Unit 8 (Systems):
Rube Goldberg Greetings

Concept

We can apply what we learned in some inventive fun.

Content Objective

Student teams design and make a device that meets specifications.

Language Objective

Demonstrate understanding of causation using drawing and increasingly specific academic vocabulary.
Summarize reflections on learning in DTEEL using specific vocabulary.
Report a group consensus in writing using past tense verbs: *determined, concluded*, etc.

Standards

- **NGSS:**
  - **3-5-ETS1-1:** Define a simple design problem, including criteria for success and constraints on materials, time, or cost.
  - **3-5-ETS1-2:** Generate and compare multiple solutions based on criteria and constraints of the problem.
- **TEKS:**
  - **1A** Students will demonstrate safe practices and the use of safety equipment**.**
  - **1B** Students will make informed choices in the conservation, disposal, and recycling of materials.
  - **3A** Students will analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing**.**
  - **3D** Students will connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.
  - **4A** Students will collect, record, and analyze information using tools**.**
  - **4B** Students will use safety equipment, including safety goggles and gloves.
  - **6A** Students will explore the uses of energy, including mechanical, light, thermal, electrical, and sound energy.
  - **6D** Students will design an experiment that tests the effect of force on an object.

- **ELPS:**
    - **1C** Students will use strategic learning techniques such as concept mapping, drawing, memorizing, comparing, contrasting, and reviewing to acquire basic and grade-level vocabulary
    - **3D** Students will connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.
    - **3E** Students will share information in cooperative learning interactions.
    - **3H** Students will narrate, describe, and explain with increasing specificity and detail.

Materials

Design Materials:

Copy of the design problem; Blank overhead transparencies and pens, 1 set per team of 4; Handouts **5.8.1-5.8.2**, Copies of Rube Goldberg cartoons

Construction Materials:

All construction materials previously used; Tools; Circuits and components, OR hydraulic systems, OR stiff paper

Literature Connection
Rugy Goldberg's Bright Idea by Anna Humphrey

BACKGROUND

Who was Rube Goldberg?

A cartoonist known for his comical drawings of elaborate machines, Rube Goldberg cleverly found and drew the *most complicated* method of getting a simple job done. Making toast, for example, might require seventeen machine steps, starting with flossing of false teeth!

Today's Rube Goldberg competitions are quite different from invention fairs, for true inventions are prized if they make work easier, not more complex. A Rube Goldberg competition prizes overdone effort and is a good test of ingenuity.

See an old magazine article at this blog, http://blog.modernmechanix.com/meet-rube-goldberg/#more

Mr. Goldberg offers this description of an invention anyone is free to mass-produce, should they care to. It's a method for getting a dull comedian offstage. Here's how it works:

1. A barber shop quartet sings a sad song.
2. It's so sad a little man standing nearby cries big tears into a flower pot.
3. The plant in the pot grows until it tickles the bare feet of a boy sitting atop a slide.
4. The kid slides down, bumps a Civil War bugler at the bottom.
5. Bugler wakes up, leaps to his feet and begins blowing reveille in another Civil War vet's face.
6. Second vet catches cold from the breeze and sneezes into a propeller.
7. Propeller revolves, operating two hands holding broom.
8. Broom sweeps comedian off stage or platform.

Other resources are online for contests to design the most complicated series of steps to accomplish a function:
http://www.purdue.edu/newsroom/rubegoldberg/ http://contest.rubegoldberg.com/?page=team&id=IS289

The Potential for a Schoolwide Engineering Fair

If other teachers are using these lessons, plan to hold an Engineering Fair together! It could be held in conjunction with a science fair, invention, technology, or even a cultural fair.

Preparation

Secure a space for the devices to be assembled and displayed. Also, set a budget for the materials to be used. Consider the materials' actual costs for this task, then write the costs on labels. Budget is not a judging factor in this design, so students should not feel they are forced to avoid electric circuitry as a means to solve the problem. Students may work in teams of up to four.

Make invitations to administrators, parents, partners, and the media once you know when the devices will be completed.

Day 1: Engage *Systems: Rube Goldberg Greetings*

Teacher Says/Does	Student Says/Does	Language requirements
1. Begin whole group by telling students about Rube Goldberg's biography and fame as a cartoonist. Information about his life, along with videos and cartoons can be found at: https://www.rubegoldberg.com/about/ 2. Split students into teams and give each team a different copy of one of his cartoons. Give the teams time to look at their cartoon to determine the sequenced steps. They may write them down if needed. Model the use of past tense verbs to express consensus. 3. Have students share their cartoon with the class on the document camera by describing in complete sentences the list of events in their cartoon and the end product.	Students analyze the cartoon contraptions and articulate the sequence of steps. Students share their cartoons and analysis with the rest of the class.	***Brick words:*** ***Mortar words:*** *specifications, causation, summarize, reflections* past tense verbs: *determined, concluded*

Day 2-3: Explore/Explain *Systems: Rube Goldberg Greetings*

Teacher Says/Does	Student Says/Does	Language requirements
1. Read to the teams the Design Brief (**5.8.1**). Discuss with the students what most people would think of a simple welcome mat or a sign on the door. Ask: But how would *Rube Goldberg* treat this challenge?	Students share their ideas about welcoming guests to the school based on their knowledge from the previous lesson.	
2. Have students begin working on their design plan, which they draw and label on chart paper.	Student teams create a design plan on chart paper.	
3. Conduct a design review asking students to show and explain their plans before they begin. Students may give suggestions or ask questions about other teams' designs.	Students present their initial plans and other teams ask questions and give suggestions and feedback.	past tense verbs: *determined, concluded*,
4. Direct the student teams to begin construction. Circulate around the classroom encouraging discussion and collaboration. While the students are working, use the **Collaborative Dialogue Template** (p. 32 in Teacher Handbook) to guide conversations and take a running record of students' progress on content and language objectives.	Student teams adapt their plans and begin construction.	

Day 4: Elaborate *Systems: Rube Goldberg Greetings*

Teacher Says/Does	Student Says/Does	Language requirements
1. Once the teams have completed their contraptions, discuss the creation of engineering portfolios, and how these will help them present their learning to an audience (**5.8.2**).		
2. Model selecting a piece of quality work that represents one of the four major areas of the DTEEL curriculum: 1) Materials, 2) Structures, 3) Mechanisms, and 4) Work & Energy/Systems		past tense verbs: *determined, concluded*,
3. Conduct a "think aloud" to model the 3R reflection process (Retell, Relate, Reflect) using sample stems from the portfolio Design Brief. Write simple sentences at first. **Retelling** involves summarizing the purpose of the work, **relating** involves connecting it to other projects and ideas in the curriculum, and **reflecting** involves synthesizing the learning that resulted and the continuing questions that emerged from the work.	Students think about expanding the sentences, discuss in pairs, and then share in the whole group (think-pair-share).	**Retell** This was about _____. I noticed that _____. **Relate** This reminds me of _____. What I found especially meaningful was _____. **Reflect** Now I understand that __. I learned that _____. A question that I have is _____.
4. Invite students to expand upon your simple sentence reflections, thereby creating complex sentences.		
5. Direct student teams to select quality work and complete their written reflections on the individual pieces. Each member of the group should select at least one piece to present, and each group should have at least one piece for each of the four DTEEL categories (materials, structures, mechanisms, work & energy).	Student teams work together to compile their portfolios and write reflections on the individual pieces.	(Adapted from Rolheiser, Bower, & Stevahn, 2000).
6. As the teams work on their portfolios, circulate around the room and provide assistance as needed. Help students connect their previous work to their Rube Goldberg contraptions.		

Day 5: Evaluate *Systems: Rube Goldberg Greetings*

Teacher Says/Does	Student Says/Does	Language requirements
When the teams are ready to demonstrate their devices, plan to bring in parents and other classes. Use the non-competitive awards in the back of this book, or have judges honor the projects that meet the specifications.	Student teams present their portfolios to the audience, and explain their Rube Goldberg designs.	past tense verbs: *determined, concluded*, **Retell** This was about _____. I noticed that _____. **Relate** This reminds me of _____. What I found especially meaningful was _____. **Reflect** Now I understand that __. I learned that _____. A question that I have is _____. (Adapted from Rolheiser, Bower, & Stevahn, 2000).

Design Brief: Rube Goldberg Greetings

Design Problem **Design and make a device that welcomes visitors to your school.** <u>Specifications and constraints:</u> 1. The device must have at least 3 actions that operate it once activated. 2. You may activate it with your hands, but you should describe how a *visitor* would activate it when they arrive. 3. You should use "green design" in your planning. 4. You should have at least one of the actions made possible with potential energy. 5. You must create and present the following written materials in a portfolio: a. A black box model of the device showing input, chain of events, and output b. A labeled diagram showing how the device works. c. The cost of the materials used in your device. d. How you used "green design."	**Words to Remember/** **Palabras para recordar**

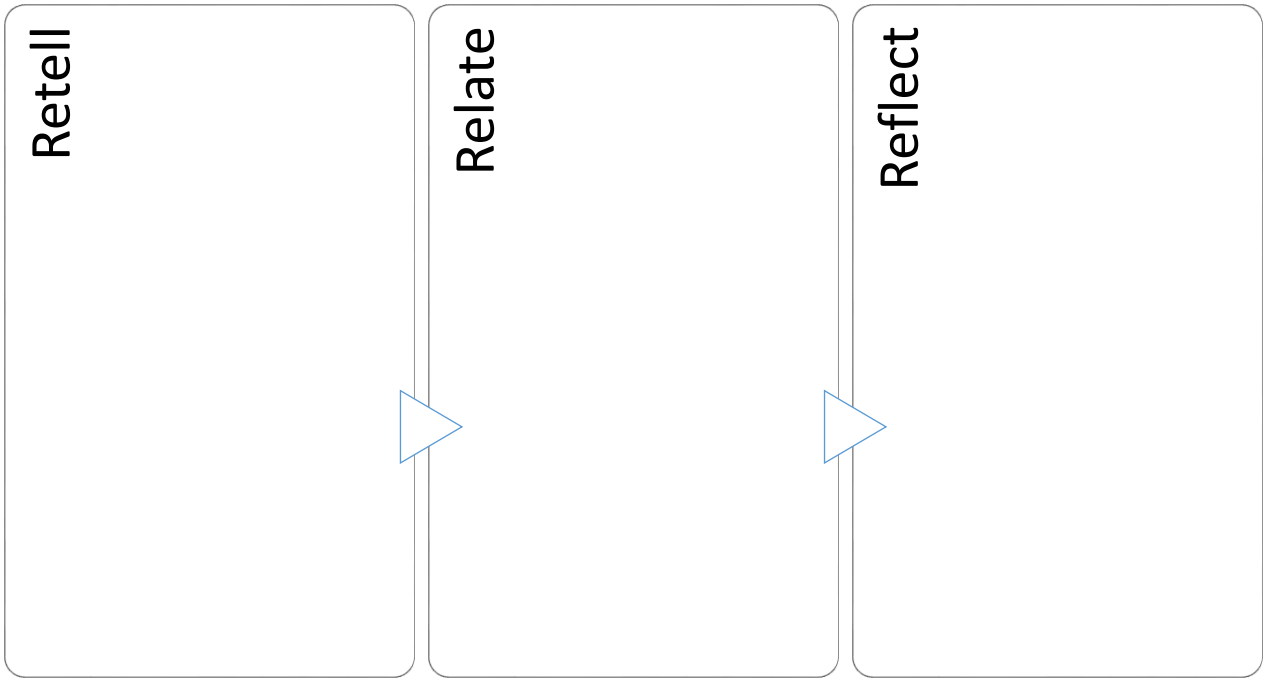
Create a drawing or model of your plan on the back of the page.

Portfolio Planning Sheet

Review the engineering work that you have completed this year and select one piece of work for each category below.

Materials	Structures	Mechanisms	Work & Energy/Systems

Now work with your group to complete a written reflection on the individual pieces. Each member of the group should select at least one piece to present, and each group should have at least one piece for each of the four categories listed above.



Portfolio Planning Questions and Sentence Stems

Retell

What was this work about?

- This was about _____.
- I noticed that _____.
- The most significant part was _____.

Relate

How does this work relate to other ideas?

- This reminds me of _____.
- This makes me think of _____.
- Something I identify with is _____.

Reflect

What did you learn from doing this work?

- Now I understand that _____.
- I learned that _____.
- A question that I have is _____.

Adapted from: Rolheiser, C., Bower, B., & Stevahn, L. (2000). *The portfolio organizer: Succeeding with portfolios in your classroom.* Alexandria, VA: ASCD.