STEAM-y Fairytales!!

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STEM Director
ESD112

Integrating STEM habits of mind in K-2
Main Objective

To highlight curricular approaches to integrating STEM featuring fairy tales to implement *phenomena-based* and *problem-driven* instruction.
Outcomes

- Introduce teachers to integrative STEaM in early elementary
- Clarify STEM competencies for K-2
- Model the engineering design process with early learners
- Provide examples of strategies and assessments for inclusivity
What is STEM?

STEM Core Competencies

Georgetown University Center on Education and the Workforce and Occupational Information Network (O*NET)
STEM Competencies

Are not derived from content but from the development and transfer of 21st century skills ("soft skills")

The 4 C’s of 21st Century Skills

1. Critical Thinking
   Finding solutions to problems

2. Creativity
   Thinking outside the box

3. Collaboration
   Working with others

4. Communication
   Conveying ideas

AKA: Learning Skills
Original Fairytale Concepts
Developed By

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Lukas Hefty, Elementary Math Director

Engineering Innovative Thinkers for Global Success!
High Quality STEM Activities

A.R.E.

- Authentic in context & content
- Relevant to student’s daily lives and out-of-school experiences
- Engaging over the duration of several learning sessions
Fairy Tales are “Phenomenal”

- Provide context for students to learn important science, math, social studies, art, computer science and engineering-design concepts by identifying
  - Character-driven problems that can be solved through STEaM
  - Engaging phenomena to drive extended, integrative instruction
Run, Run, As Fast as You Can!!!
Can you design a way for the Gingerbread Man to safely cross the River in under 15 mins?

- Straws
- Clay
- Tape
- Craft sticks
- Plastic wrap
- Rubber bands

Did you know...engineers call this “rapid prototyping”
STEM Competency 1
Resilience

https://studio.code.org/s/course1/stage/9/puzzle/1
The Thrill of Victory

The Value of Failure

With repeated opportunities to fail - modify - optimize, we begin to counteract learned helplessness through productive, collaborative struggle!
# Gingerbread Unit Overview

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Focus</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>‘Gingerbread Man Loose in the School’; Initial Model of Solution</td>
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<tr>
<td>2</td>
<td>Just for Kicks! Introduce pushes and pulls</td>
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<tr>
<td>3</td>
<td>‘The Enormous Turnip’ - compare/contrast &amp; increase strength of pushes/pulls</td>
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<tr>
<td>4</td>
<td>‘Sheep in A Jeep’ - increasing speed of pushes/pulls</td>
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<td>5</td>
<td>GRoup design of model solution</td>
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<tr>
<td>6</td>
<td>Rolling and Balance</td>
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<tr>
<td>7</td>
<td>Forces Together - Revised Group Model</td>
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<td>8</td>
<td>Engineering Exploration - Career Awareness</td>
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<tr>
<td>9</td>
<td>Testing Design Solution</td>
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<td>10</td>
<td>CER Assessment</td>
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<tr>
<td>11</td>
<td>Optional Extension - Materials that Float (bridge activity)</td>
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</tbody>
</table>
STEM Competency 2
Math/Science Problem Solving
The moral of the story and engineering practices come together

- Rosie Revere, Engineer!
Jamerson Engineering Design Process

Plan

1. Identify the design problem.
2. Clarify the design limitation and requirements.
3. Investigate (research) the problem.

Design

1. Generate design alternatives.
2. Choose the best option and explain why.
3. Develop a design model or prototype.

Share

1. Communicate achievements.

Check

1. Test and evaluate the design solution.
2. Modify the design to meet developing needs.
The Engineering Design Process

Ask
What is the problem? Why is it a problem? What have others done in the past about this or a similar problem?

Imagine
What are some solutions? What are some things in nature that could inspire my design?

Plan
What materials will I need? How will I build my prototype or design? What are my limitations and requirements?

Create
Let me build my design.

Improve
How can I test if my design does what it is supposed to? How can I make my design better?

Share
How can I share my design with others? How did I make my design? Why is my design great?
STEM Competency 3
Teamwork/Collaboration

STEM

- is not a curriculum
- is not what you teach, it’s how you teach
- is embedded in NGSS
- must be based in content
- provides opportunities to problem solve & fail
- does not address all content areas at the same time; or equally
Was Goldilocks an Engineer?

A Kindergarten STEAM Storyline (in development)
Our Favorites...

- We have used many versions of Goldilocks through the years
- This year a new book came along

- Please take a moment to talk about your favorite Goldilocks stories
The Story of Goldilocks and the Three Bears

Once upon a time, there was a little girl named Goldilocks. She went for a walk in the forest. Pretty soon, she came upon a house. She knocked and, when no one answered, she walked right in.

At the table in the kitchen, there were three bowls of porridge. Goldilocks was hungry. She tasted the porridge from the first bowl.
"This porridge is too hot!" she exclaimed. So, she tasted the porridge from the second bowl.

"This porridge is too cold," she said. So, she tasted the last bowl of porridge. "Ahhh, this porridge is just right," she said happily and she ate it all up.

After she'd eaten the three bears' breakfasts she decided she was feeling a little tired. So, she walked into the living room where she saw three chairs. Goldilocks sat in the first chair to rest her feet.

"This chair is too big!" she exclaimed. So she sat in the second chair. "This chair is too big, too!" she whined. So she tried the last and smallest chair. "Ahhh, this chair is just right," she sighed. But just as she settled down into the chair to rest, it broke into pieces!
## Goldilocks Unit Overview

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<tr>
<td>1</td>
<td>Retelling the story: Goldilocks and the 3 Bears</td>
</tr>
<tr>
<td>2</td>
<td>Elements of an effective engineering team</td>
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<tr>
<td>3</td>
<td>Bears and their habitats</td>
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<tr>
<td>4</td>
<td>Making safe choices</td>
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<tr>
<td>5</td>
<td>Properties of materials</td>
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<tr>
<td>6</td>
<td>More weight and less weight</td>
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<tr>
<td>7</td>
<td>Forces as pushes and pulls</td>
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<tr>
<td>8</td>
<td>Structural design: homes, chairs, and beds</td>
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<tr>
<td>9</td>
<td>Exploration of building materials</td>
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<tr>
<td>10</td>
<td>Plan and Design: blueprints, materials selection, construction</td>
</tr>
<tr>
<td>11</td>
<td>Check and Share: design constraints, comparison of design solutions</td>
</tr>
</tbody>
</table>
English Language Arts

**K.RL.1.1**
With prompting and support, ask and answer questions about key details in a text.

**K.RL.1.2**
With prompting and support, retell familiar stories, including key details.

**K.RL.1.3**
With prompting and support, identify characters, settings, and major events in a story.

**K.RL.3.9**
With prompting and support, compare and contrast the adventures and experiences of characters in familiar stories.

This may include comparing Goldilocks to The Three Billy Goats Gruff or Comparing two different versions of The Three Little Pigs.
Science

**K-ESS2-2.** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.

**Habitats, Bears, and Survival Needs**

[Image of a bear and a book titled "The Bear Ate Your Sandwich"]
Standards for Engineering Design

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Structure & Function

The shape and stability of structures of natural and designed objects are related to their functions.
Mathematics

Describe and compare measurable attributes.

K.MD.1.1
Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.

K.MD.1.2
Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference.
Computational Thinking: Modeling a Solution

Goldilocks' Chair Blueprint

Team Name: Red-Construction-Toys

Characteristics of a Chair:

- seat of chair
- back of chair
- legs

Blueprint:

Douglas L. Jamieson, Jr. Elementary School for Mathematics and Engineering - Standards-based Integrated Engineering Unit
updated 12/08/07

Olivia Kaiden
And ANY Book is a potential launching place for a STEM integration unit!

Fairy Tales are STEAM-y...but Folk Tales are Also Phenomenal!

- Anansi the Spider
- How the Sun, Moon and Wind Went Out to Dinner
- A Rumour Takes Wing
- The Lucky Bird
1-PS4-4
Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.

Arts Integration…
Develop drum pattern messages in music class
The Sun & The North Wind

1-LS1-1

Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.

Crosscutting Concept…
Structure & Function

Arts Integration (Papier Mache’)

Structure and Function
1. Construct a tower.
2. Draw front, side and bird’s eye views with 1:1 scale.
3. Disassemble the tower and design a bridge with 20 cm span.
4. Use the architectural drawings to reassemble the tower.

*Arts Connection (Scale Drawing)

3-PS2-1 & ETS1-2
Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.
The Three Little Pigs (with a twist)

Design a home to protect the Three Little Pigs from the Big Bad Wolf.

Test the home on different foundations against wind and water forces.

2-ESS2-1
4-ESS3-2
Cinderella

What if the birds had not picked the lentils out of the ashes?

Conduct an investigation to determine whether mixing two or more substances results in new substances

5- PS1-3
Who really has the problem?
What’s the Problem?

○ Think about a familiar fairytale/folktale or other story your kids love
○ Brainstorm the problem that best fits a character
○ Share out your problem and how it connects to STEM content/competencies
Develop Alternatives

○ Write 3 versions of the problem that captures the situation:
  ○ Redesign the ____________________.
  ○ Design a way for __________ to better__________.
  ○ How might we help ______?

○ Pick a scenario & check…
  ○ Are there multiple ways to solve the problem
  ○ Are there unanticipated materials
  ○ What constraints will challenge, but not frustrate your students?
Not just for Primary Grades!

The key is choosing the content you wish to focus student learning on, and then finding an appropriate tale with a problem...
Douglas Jamerson Elementary

- Urban, high poverty neighborhood in St. Petersburg
- 100% application school with no entrance criteria
- Teacher-created engineering curriculum aligned to Florida Science Standards and the NGSS
- 575 students in Kindergarten through Fifth Grade

  - 47% Caucasian
  - 38% Black/African American
  - 8% Hispanic
  - 5% Multiracial
  - 2% Asian

  55% Low Socio-Economic Status
Evidence from
Douglas Jamerson Elementary

![Graph showing percentage of students at Level 3 or Higher from 2007-08 to 2014-15 for White, Total, and Black students.]
Evidence from  
Douglas Jamerson Elementary

**Engineering Curriculum Overview**

**Science Achievement**

<table>
<thead>
<tr>
<th>FCAT Science 2.0</th>
<th>2014</th>
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<th>2016</th>
<th>2017</th>
<th>2018</th>
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<td>Jamerson</td>
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<td>81%</td>
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<td>16%</td>
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Thank you!!

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Evidence from Douglas Jamerson Elementary

FSA Mathematics Achievement Data

84% scored at Level 3-5 (5th highest in the district)
74% made a Learning Gain (8th highest in the district)