Unit 9 (Systems):
"If…, then" Chains in a Gadget

Concept
We can analyze gadgets to find the chain of events that make it work.

Content objective
(Technology Fair) Teams respond to a problem to design a device that will raise a sunken object.

Language objectives
Students will use "if …, then" to orally discuss features of a design.
Students will describe design briefs, black box model, and planning map *using the conditional tense.*
Students will describe experiments using *target vocabulary*.

Standards

a. **NGSS**:
   - **3-PS2-1.** Plan and investigate the effects of balanced and unbalanced forces on the motion of an object.
   - **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 use safety equipment.
   - **2A** Students will plan and implement descriptive investigations, including asking well-defined questions, making inferences, and selecting and using appropriate equipment or technology to answer his/her questions.
   - **3A** Students will analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing.
   - **3C** Students will represent the natural world using models.
   - **4A** Students will collect, record, and analyze information using tools.
   - **4B** Students will use safety equipment as appropriate, including safety goggles and gloves.
- **ELPS**:
   - **2G** Students will understand the general meaning, main points, and important details of spoken language ranging from situations in which topics, language, and contexts are familiar to unfamiliar [LC: Abstract & Concrete]

- **3E** Students will share information in cooperative learning interactions. [Communicative Competence]
- **3G** Students will express opinions, ideas, and feelings ranging from communicating single words and short phrases to participating in extended discussions on a variety of social and grade-appropriate academic topics. [Speech Production at Grade Level]

Materials:

- Access to all construction materials
- Dishpan or aquarium and toy boat
- Copy of the Design Brief on a chart

Preparation

Place the plastic toy boat in a dishpan full of water. If you tip the boat so that it fills with water, it will sink. You can also slide a few pennies inside one of its windows to make it lie on the bottom of the "lake."

Literature Connections

Sunken Treasure by Gail Gibbons

Day 1: Engage/Explore:

Teacher Says/Does	Student Says/Does	Language Requirements
1. Tell the students that they have learned a lot about materials, mechanisms, energy, and power during their engineering work. 2. Show students the charts of words and ideas made together and remind students of the Design Gallery creations they have displayed. 3. Review with students some ideas about materials, levers, gears, pulleys, and hydraulic and pneumatic power systems by having student pairs choose one favorite concept and share with the rest of the class. 4. Start a web with the following words and ask students to work in groups to connect ideas: • MATERIALS (elastic/shear resistant) • WORK • POWER (transmitted by mechanisms, hydraulics, or pneumatics) • MECHANISMS (gears, pulleys, levers, wheels, cams) TEAMWORK • PLANNING 5. Have students add words and connections of their own so that you can hear what they understand about the major concepts. 6. After each group has built a web together, place it on display for teams to see during the next few periods of work on the Design Brief.	Student pairs discuss the features of one chosen engineering concept studied Student groups create a web connecting engineering concepts	Gadgets Materials Mechanisms Energy Power Engineering Levers Gears Pulleys Hydraulic power Pneumatic power

Day 2: Explore/Explain

Teacher Says/Does	Student Says/Does	Language Requirements
1. Show the students the Design Brief: *Design a device that will raise the sunken (boat) and bring it out of the water —without using your hands to touch the boat and without damaging the boat. Use at least two different mechanisms for movement. You may also use hydraulic or pneumatic power to raise the boat.* 2. Remind the students of how to begin work on the Design Brief: o • Look at the Design Brief. o • Ask questions about what the words mean. o When you understand what the words in the Design Brief mean, talk with your partner and plan what you might like to make. o • Draw a Black Box Model of your system. o • Draw a side-view sketch of your device. o • Make a planning map. 3. Talk about who will do what jobs and how you will make sure both people have interesting jobs to do. 4. Let the teams work on their designs, allowing them to try out their models on the sunken toy after they have shown you a planning map, a Black Box Model, and a side-view sketch.	Students discuss features of a Design Brief and construct a planning map, a Black Box Model, and a side-view sketch. Students experiment with different options to implement their Design Brief	

Day 3: Elaborate and Evaluate

Teacher Says/Does	Student Says/Does	Language Requirements
1. When the products are ready, put them on display along with each team's written description of how teams chose to solve the problem and what mechanisms make their devices work. 2. Set up the Design Technology Fair where other teachers and students can see the displays. Be sure to invite parents to visit the Technology Fair. Non-competitive awards can be given to celebrate diversity, creativity, and problem solving expertise!	Students display their products with other students, teachers and parents	