Unit 6 (Mechanisms):
Bean- Ho!

Concept Mechanisms can change the size of input movement; movement on one end of a lever depends on distance from pivot point.

Content Objective Teams use black box modeling to design and make a device that will launch a bean a distance of at least 5 meters.

Language Objectives Students will understand the meaning of the words *input, system of events,* and *output* using concrete examples.
Students will produce examples that fit the meaning of input, system of events, and output.
Students will use engineering vocabulary as part of cooperative discussions

Standards

- **NGSS**
  - **K-2-ETS1-2** Make a drawing or physical model to illustrate how the shape of an object helps it to solve a problem.

- **TEKS**
  - **2A** Plan and implement descriptive investigations, including asking and answering questions, making inferences, and selecting and using equipment or technology needed, to solve a specific problem in the natural world
  - **2B** Collect data by observing and measuring using the metric system and recognize differences between observed and measured data
  - **2E** Demonstrate that repeated investigations may increase the reliability of results
  - **2F** Communicate valid conclusions supported by data in writing, by drawing pictures, and
  - through verbal discussion
  - **4B** Use safety equipment as appropriate, including safety goggles and gloves
  - **6A** Explore different forms of energy, including mechanical, light, sound, and heat/thermal in everyday life
  - **6B** Demonstrate and observe how position and motion can be changed by pushing and pulling objects to show work being done such as swings, balls, pulleys, and wagons

- **ELPS**
  - **2E** Use visual, contextual, and linguistic support to enhance and confirm understanding of increasingly complex and elaborated spoken language [Context Clues]

- **3E** Share information in cooperative learning interactions [Communicative Competence]
- **3D** Speak using grade-level content area vocabulary in context to internalize new English words and build academic language proficiency [Application for Acquisition]

Tools Materials	Black Box handouts **3.6.1** and cutouts of **3.6.2, 3.6.3**
Literature Connections	*The Knight and the Dragon* by Tomie DePaola

Day 1: Engage/Explore

Teacher Says/Does	Student Says/Does	Language requirements
1. Tell students that they will learn about devices that can throw small objects, like a bean, at a distance. Show them the *Marshmallow Catapult* video https://www.youtube.com/watch?v=R7hBg91_DZI 2. Have student pairs describe what they saw in the video 3. Explain to students that they will work with "Black Box" problems. These are problems that begin with one thing (called an "input"); something happens to it (called "a system of events"), and you end up with something different (called "an output"). 4. Use the handout **3.6.1** to give an example of an input: 2, a system of events: [X3], and an output: 6. 5. Have students use the cards in handout **3.6.2** to practice with another example. Then, have students generate their own examples of inputs, systems of events, and outputs and share them with the class. 6. Tell them that what they did is create what engineers call " mechanisms", processes and devices that convert something like a force into something else. 7. If considered appropriate, talk about examples of mechanisms in simple machines (lever, gear, pulley, wheel and axle, screw, and inclined plane).	Students discuss a video Students get familiar with black-box thinking	• input • system of events • output • mechanisms • Review: • lever • gear • pulley • wheel and axle • screw • inclined plane

Day 2: Explore/ Explain

Teacher Says/Does	Student Says/Does	Language requirements
1. Show them the construction materials available and the Design Brief: **Design a device that will send a bean across a distance of at least 5 meters from where it starts.** 2. Remind the students of how to begin work on a Design Brief. 3. Ask questions about what the words mean. 4. When you understand what the words in the Design Brief mean, talk with your partner and plan what you might like to make. 5. Make a planning map and label who will do what jobs. 6. Draw a sketch that shows a side view of what your device will look like. Label the sketch with the materials you plan to use. 7. Consider asking students: "What do you think a side-view sketch is?" Give them some examples by drawing some above-view pictures, some front-view pictures, and side-view pictures. Explain that a side-view sketch shows how something looks from the side, and that they will use their sketch as a blueprint. Show examples of the labeling that makes such sketches easy for someone to understand. To clarify the problem, show the students a launching "pad" location and have another student measure off five meters. The bean should fall somewhere within that distance.	Students deepen their understanding of a Design Brief and Black-box thinking	• Design brief • Sketch • Front-view • Side-view • Black-box model

Teacher Says/Does	Student Says/Does	Language requirements
8. Use a Black Box Model in handout **3.6.3** to further define the task: The teams should make several preliminary sketches, select one they like, then make a labeled sketch on an overhead transparency. Let the teams begin work on their bean launching models. Do not let anyone try to launch a bean until they show you a planning map and a side-view sketch for the device they have constructed. Remind them that safety is their job and ask them how they will be sure no one gets hit with their bean during testing.		

Day 3 Elaborate and Evaluate

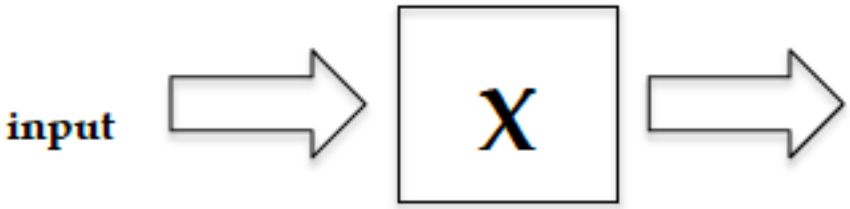
Teacher Says/Does	Practical Extensions	Language requirements
1. When teams are finished and have tested their models, have them present these materials, in turn: a. Their planning map b. The side-view sketch they drew as a blueprint c. The device they have constructed 2. Ask each team to demonstrate their device, and involve the rest of the class in evaluation: a. Was the planning map used well? b. Did the team seem to follow their blueprint? c. Does the device meet specifications and send a bean at least five meters away from the launch pad? 3. Each team reports: a. Where is the input work on the device? b. How many different pivot points did they try? What happened? c. Why did they choose the materials that you used? What properties of some of the materials were especially useful for the task? d. Where is the output work? e. How does a Black Box Model help think about the task? The rest of the class should ask the sharing team questions. f. Place the launching devices in the Design Gallery, along with the side-view sketches and each teams' written description of making the mechanism. Have the students place their planning map in the Design Portfolio.	Students share their planning and their bean-launching devices using Black-box thinking Students will brainstorm with parents real world examples of catapaults	Sketch Side-view sketch Planning map Black box model

Engage/explore

What you start with (input)	Things that happen in the middle (System of events)	What you end up with (Output)
2	(x 3) or (+2+2)	6

dog enters kitchen	cup tips over
1. dog sees cat 2. dog runs toward cat 3. cat jumps up on counter 4. cat bumps into cup of water cup tips over	
	a cat runs up a tree

A mysterious man adds a record to the jukebox in the doughnut shop.	1. Homer hears the tune. 2. Homer sings the tune to a friend 3. His friend sings it to another friend. 4. The whole town hears the catchy tune.
Everyone in town starts singing the tune and can't stop.	2
6	(x 3) or (+2+2)



Bean goes into the device.

Bean lands at least 5m away.

Design a device that will send a bean across a distance of at least 5 meters from where it starts.