Concept

We can invent new toys and devices after defining what chain of events needs to occur in the device.

Content Objective

Teams design new gadgets with two or more moving parts.

Language Objective

Infer potential solutions to a design problem by making connections with prior knowledge of engineering.
Provide constructive feedback to peers in oral speech and writing.
Summarize chain of events using a *topic sentence* and *conclusion*.
Describe solution using *complex sentences*.

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:**
    - **2A** Students will describe, plan, and implement simple experimental investigations testing one variable.
    - **2C** Students will collect information with detailed observations and accurate measuring.
    - **2E** Students will demonstrate that repeated investigations may increase the reliability of results.
    - **2F** Students will communicate valid conclusions in both written and verbal forms.
    - **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:**
    - **3E** Students will share information in cooperative learning interactions.
    - **4J** Students will demonstrate English comprehension and expand reading skills by employing inferential skills such as predicting, making connections between ideas, drawing inferences and conclusions from text and graphic sources.

- **5B** Students will write using newly acquired basic vocabulary and content-based grade-level vocabulary.
- **5E** Students will employ increasingly complex grammatical structures in content area writing commensurate with grade-level expectations.
- **5G** Students will narrate, describe, and explain with increasing specificity and detail to fulfill content area writing needs.

Materials
Design Materials: Paper, Stickies, Blank transparencies/Chart paper and pens, one per team of two

Construction Materials: posterboard, tagboard, glue guns, string, straws, and craft sticks; Electric circuit supplies, including wire, batteries, lights, resistors, relays, and switches, syringes and plastic tubing, clamps, screws and wood strips for making a structure; Tools including screwdrivers, pliers, and drills

Literature Connections

Save My Rainforest by Monica Zak (Spanish/English), and *Baby Coyote and the Old Woman* by Carmen Tafolla (Spanish/English)

Day 1: Engage *Systems: Inventing with Control Logic*

Teacher Says/Does	Student Says/Does	Language requirements

1. Conduct a *Think, Pair, Share* activity discussing the practical importance of engineering by posing the question: If you asked an engineer why his/her work is important, what do you think s/he would say? Allow students time to think, then to share their ideas with a partner, then call on students to share with the class.
 	
2. Focus students in on the importance of engineering in designing solutions to problems. Prepare three different problem scenarios from fiction, history, or community service. Here are some examples of design problems you (or the students) might choose from or you may design your own:
 	
    a. From Tafolla's *Baby Coyote and the Old Woman*: The Old Woman's human neighbors ask for her help because so much trash has accumulated around their town that they cannot pick all of it up to recycle. Design and make a mobile device that can pick up objects and sort them according to material.
    b. People who lived in castles a long time ago had no way to tell if visitors approaching were friendly or not. Design and make a model of a gadget that would let you know someone had arrived at your gate and whether or not you should let them in.
    c. The nursing home down the street is looking to hire people, but, in the meantime, their staff is having trouble keeping up with all the folks who need medications on time. Design and make a device that dispenses pills on schedule and reminds or notifies an elderly person when it's time to take the dose. They will predict problems with the device and write how to trouble-shoot in those instances in a chart.
 	
3. List each scenario on an anchor chart with accompanying pictures.
 	
4. Have students brainstorm needed characteristics of the gadget for each problem scenario: (ie. small, energy-efficient, quiet, etc.)
	Students think, discuss with a partner, and then share their responses in the whole group.
	
	Students work in pairs to record the characteristics for a gadget for each scenario.
		Brick words:
		
		Mortar words: *infer, solutions, making connections, feedback, summarize, chain of events*

5. (OPTIONAL) As the exit slip, have each student rank the scenarios in terms of interest.	Students rank the scenarios.	
		Complex sentences, topic sentence, and conclusion. *First of all,* *Initially,* *The main problem was* *In conclusion,* *Finally,* *Lastly,*

Day 2: Explore/Explain *Systems: Inventing with Control Logic*

Teacher Says/Does	Student Says/Does	Language requirements
1. **Preparation:** You may consider grouping students according to their interests in the scenarios.		
2. Each team will choose one scenario and begin their detailed design plan on chart paper. Show the children the following constraints: a. Their gadget must have at least two moving parts. b. They must be able to explain their gadget and the chain of events that make it work. c. They will make a diagram after they are done.	Students create a detailed plan for building a gadget that meets the design criteria.	
3. Meet with each team as they create their plans and begin to construct their gadgets.	Once they have teacher approval for the initial design, students begin to build their gadgets.	

Day 3: Explain/Elaborate *Systems: Inventing with Control Logic*

Teacher Says/Does	Student Says/Does	Language requirements
1. Once the teams have completed their plans, hold a "silent gallery" design review to involve the entire class in analyzing the planned gadget and asking questions of the design team. Review respectful sentence stems that the students can use to help structure their feedback.	Students walk around the classroom with writing utensils and/or sticky notes and add questions, comments, suggestions to each design plan.	
2. Explain that the teams will now have the chance to modify their gadgets based on their peers' feedback.	Student teams finish building/adjusting their gadgets.	I like how your team _____. I wonder why _____. I would suggest that _____. I had not thought about _____.

Day 4: Evaluate *Systems: Inventing with Control Logic*

Teacher Says/Does	Student Says/Does	Language requirements
1. After the gadgets are finished, have teams present by scenario. For each scenario, invite students to compare the advantages and challenges of each gadget using a T-chart. While the teams present, consider asking the following questions. You may want to provide them to the groups before having them present in front of their classmates. • What are the advantages and disadvantages of your gadget? • When did you use trouble-shooting, or when did you have to "de-bug" your invention? • If you made lots of these gadgets, what steps would you probably need in manufacturing?	Student teams present their gadgets and suggest advantages/disadvantages for each gadget.	Complex sentences, topic sentence, and conclusion.
2. After the finished gadgets are presented, have the teams trade gadgets to see if another team can operate it.	Student teams try to operate the different gadgets from each scenario.	
3. Have students create a small poster as an ad for their invention which accompanies it on display. Brainstorm criteria for quality; some criteria could include: • Attractiveness of lay-out • Effectiveness of message for target audience • Legibility • Incorporation of complex sentences	Students help determine the criteria for quality work and they work in teams to create ads for their inventions.	