Science Curriculum

Kindergarten Unit One: Engineering & Design
Course Description

In unit one, students engage in an engineering challenge to develop habits of mind and classroom practices that will be reinforced throughout the school year. In unit two, students engage in systematic investigations of trees over the seasons that will bring students to a better understanding of the place of trees at school and in the community. Students will observe day-to-day changes in weather over the year, as well as the impact weather has on living things. Students will develop an understanding of what plants (and animals) need to survive and the relationship between their needs and where they live. By monitoring local weather, students experience the patterns and variations in weather and come to understand the importance of weather forecasts to prepare for severe weather. In unit three, students study natural resources and properties of materials and how those properties determine their use—wood, paper, and fabric. Students come to understand that humans use natural resources for everything they do and that people affect the world around them. Students use those materials to engineer structures, applying physical science core ideas of energy transfer. After building a repertoire of practices with materials, students investigate the effect of pushes and pulls, and apply their intuitive notion of the concept of variables to change the strength and direction of rolling balls to achieve specific outcomes. In unit four, students observe and describe the structures of fish, birds, snails, earthworms, and isopods. Appropriate classroom habitats are established, and students learn to care for the animals. In four investigations, animals are studied in pairs. Students observe and care for one animal over time, and then they are introduced to another animal similar to the first but with differences in structure and behavior. Students learn what animals need to survive and the relationship between their needs and where they live. The firsthand experiences are enriched with close-up photos of animals, some related to animals that students have observed in class and some to animals that are new. This process enhances observation, communication, and comparison. Throughout all units, students engage in science and engineering practices by asking questions, participating in collaborative investigations, observing, recording, and interpreting data to build explanations, and obtaining information from photographs. Students gain experiences that will contribute to an understanding of the crosscutting concepts of patterns; cause and effect; systems and system models; and structure and function.
Teachers may choose from a variety of instructional approaches that are aligned with 3 dimensional learning to achieve this goal. These approaches include:

<table>
<thead>
<tr>
<th>Inquiry Kit Instruction (modified)</th>
<th>Challenge Based Instruction</th>
<th>5 E Instructional Model (BSCS)</th>
<th>Culturally Relevant Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project-Based Instruction</td>
<td>Tinkering Pedagogy</td>
<td>Learning Progressions</td>
<td>Knowledge Integration</td>
</tr>
<tr>
<td>Model-based Reasoning</td>
<td>Place-based Instruction</td>
<td>Meaningful Expertise Instruction</td>
<td>Emergent Investigations (RSS)</td>
</tr>
</tbody>
</table>
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Instructional Days: 10

Pacing Chart

This pacing chart is based upon 160 minutes of instruction per cycle (roughly 120 days).

<table>
<thead>
<tr>
<th>Unit</th>
<th>Grade Level</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1</td>
<td>Engineering and Design</td>
<td>10 days</td>
</tr>
<tr>
<td>Unit 2</td>
<td>Earth’s Weather &amp; Trees</td>
<td>30 days</td>
</tr>
<tr>
<td>Unit 3</td>
<td>FOSS Materials &amp; Motion</td>
<td>40 days</td>
</tr>
<tr>
<td>Unit 4</td>
<td>FOSS Animals Two by Two</td>
<td>40 days</td>
</tr>
</tbody>
</table>

Unit Summary

This 2 week introductory unit introduces the engineering design process and supports practices that will build a strong collaborative learning community for the year. The teacher uses a read aloud to introduce a design problem. Students identify the problem, empathize with the person who has the problem and use the engineering design process to develop and refine a solution to it.

Student Learning Objectives

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.

Unit Sequence

Part A - Storyline: It’s Llama Llama’s first day of school and Llama Llama’s mama makes sure he’s ready. They meet the teachers. See the other children. Look at all the books and games. But then it’s time for Mama to leave. And suddenly Llama Llama isn’t so excited anymore. Did you feel like Llama on your first day of school?

Overarching Question: What problem is Llama having on his first day of school? What makes you feel better when you are sad/scared/nervous?
- Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions.
- Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.
- Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Designs can be conveyed through sketches, drawings, or physical models.
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

Students who understand the concepts are able to:
- Ask questions
- Identify the problem
- Brainstorm solutions to the problem
- Design and create a solution to the problem
- Draw diagrams and label in their lab notebooks

<table>
<thead>
<tr>
<th>NJDOE Student Learning Objective</th>
<th>Essential Questions</th>
<th>Content Related to DCI’s</th>
<th>Sample Activities</th>
<th>Resources</th>
</tr>
</thead>
</table>
| Students will identify a problem that can be solved through engineering. Create an interactive science notebook. | What problem does Llama have on his first day of school? | • A situation that people want to change or create can be approached as a problem to be solved through engineering.  
• Asking questions, making observations, and gathering | Read or listen to *Llama Llama Misses Mama*.  
Identify the problem that Llama is having through discussion.  
Draw a picture in the science notebook of a time that you felt like Llama. | Video of read aloud: "Llama Llama Misses Mama" |
| Students will use empathy to better define a problem. Students explore the role that engineers play in solving problems. | How did the other characters try to help Llama feel better? What makes me feel better when I am scared/nervous/sad? How can I make my classmate feel better? | information are helpful in thinking about problems.  
• Before beginning to design a solution, it is important to clearly understand the problem. | Revisit the story for examples of the students do not remember them. Anchor chart Class Discussion, Small Group, Partner, etc.  
Explain that when we identify a problem and try to solve it, we are acting like engineers.  
Draw a picture in your science notebook of a time that you have acted like an engineer by trying to solve a problem.  
Talk about stuffed animals or other special items they have at home that make them feel better when they are scared (a lovey...bring an example if you have one). Point out Llama's lovey.  
Each student gets a partner. They must ask their partner questions about what they like, such as:  
• What is your favorite color?  
• What is your favorite animal?  
• What is your favorite thing to do?  
• What is your favorite sport?  
• What are colors you don’t like?  
• What are animals you don’t like? |
|---|---|---|---|
| Students brainstorm possible solutions to a problem. | Llama liked the same things as my partner, what could I make for them that would help them feel better? | Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem’s solutions to other people. | Have students draw a design in their science notebooks.  
Make a list of the materials want to use. Use the flashcards to as an aid, or students can cut and glue them into their notebooks. |
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| Students will refine their designs based upon feedback from their partner. K-2-ETS1-2 | How can I create a lovey, using things my partner likes, to make them feel better? How do you know your partner is going to like your design? What is your partner's favorite part of the lovey you created for them? | Have students share their design with their partner and ask them to suggest ways to make it better. Draw the finished design in their lab notebook. Give the lovey to your partner. Let the partners keep it on their desks or bring it home. Have partners tell each other what their favorite parts of their new lovey are. | Science Notebook |

### Unit Sequence

**Part B - Storyline:** Is Mr. Fookwire an engineer? What is an engineer? What do engineers do? (Based upon read aloud of *Those Darn Squirrels* by Adam Rubin)

### Overarching Question:
What makes someone an engineer?

### Concepts
- Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions.
- Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.
- Analyzing data in K–2 builds on prior experiences and progresses to

### Formative Assessments

**Students who understand the concepts are able to:**
- Ask
- Identify
- Plan
- Design
- Create
collected, recording, and sharing observations.

- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Designs can be conveyed through sketches, drawings, or physical models.
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

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| Students will identify a problem that can be solved through engineering. K-2-ETS1-1 | What problem is Mr. Fookwire attempting to solve? | • A situation that people want to change or create can be approached as a problem to be solved through engineering.  
• Asking questions, making observations, and gathering information are helpful in thinking about problems.  
• Before beginning to design a solution, it is important to clearly understand the problem. | Read aloud and class discussion. | “Those Darn Squirrels”  
Read Aloud  
Science Notebooks  
Alternative lesson in Resource Folder |

| Students will identify the traits of an engineer. Judge whether a character exhibits these traits. | What does an engineer do?  
Was Mr. Fookwire acting like an engineer?  
What did Mr. Fookwire | • A situation that people want to change or create can be approached as a problem to be solved through engineering. | Have students draw in their lab notebooks/discuss action words for what Mr. Fookwire did during the story. Come up with a class list. Use an anchor chart. Relate | Science Notebooks  
An Engineer is Someone Who- See resource folder |
Students will design their own solution to Mr. Fookwire’s problem.

How would you solve the problem if you were Mr. Fookwire?

- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.
- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem’s solutions to other people.

Have students draw their own solutions to Mr. Fookwire’s problem. Share with a partner and with whole group.

Science Notebooks

What It Looks Like in the Classroom

Students begin to explore the engineering design process via class read alouds and follow up design activities. Students develop empathy with the story’s main character and apply design thinking to solve the character’s problem. Students are encouraged to think that there are many possible solutions to a problem and do not look for one “correct” answer. They engage in class discussions and partner shares to build on and refine their ideas. Students begin to develop the habit of using a scientific notebook during this time, even if they are only able to draw pictures or write one-word responses.

Modifications

(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

- Structure lessons around questions that are authentic, relate to students’ interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the...
community helping with a project, journal articles, and biographies).

- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#VXmoXcfD_UA).

### Interdisciplinary Connections

**ELA/Literacy**

- **RI.2.1** - Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (K-2-ETS1-1)
- **W.2.6** - With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-1)
- **W.2.8** - Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1)

**Mathematics**

- **2.MD.D.10** - Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1)
- **MP.2** - Reason abstractly and quantitatively. (K-2-ETS1-1)
- **MP.4** - Model with mathematics. (K-2-ETS1-1)
- **MP.5** - Use appropriate tools strategically. (K-2-ETS1-1)

### Unit Vocabulary

<table>
<thead>
<tr>
<th>Structure</th>
<th>Improve</th>
<th>Ask</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Technology</td>
<td>Define</td>
<td>Test</td>
</tr>
<tr>
<td>Plan</td>
<td>Design</td>
<td>Problem</td>
<td>Observation</td>
</tr>
</tbody>
</table>
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<table>
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<tr>
<th>Create</th>
<th>Brainstorm</th>
<th>Change</th>
<th>Develop</th>
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</thead>
<tbody>
<tr>
<td>Strength</td>
<td>Weakness</td>
<td>Perform</td>
<td>Label</td>
</tr>
<tr>
<td>Observe</td>
<td>Model</td>
<td>Diagram</td>
<td>Tool</td>
</tr>
<tr>
<td>Gather</td>
<td>Communicate</td>
<td>Solution</td>
<td></td>
</tr>
</tbody>
</table>

### Educational Technology Standards

| 8.1.2.A.1, 8.1.2.A.2, 8.1.2.A.3, 8.1.2.A.5, 8.1.2.B.1, 8.1.2.C.1, 8.1.2.D.1, 8.1.2.E.1, 8.1.2.F.1 |

- **Technology Operations and Concepts**
  - Identify the basic features of a computer and explain how to use them effectively.
  - Create a document using a word processing application.
  - Compare the common uses of at least two different digital applications and identify the advantages and disadvantages of using each.
  - Enter information into a spreadsheet and sort the information.

- **Creativity and Innovation**
  - Illustrate and communicate original ideas and stories using multiple digital tools and resources.

- **Communication and Collaboration**
  - Engage in a variety of developmentally appropriate learning activities with students in other classes, schools, or countries using various media formats such as online collaborative tools and social media.

- **Digital Citizenship**
  - Develop an understanding of ownership of print and non-print information.

- **Research and Information Literacy**
  - Use digital tools and online resources to explore a problem or issue.

- **Critical Thinking, Problem Solving, and Decision-Making**
  - Use geographic mapping tools to plan and solve problems.

### Career Ready Practices

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

- **CRP1. Act as a responsible and contributing citizen and employee**
  
  Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day.
through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.

CRP2. Apply appropriate academic and technical skills.
Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.

CRP4. Communicate clearly and effectively and with reason.
Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others’ time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

Appendix A: NGSS and Foundations for the Unit

| 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. | The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education:* |
| **Science and Engineering Practices** | **Disciplinary Core Ideas** | **Crosscutting Concepts** |
| **Asking Questions and Defining Problems** | **ETS1.A: Defining and Delimiting Engineering Problems** | **Structure and Function** |
| Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions. |
| ● Ask questions based on observations to find more information about the natural and/or designed world. (K-2-ETS1-1) |
| ● Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1) |
| ● A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) |
| ● Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) |
| ● Before beginning to design a solution, it | ● The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2) |
### Developing and Using Models

Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

- Develop a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2)

### ETS1.B: Developing Possible Solutions

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem’s solutions to other people. (K-2-ETS1-2)

### English Language Arts

**Common Core State Standards Connections:**

- **RI.2.1** Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (K-2-ETS1-1)
- **W.2.6** With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-1), (K-2-ETS1-3)
- **W.2.8** Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1), (K-2-ETS1-3)
- **SL.2.5** Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K-2-ETS1-2)

### Mathematics

**Common Core State Standards Connections:**

- **MP.2** Reason abstractly and quantitatively. (K-2-ETS1-1), (K-2-ETS1-3)
- **MP.4** Model with mathematics. (K-2-ETS1-1), (K-2-ETS1-3)
- **MP.5** Use appropriate tools strategically. (K-2-ETS1-1), (K-2-ETS1-3)
- **2.MD.D.10** Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1), (K-2-ETS1-3)

**Rubric(s):** See resource folder

**Field Trip Ideas:** New York Hall of Science