Integrating Literacy and STEM in your Classroom

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Where is Arkansas?
Landmass Comparison of Arkansas and the Republic of Moldova?
About Arkansas

• 3 million people
• Home of the only diamond mine in the United States
• Largest rice producing region in the United States
• Large forestry and lumber industry
• Walmart: The world’s largest company—employs 2.2 million people
• President Bill Clinton is from Arkansas
What is Integrated STEM and Why is it Important?

• Quality Science, Technology, Engineering, and Mathematics (STEM) education is vital for the future success of students.

• Integrated STEM education is one way to make learning more connected/relevant for students.

• Integrated STEM education is an effort to combine science, technology, engineering, and mathematics into one class
  • based on connections between the subjects and real world problems.

• Integrated STEM education does not always involve all four disciplines of STEM—and can involve other subjects.
Why you should consider adding STEM to your instruction

• Some teachers are uneasy teaching STEM, because their instructional time is limited.
• STEM learning doesn’t need to detract from time spent on reading, writing, and comprehension instruction.
• STEM learning can positively influence literacy instruction by providing a context for the learning.
• Reading and writing can be perfect partners with STEM instruction.
Why We Must Deliver STEM in the Elementary School?

• The ultimate goal of the STEM movement is to increase students’ interest and ability in STEM.
• Engage students early—natural interest fades substantially by age 10.
• Integrated STEM education is NOT simply the addition of curriculum to hectic schedules.
• By integrating STEM into literacy instruction, we can enhance learning in all subject areas.
• It’s a non-threatening way to increase student engagement in math and science, as well as literacy.
What does Integrated STEM Look Like in the Elementary Classroom?

STEM in the classroom involves:

- Students working in teams
- Solving real-world problems related to a big idea or reading
- Encouraging creative thinking/innovation
- Applying important STEM concepts
- Defending ideas
- Using tools and materials to solve problems (hands/mind)
- Illustrating the importance of the information being taught
- Expanding concepts delivered through reading and writing
- Using the thinking tools of scientists and engineers
Cognitive Tools
(The engineering design process)

STEM Engineering Design Loop

- **Ask**
  - What is the problem?

- **Create**
  - Build your solution

- **Select/Plan**
  - Choose the best solution and the steps needed

- **Improve and Share**
  - Make changes and share your solution with others

- **Test and Evaluate**
  - Try the solution, and evaluate its ability to solve the problem

- **Imagine**
  - How can the problem be solved
How is STEM Effective for Learning?

Challenge-based Learning Environments

- Expanding problem solving skills
- Self-directed learning
- Finding and using resources
- Expanding critical thinking
- Building social and ethical skills
- Building psychomotor skills
- Putting learning into context

- Building self-motivation skills
- Advancing leadership skills
- Building teamwork skills
- Expanding communication skills
- Encouraging proactive thinking
- Mirroring workplace skills and habits
THE NARRATIVE STEM CURRICULUM

Teaching STEM using literacy

Use children’s literature to teach STEM
- Expand upon a book commonly shared in schools
- Move from comfortable to uncomfortable/known to unknown

Story-centric problem solving activities
- Compelling virtual worlds
- Believable characters
- Thought provoking themes
Elementary Narrative STEM Curriculum

3 Questions answered in all Narrative STEM Curricula
What do we know? - What do we need to know? - How can we find out?

Key Features of Narrative Curriculum (or a book)
• The presence of a mystery, dilemma, or oddity is essential
• We are placed into an environment that has to be learned
• Think of a lesson designed to provide drama and offer surprises
• What drives a story? What makes it worth telling? (TROUBLE)
  • Some misfit between the characters, action, the goals of the story, the setting, and the means
Characteristics of Children’s Literature

Informational Text Characteristics:

- Colorful
- Fun
- Engaging
- Rich content
- Meet Learning standards
- Not boring
- Ample opportunities for learning
- Foundation for future learning
- Launch point for additional concept learning
Examples of Narrative STEM Design Challenges

**Publics that Matter: Building a paddle boat to row the fastest in the water**

**Disciplinary Area:** STEM

**Unit:** Structures, Motion, Engineering, Water

**Literacy:** A list of questions written by Julianne Talbott

**Grade Level:** 4

**Standards:**
- Standards for Technological Literacy and Benchmark (Energy and Power technologies): Tools, machines, products, and systems use energy in order to do work.
- Standards for Technological Literacy and Benchmark (Transportation Technologies): The use of transportation allows people and goods to be moved from place to place.
- Common Core Math Standard (Measurement and Data): Know relative sizes of measurement units within one system of units including km, m, cm; l, ml, cup; lb, oz.; yr, mo, wk. within a single system of measurement, express measurements in a larger unit in terms of a smaller unit.
- Common Core Science Standard (Energy): Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

**Big Ideas:**
- Principles of area and volume
- Attributes of shape and their effect on sustainability
- Properties of materials and their ability to survive the wind
- Proper use of the design loop
- Role of brainstorming to come up with ideas
- Ability to present final design to a group/teacher

**Essential Question:** Can your group design a paddle boat that can travel the fastest in water?

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**Building BIG**

**Title:** Build Your Skyscraper

**Grade:** 5

**Disciplinary Area:** STEM

**Unit:** Measurement & Data, Geometry, Forces, and Structure

**Big Ideas:**
- Principles of area and volume
- Attributes of shape and their effect on sustainability
- Properties of materials and their ability to survive the wind
- Proper use of the design loop
- Role of brainstorming to come up with ideas
- Ability to present final design to a group/teacher

**Essential Question:** Can you design a skyscraper which at least has three different geometry shapes and wind proof?

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**Racing For The Future**

**Disciplinary Area:** STEM

**Unit:** Newton’s Laws of Motion

**Grade Level:** 3

**Literacy:** Eat My Dirt! Henry Ford’s First Race by Monica Kulling

**Big Ideas:**
- Follow detailed instructions to complete an experiment
- Demonstrate a basic understanding of Newton’s first two Laws of Motion
- Proper use of the design loop

**Essential Question:** After building a car, following detailed instructions, can you apply your knowledge of Newton’s Laws of Motion to modify it to go faster and further?

**Scenario:** Henry Ford wants to build a car that is affordable for everyone, but he needs money to start his factory. He sees that a race is being held with a prize of $2,000, and he just knows he can win. Unfortunately, his car is just a regular car—not a racecar! Using the design loop and what you have learned about Newton’s Laws of Motion, can you modify his original car design so that he can best The Dunderers?
Paddle Boat Race: Design paddle boat to move fastest in water

Big Ideas:
- Engineering design
- Recycling/reusing materials
- Material properties
- Potential and kinetic energy
- Water transportation
- Presenting and defending an idea to others
Car Builder: Design a Passenger Vehicle

Big Ideas:
• Using the Engineering design process
• Brainstorming/problem solving
• Creative thinking/innovation
• Measurement
• motion, force, and energy
• The value of money
Mars Ascension Vehicle: Design a Mars launcher

Big Ideas:

• Engineering design
• Transfer of energy
• Converting measurements
• Creating devices that meet given requirements
• Conservation of fuel (natural resources)
Sample: The Dream Weaver

Based on the book: *Dream Weaver*

- The relationship between nature and technology
- How humans learn from surroundings
- How humans solve problems
- How humans make tools and materials
- How human-made materials can be stronger than natural materials

These two pre-service teachers developed the lesson
Reading the Book: *Dream Weaver*
Demonstrating How Spider Webs Work
Testing the Strength of the Web
Challenging the Students to Make the Strongest Web Weaving
Ultimate Goal

We need to prepare a generation of students who can “out innovate” the competition, who can adapt to vast advances in technology and engineering, who can apply known solutions to unknown applications, who readily cross disciplinary lines to gather the tools necessary to solve the problems of humanity.
STEM RESOURCES

http://stem.uark.edu/