**STEM Stories: Iggy Peck, Architect**

**Lesson Plan**

**STEM** **Career** **Connections:** Civil Engineering, Chemical Engineering, Architecture and Construction

**STEM Disciplines:** Science, Technology, Engineering, & Mathematics

**Non-STEM Disciplines:** English Language Arts

**Academic Content Standards**

**English Language Arts Standards:**

* RL.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
* W.3.3 Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences
* SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.
* SL.3.6 Speak in complete sentences when appropriate to task and situation in order to provide requested detail or clarification.

**Mathematics Standards:**

**Science Standards:**

**Design** **Challenge** **Problem/Scenario:** Last week we built bridges following the directions from K'nex kits that would allow people to cross a river. This week you are Architect, just like Iggy Peck, and you have been commissioned to design a bridge that will cross a wider river.

**Engineering** **Design** **Challenge:** Your team’s challenge is to design then create a prototype of a bridge that people and cars could use cross the wide river.

**Essential** **Question Students Investigate:**

Will a longer bridge be weaker than a shorter bridge? Do you need to change how the panels are supported?

**Enduring** **Understandings**

● Using the engineering design process when approaching problems results in unique solutions.

● Collaboration and following the engineering design process lead to more creative and effective solutions to problems.

● The concepts of strength of materials and structural integrity are important for this problem. The design structure should hold weight without breaking or deflecting beyond safe limits.

**Prerequisite** **Knowledge** **(as connected to academic content standards)**

● Concepts Related to Energy in Grades PreK-2: A variety of sounds and motions are experienced. The sun is the principle source of energy.

● Concepts Related to Energy in Grade 3: Objects with energy have the ability to cause change. Heat, electrical energy, light, sound and magnetic energy are forms of energy.

● Concepts Related to Earth and Space Science in Grade 4: The surface of the Earth has been shaped and reshaped by a variety of processes.

**Materials** **List**

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| **Material** | **Quantity** **per** **Team** | **✓** | **Quantity** **per** **Kit** | **✓** |
| *Iggy Peck Architect by Andrea Beaty* | ~ |  | 3 |  |
| K’Nex Education Bridges Kits | 1 |  | 8 |  |
| Masses for Testing | ~ |  | 1 set |  |

**Day 1**

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| **Introduction: 15 minutes*** Sit in a chair and gather the students on the floor around you so they can all see the book.
* Remind the students of the full scope of the Engineering Challenge (Day 1, Day 2, Day 3, Day 4).
* Introduce *Iggy Peck, Architect* by Andrea Beatty. Show them the cover of the book and ask them what they think the book might be about. Take a picture walk through the book to identify the main events at the beginning, middle, and end of the story.
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| **Pre-Reading: 10 minutes*** Ask the students if they know what an architect is. Invite students to offer possible responses, then show them this video clip of an architect: https://youtu.be/zvewCudtFZs. When the video is finished, ask them if their definition of an architect has changed. Write a definition of an architect on the board using the students’ responses.
* Explain that in the story we will read today, the main character wants to be an architect, and we will learn about all the reasons why he wants to be an architect throughout the story. Ask them to listen for the reasons he wants to be an architect.
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| **Read Aloud: 20 minutes*** Read the book aloud to the students. Stop periodically and ask the students if they have heard any of the reasons Iggy would like to be an architect. Record these reasons on the board under the definition.
* After reading the book, ask the students to turn to a partner and provide a one-sentence summary of the book. Invite students to share their summaries with the class. Remind students that a summary states the main idea of the story without a lot of details. A retelling tells all of the details of the story.
* If time allows, students can record this one-sentence summary in their STEM notebooks. They can use ideas they heard from their partners to make their summaries stronger.
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| **Post Reading: 15 minutes*** Ask students what Iggy’s dream job was (to be an architect). Ask them to think about what their own dream job would be, particularly in the STEM fields. Provide examples of jobs we have discussed this year (engineer, architect, scientist, etc.). Other jobs are acceptable, but encourage discussion about possible careers in STEM.
* Share your dream STEM job with the students. Display the interview questions on the document camera. Read each question aloud, and answer the question for your own dream STEM job to model the process to the students. If two teachers are present, model the interview process by having one teacher ask the questions, the other answer the questions, and by modeling the notes the interviewer will take on the document camera. Talk with the students about how they do not have to record their partner’s entire answer, but can record the main points using one word or a phrase. Spelling does not matter, as long as they can read their own writing.
* Students will conduct interviews with one other person in the class. Distribute the list of interview questions to the students, and paste them into a new page in the STEM notebook (Entry #X, Interview). Alternatively, students can brainstorm and write their own interview questions, if time and ability allow.
* Pair the students up, and invite them to find a cozy spot in the room to conduct the interviews.
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| **Quick Write: 15 minutes*** In their notebooks, ask the students to draw a picture of their partner doing his or her dream job and write one to five sentences about what they learned about their partner’s dream job.
* You can also provide sentence stems to provide support for struggling writers.
* Invite students to share their writing in an author’s chair to get to know the dream jobs of others in the class. Students can ask questions of the author if time allows. Review the protocol for asking kind, constructive questions.
* As students share, record the dream jobs of the class on an anchor chart using large chart paper. Invite students to write their dream job on the chart themselves if there is not time for everyone to share.
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| **Application: 20 minutes*** Display Slide 1 of the PowerPoint
* Slide 2: Complete the journal entry for Day 1.
* Slide 3: Review the classroom rules with students. Set a goal together.
* Slide 4: Explain what an architect (like Iggy Peck) is. Show the video.
* Slide 5: Present the “Engineering Design Problem” and Challenge.”
	+ **Design Challenge Scenario:** Last week we built bridges following the directions from K'nex kits that would allow people to cross a river. This week you are Architect, just like Iggy Peck, and you have been commissioned to design a bridge that will cross a wider river.
	+ **Engineering Design Challenge:** Your team’s challenge is to design then create a prototype of a bridge that people and cars could use cross the wide river.
* Slide 6: Explain or share the “Design Goals”.
* Slide 7: Introduce the resources/materials available.
* Slide 8: Explain the design testing procedures.
* Slide 9: Explain the “Engineering Design Process”
	+ To differentiate instruction, the “Engineering Design Process” is on two handouts. More proficient readers should receive a copy of the “Engineering Design Process Graphic Organizer” and the handout labeled “Engineering Design Process (Full).”
* Slide 10: Have the students complete the “Ask” step of the Engineering Design Process.
	+ Ask the students to notice that the word Ask is in one of the circles of the “Engineering Design Process”.
	+ Share with students that we will be exploring more about bridges to answer the Ask questions displayed on the slide.
	+ Students should write the question they want to explore more about on their STEM Challenge handout.
	+ Walk around as the students complete the Ask step of the Engineering Design Process and query them about how they will research their question.
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| **Wrap Up: 10 minutes**Review what was learned during today’s session. * Invite a retelling of the book by asking students to share what happened first, second, third, and so on in the story.
* Remind the students of the Engineering Design Challenge.
* Preview the next session by explaining to students that they will continue the Engineering Design Process by designing and building a bridge with K’Nex and testing to see how strong the bridge is.
* Encourage students to look for bridges they travel over or see everyday.
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**Day 2**

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| **Set-Up** * Designate space for displaying and gathering available materials.
* Designate space for each team to collaborate and build their design ideas.
* Make sure all students will be able to see the presentation.
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| **Introduction: 15 minutes*** Remind the students that during the previous session they read and discussed the book *Iggy Peck, Architect* by Andrea Beatty and were presented with a Design Challenge Scenario and Engineering Design Challenge. Generate a discussion about the Design Challenge Scenario and Engineering Design Challenge. Do a “picture walk” through the book to remind students of the main idea.
* Slide 11: Have students complete the journal prompt and encourage them to share their answers with the class.
* An example of something that has been changed by engineers to make it better would be the inside of cars. Cars did not have seat belts. When people started to be injured in car accidents, an engineer designed a way to make the car safer. The first patented seat belt was created by American Edward J. Claghorn on February 10, 1885 in order to [keep tourists safe](http://www.secondchancegarage.com/public/seat-belt-history.cfm) in taxis in New York City. Over time, car manufacturers began installing them in all cars.
* Another example is the electric self car-starter invented by Charles Kettering in 1915. Before this invention, people had to use a hand crank to start the car-no key required. It was a lot of dirty work.
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| **Engineering Design Process: Improve: 15 minutes*** Distribute the Redesign Idea Sheet handout and a STEM Challenge handout.
* Display slide 12 of the PowerPoint:
	+ Ask the students to notice that the word Improve is in one of the circles of the “Engineering Design Process”.
	+ Students should improve their bridge by making it longer so it can cross bigger rivers.
	+ Students should use the Redesign Idea Sheet to help them critique the bridge they made last week and think through what will work or not work for their new bridge design.
	+ Students should then draw a picture of their redesigns on their STEM Challenge handout in the Improve box.
	+ Walk around as the students complete the Improve step of the Engineering Design Process.
	+ Ask the students to share their ideas with their team.
	+ Walk around as the students share their ideas with their teammates. Make sure that each student is given ample time to share his or her ideas. Students get excited about wanting to build a structure and often rush through the sharing process. Remind students that the sharing process is extremely important as engineers often alter their designs based on ideas shared during the brainstorming process.
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| **Engineering Design Process: Plan: 15 minutes** * Display slide 12 of the PowerPoint:
	+ Students should Plan as a team what their structure will look like.
	+ Students can use teammates’ ideas or a combination of the teams’ ideas, but remind them that they must create one structure together as a team!
	+ Students should draw a picture of their bridge on the back of their Redesign Idea Sheet. Allow the students to see the K’Nex boxes with the different size piece options. This bridge should be 8 green plates long.
	+ Walk around as the students complete the Plan step of the Engineering Design Process.
	+ Make sure all students are contributing to the planning process. Often the dominant students expect the other students to use his or her ideas. Remind students that coming to a team consensus is important as engineers are often expected to plan with a group of people.
	+ Before allowing teams to build their redesigned bridge, require them to gain approval of their sketch of the team’s prototype design idea.
	+ Make sure students have a list of any additional knex piece they need.
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| **Engineering Design Process, Create: 30 minutes*** Slide 12: Teams build their redesigned bridge using the knex from their first bridge and additional pieces from the K'nex kit as needed.
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| **Wrap Up: 5 minutes*** Ask students to place their handouts and materials in a safe location and to clean up their area.
* Distribute a parent letter to each student.
* Share with the student that next time we will begin to test their redesign.
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**Day 3**

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| **Introduction: 10 minutes*** Show the students the book, *Iggy Peck, Architect* by Andrea Beatty, and ask them to raise their hands and offer a one-sentence summary of the book. Invite as many one-sentence summaries as time allows. Alternatively, ask the students to turn to a partner and tell a one-sentence summary of the book. Remind students that they are working on redesigning their bridge to help more people cross a bigger river.
* Help teams of students locate their handouts and materials.
* Remind the students that during the previous session they built their own longer bridge
* Today, students are going to finish building and test their new designs.
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| **Structure Redesign Construction: 20 minutes*** Slide 12:
	+ As the students are working on completing their new designs, walk around the room and ask them probing questions about their redesign. For example:
		- How well did your first design work?
		- Why are you making that change?
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| **Bridge Structure Testing: 30 minutes*** Slide 13,14,15: Testing procedures
* Before testing, set up the testing area by placing two tables 20 inches apart.
* Students will place their new design on the tables so that the bridge spans the gap. Then they will add weight to the bridge one at a time and calculate how much weight their new bridge will hold.

**Compare** Students will compare the amount of weight their new bridge held to the amount of weight their original design held and determine which bridge held the most weight. |
| **Reflection: 10 minutes*** Slide 15: Ask students to discuss with their team:
	+ Which design held the most weight?
	+ What aspects of other team designs stood out to you?
	+ Did other designs give you any ideas for ways to improve your design?
	+ What modifications will you make to redesign your structure?
* If time permits, ask some students to share their ideas with the entire class.
* Ask the students if they have any ideas as to what type of engineer might design and build lava flow protection structures.
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| **Wrap Up: 15 minutes** * Ask students to place their handouts and materials in a safe location and clean up their area.
* Slide 16: Conclude by discussing the following questions as post-activity surveys are distributed.
	+ What ideas do you have for engineering a better world?
	+ How can you turn ideas into reality?
* Allow time for students to complete their post-activity survey.
* Distribute the parent letter to each student.
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