At the elementary level, they are most often used to teach writing and comprehension and are usually picture books.

Using children's literature to teach across the curriculum isn't a new idea. In her Next Step Forward in Guided Reading, Jan Richardson (2009) provides sample whole-class lessons using mentor texts and shows how to use mentor texts to teach reading strategies. Because mentor texts are a common tool in elementary classrooms, we are offering children's literature as a means of teaching computer science.

Why use children’s literature to teach computer science? Technology is a moving target. Teachers are preparing students for careers that have not been invented and we do not know what skills they will need. A foundation in computer science facilitates mathematics and science understanding and is a baseline for future learning. Computer science is becoming the fourth literacy, after reading, writing, and arithmetic.

Children's literature is a friendly way of teaching abstract concepts. Computer science can be intimidating for anyone, but using a familiar medium like children’s literature gives teachers an easy entry point. Because we all teach language arts, it's likely that teachers have several excellent resources in their class or personal library. This makes finding materials accessible to all teachers.

Children's literature builds on students’ background knowledge. Gail Boushey in the Daily 5 states that there are three ways to read a book: Read the pictures, read the words, and retell the story. When students bring their background knowledge to reading, learning is compounded. With every reading, children's background knowledge grows larger and helps them make connections to new knowledge.

Computer science is now part of Virginia’s curriculum. Standards were adopted in 2017 and are available on the VDOE website. There are six strands for K-12 that can be taught synchronously with other content areas, especially language arts. These strands were the reason we aligned children’s literature with teaching computer science. Combining children's literature with computer science helps teachers teach these objectives by making small changes in their instruction. Using familiar literature that is already used in the classroom allows students to access computer science objectives.

Here are some of our favorite activities per computer science strand.

Algorithms and Programming

K-2: Students can use The Snowy Day, The True Story of the Three Little Pigs and We’re Going on a Bear Hunt to explore computer science concepts such as planning, computational thinking, conditionals, loops, and outcomes in pattern recognition. A great resource for The Snowy Day and We’re Going on a Bear Hunt is the website jdaniel4smom.com.

3-5: Students can explore computational thinking, debugging, loops, sequencing, and conditionals while reading How to Code a Sandcastle. Solve problems by breaking them into smaller, manageable parts and use editable Scratch blocks for coding everyday activities. The Scratch Blocks Conditionals Game helps students become familiar with what drag-and-drop blockly coding looks like before using it independently.

Computing Systems

K-2: Students can learn all about how a computer works through the Hello Ruby series. Hello Ruby, My Magical Computer, explains how a computer works, identifies computer vocabulary and the role of the internet. Use this book to engage in the following lessons about computer design: Lesson 2 on Binary Code, the Hello Ruby Educator Page, and My First Computer.
3-5: Students can identify and explore how a computer works through the Girls Who Code book. Each chapter addresses a computer science idea and the different ways coding can be used. Students can also create projects in Scratch to match the lessons in the book.

Cybersecurity
K-2: With Webster's Friend, students can explore cybersecurity, digital friendships, netiquette, email, and online safety. In Chicken Clicking, students can finish the story or predict what happens to the chicken. Students can then rewrite the story ending with the chicken safe from the wolf.

3-5: Students can revisit in detail cybersecurity, digital friendships, netiquette, email, and online safety. The following are activities to complete in tandem with the literature: Interland Online Safety game from Google, Common Sense Media's Rings of Responsibility, Create your rings of responsibility (Wixie, Word, PowerPoint), Private and Personal Information, creating a t-chart for a visual sort for what is safe to share online, and what to keep private (Wixie, Word, PowerPoint).

Data and Analysis
K-2: Students can explore loops, algorithms and programming, and data and analysis through Wanda Gag’s Millions of Cats. Students can create step-by-step instructions, emphasizing a beginning, middle, and end; then re-create the story in Scratch. They can also group items (cats) by their attributes (color, size, spots or stripes) and decompose a problem (how to stop a cat fight).

3-5: Students can analyze and manipulate data to draw conclusions and make predictions using the online book Keeya’s Numbers. This book is also a great introduction to mean, median, and mode and exploring how data is analyzed. Margaret Wise Brown’s The Important Book can be used to sort objects by their attributes, teach repetitive patterns, and use decomposition to “code” everyday habits and routines.

Effects of Computing
K-2: Students will learn about change over time, how technology has changed the world and influenced human behavior, responsible behaviors associated with using information and technology, patterns. After reading The Little House, students could complete sorting activities, old versus new, sequencing, creating circle stories, design a house using SketchUp Pro, or create a paper house template.

3-5: Students will focus on equity, minorities in the sciences, gender equality, and perseverance. Compare/contrast computers to people, digital storytelling with CSFirst, Smithsonian Magazine – True Story of “Hidden Figures,” NASA’s Modern Figures Toolkit, From Hidden to Modern Figures, Hidden Figures website, Princess of Parallelograms-Facts about Ada Lovelace, Hidden Figures, Kiddle website, paper circuits, Ada’s Poetry Generator, Micro: Bit and Make Code, and BrainPOP lesson plans.

Networking and the Internet
K-2: Students can investigate the internet, networks, mail vs. email, and communication through blogs, social media, or videoconferencing, debugging, decomposition, and perseverance. Students can experience writing letters and mailing them and understand that the receiving mail will come in a few days. What is the internet? Khan Academy Video shows background information and how to use a cup with string to make one kind of connection with a friend.

3-5: Students can investigate the internet, networking, mail vs. electronic mail, and communication through blogs, social media, or videoconferencing. Activities to support this include Create a Meme using Google Slides or PowerPoint. Students can discuss how memes go viral, how they are transmitted, and the need to be aware of cyberbullying and how to be a responsible digital citizen.

Putting it Together
By now, your head is spinning and you’re asking yourself, “Where do I begin?” We’re going to help you with that. Read on!
Look for Parallels with Computer Science

Begin by familiarizing yourself with Virginia’s Computer Science Standards. Go to the VDOE website, find computer science and your grade level. Start with one standard and look for parallel concepts in the books you use in your classroom. Parallel concepts are divided into three categories: repetition, sequencing, and conditionals.

- Repetition
  Stories all have plots and characters whose actions make the story worth reading. Characters engage in repeated actions using actions and dialogue and there’s always a setting. Each of these may vary with the character and parts of the story, such as the beginning, middle, and end. Similar patterns occur in computer science. With programming, repeated actions are called loops. Loops can be a few lines of code or they can be nested or embedded within each other. This is analogous to a complex plot with characters repeating the same actions but at different parts in the story.

- Sequencing
  Remember story mountains? A story mountain is a visual way of planning the structure of a story. The plot is broken into stages with the main character progressing through those stages on one side of the mountain, reaching the climax at the peak with the ending of the story occurring down the other side of the mountain. Lists, recipes, "how to" directions, even the order of the school day are great ways to teach sequencing.

- Conditionals
  When events determine outcomes, we call it cause and effect. If you are a pig and build a house out of straw, you just might get eaten by a wolf. This if-then engagement of actions is called conditionals. You can make conditionals more complex by adding an extra component to the action. If-then-else statements add an extra layer to the story mountain. If you build your house out of bricks then you will be safe from the wolf, else he'll catch and eat you.

Build Knowledge and Skills Using Unplugged Activities

The second step to using children’s literature to teach computer science is to build knowledge and skills using unplugged activities. Unplugged activities are those that are performed without a computer. They can be kinesthetic, out-of-your-seat activities that allow children to show what they know. A great way to teach unplugged activities is the RAMP method: Read, Act, Model, Program (Bell, 2009; Caldwell, 2017).

- Read. Read an interactive read-aloud highlighting parallels with computer science objectives. You've already studied the standards and found a book in your library that illustrates an objective. Now take your language arts skills and a children's book to teach a computer science objective.

- Act. Act out the story and look for patterns. Children do this every day. Just look at the playground at recess and you will find them acting out stories and testing new roles. Patterns are a part of life. Everywhere we look there are patterns. In computer science, loops and algorithms repeat and form patterns.

- Model. Model computer science concepts with unplugged activities. Create a grid on the floor and have children "walk" the story.

- Program. Use storyboards, story mountains, flowcharts, and drone maps to retell a story in order using specific directions.

Use what you have. As you begin to learn computer science standards and seek out mentor texts, you will find opportunities for lessons. Digital storytelling software can be used to retell stories. With vis-à-vis markers, erasers, card stock, and plastic sleeves, you can create a coding activity that sequences the beginning, middle, and end of a story.

Make unplugged activities kinesthetic. After using The Snowy Day as an interactive read-aloud, we used the RAMP model to teach algorithms. A shower curtain, decorative tape, cardstock, and a laminator were all that was needed to create a gross motor skill activity. Tape divided the curtain into a grid, and sequenced scenes from the story were printed onto card stock and laminated. Taking turns, two students participated synchronously. One student was the “programmer” and gave instructions. The other student followed the programmer’s instructions and was the “robot.” Movements on the grid were limited to moving forward, backward, left, or right. Using these parameters, the “robot” followed the “programmer’s” algorithms.

Our entire process for teaching computer science can be generalized into three steps.

- Choose an objective and a children’s book to teach it. The book doesn't need to be a computer science book. Picture books and mentor texts are preferred.

- Select the tool (if any) you will use and write your lesson plan. Will it be unplugged or involve coding? Decide
whether you will teach in small groups, rotations, or whole class. Create any materials you need.

- Teach the lesson. After you've taught a few lessons, you can begin building a library of books, resources, and lesson plans. You really will begin to find opportunities everywhere!

Let's Review

**Why Children's Lit?**
You are already using children's literature in your classroom.

**What Kind of Books Should I Use?**
Shorter books and picture books are best. Teachers and students are more familiar with them and they are a good fit for integrating across the curriculum.

**Do I Need Tools?**
No. There are plenty of unplugged activities available. Computer science concepts are not always technical and don’t always use coding.

**Do I Have to Know a lot of Computer Science?**
No, start small. Teach one concept and build from there.

**Is There a lot of Mathematics?**
It depends on the objective. Most picture books work with multiple concepts and are not directly mathematics-related.

**Do I Have to Code?**
No, but it is helpful. Learning block coding such as Scratch, Kodable, and Tynker will give you more options for integration. Plus, it’s fun!

We've given you many ideas, and in our resources section you will find links to a plethora of resources. Now it's your turn. Pick an objective, pick a great book, and get started!

Feel free to email us and share your experiences.

Sheryl Roberts
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Michelle Dunphy
dunphyml@pwcs.edu

Resources

Spreadsheet
https://docs.google.com/spreadsheets/d/1o73ZCshJyOgn3zw0_hX-gX7W3-1WNaj/copy

References


Janrichardsonguidedreading (http://www.janrichardsonguidedreading.com)


I taught fourth and fifth grades at Margaret Beeks Elementary School in Montgomery County for eight years. I am now the robotics teacher at Christiansburg Middle School in Montgomery County.

As we have moved forward into this global pandemic, many things around the world and in our backyards have changed, for some a new school or different schedule, new friends, new “rules” everywhere, and numerous other different and challenging expectations during this global pandemic.

Some of the robots that are appropriate for elementary age students include: Sphero Mini, Sphero Bolt, Ozobots, Botley, and Dot and Dash. These are just a few that I have experience with. There are many others available, like the Fisher Price Code-a-Pillar, Mini Me Minion, Cozmo, Sphero BB8, and more.

With these and most robots, your imagination is the limit to how you interact with your specific robot. One of my all-time favorite activities is to create an obstacle course and have your robot of choice move through it and interact with it. I especially like to see robots sensing an obstacle in its way and figuring out what to do, either stopping or turning.

Another fun activity is to use the Ozobots and program them to write. This link has some guidance on how to program Ozobots and write: Ozobot Lessons for Every Letter in STEAM.

Programming or coding a robot can be a little trickier. Teaching students from an early age the terminology of computer science makes such a difference. One example is helping students understand that an algorithm is simply following directions, which children learn from an early age. By using this terminology from an early age, we are helping our children be more natural at coding and programming.

It is clear during this past year that robotics is experiencing an explosion of successes. Robotics can be found in history, at NASA and in space, in the ocean, in the military, serving law enforcement organizations, assisting manufacturing industry, working on farms in both the field and with animals, and in education. I hope that this exposure will help to lead students into the future with a greater desire to expand their knowledge and be on the forefront of this exciting robotic frontier.

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**Design Brief**

**Rosie Revere Engineer**

*by Carly and Adam*
Plan ahead to attend the convention! The Virginia Children's Engineering Council (VCEC) invites teachers and instructional leaders to be a convention presenter. Come and share your expertise and best instructional strategies with other PreK-5 educators.

Presenters should be prepared to provide sessions that will enhance elementary school teachers ability to teach children to:

- explore how people create, use, and control technology
- apply knowledge of mathematics, science, English, and history and social studies in solving problems associated with technology
- use tools and materials to explore design, engineering, and technology
- exhibit self-confidence through the use of technology.

The convention will focus on high-quality design, engineering, and technology instruction that includes “how-to, and hands-on” deeper learning strategies and best practices with a proven track record of success. Session length will be designed for 45-minutes with 15 additional minutes for discussion.

Submit presenter proposals no later than June 30, 2021. Presenters will be notified of presentation status by July 15, 2021.

To submit a proposal, please click the "Call for Presenters" link below:
Using the children's engineering design briefs is a strategy for a lesson. Each has been designed with one or more Standards of Learning in mind. As teachers become comfortable with the strategy, they begin to think of concepts that students struggle with and design a problem to help the students understand. Student achievement and knowledge is the real goal!

Why are you doing a design brief? To evaluate the design process, or to reinforce academic concepts? I was particularly impressed by an article in the Children’s Engineering Journal by a teacher who had used the same activity year after year with the parts of plants. The activity models looked the same each year, but the children were not learning the content. Therefore, she tried the engineering design process with her students instead of the old activity. The result was that there were many types of models, and the children could answer questions about the parts of plants! That was the idea: to reinforce their knowledge about plants!

The engineering design process is often presented in graphic form ranging from three to 16 or more steps forming a loop. The loop represents the fact that design solutions need to be evaluated and predictions made as to what will happen, with steps repeated to find the best result with the given constraints. All these models are valid approaches to the engineering design process.

The three-step model of Define, Develop Solutions, and Optimize is used in the Next Generation Science Standards. Often used with children are five-step models such as that of Engineering is Elementary: Ask, Imagine, Plan, Create, and Improve. I believe that a critical step left out of many such models is the step of explaining the process.

Not only should children produce or create a model to evaluate or test, they should be able to explain why they chose their solution. If it fails the test or evaluate phase, can they explain what they might do to improve the solution? Can they explain why they decided to do something a particular way? Did they listen to ideas and choose the best parts of more than one?

If children know they will need to explain what ideas they come up with and why they chose their solution, they are more likely to think creatively about what the problem is and how to solve that problem within the constraints.

Ideally, the group would present aloud to the class, especially with very young students. As older students, they could explain things in their journals as they imagine solutions and share them with one another. They could write about and draw the steps they choose and why they chose them. An example might be “we chose the felt because it is more flexible than paper.” The teacher then has something to evaluate that is not just a model or a rubric.

That is why my model has six steps: Ask, Imagine, Plan, Build, Test, Explain. It is easy to do. They can explain what their group decided to make and why, and what they think needs improvement after testing. They can explain how their model relates to the problem, be it mathematics, science, English, or history and social studies. They are learning not only academics but a valuable process that can make them more independent learners.
SAVE THE DATE

VIRGINIA CHILDREN'S ENGINEERING CONVENTION

February 8 - 10, 2022

What to Expect

- President's Welcome
- 100% Virtual Convention
- LIVE Sessions
- Pre-recorded Sessions
- Keynote Speakers
- Door Prizes
- Contests
- Networking with fellow teachers

Due June 30, 2021

Call For Presenters
https://childrensengineering.org/