

**Unit 7 (Mechanisms):
Linear and Back and Forth Motion**

Concept Mechanisms can change size and direction of motion; linear motion is movement in a line; back-and-forth linear motion is called reciprocating motion. Up-and-down motion about a pivot point is an arcing or oscillating motion.

Content Objective Teams explore linear and reciprocating motion with linkages and slider mechanisms.

Language Objectives Students will recognize the meaning of the terms: linear, rotary and reciprocating, for types of movement
Students will write sentences using the words: linear, rotary, or reciprocating to describe types of movement
Students will deepen their knowledge of the meaning of: power, systems, input, lever and mechanisms

Standards

• **NGSS**

- **K-2-ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define problem that can be solved with a new or improved object or tool.
- **K-2-ETS1-2.** Make a drawing or physical model to illustrate how the shape of an object helps it to solve a problem.
- **K-2-ETS1-3.** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses.

• **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.
- **2F** Communicate valid conclusions supported by data in writing, by drawing pictures, and through verbal discussion.
- **3A** Analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing.
- **3C** Represent the natural world using models and identify their limitations, including size, properties, and materials.
- **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.

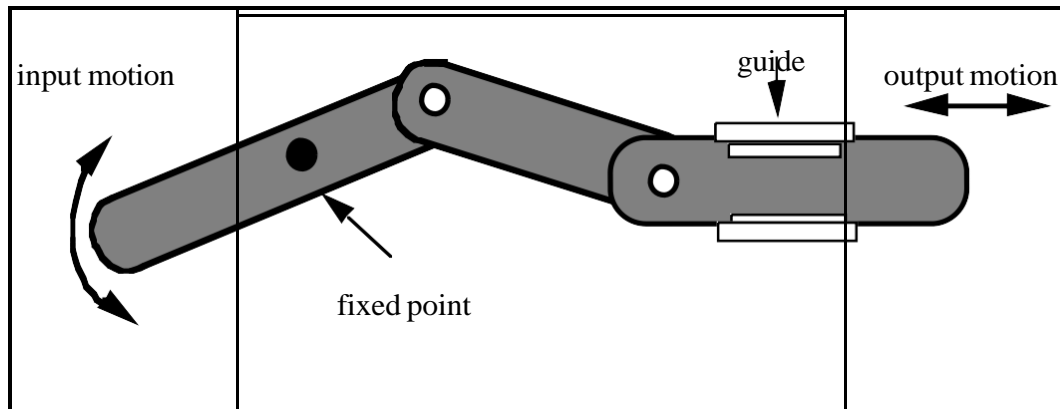
• **ELPS**

- **1C** Use strategic learning techniques such as concept mapping, drawing, memorizing, comparing, contrasting, and reviewing to acquire basic and grade-level vocabulary. [Metacognitive Strategies]

- **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]

**Tools
Materials**

Poster board strips; hole punch; paper fasteners; scissors; construction paper; glue guns; glue sticks; design brief on chart; lever model (Model of slider-crank Mechanism Figure 12).



Handouts **3.7.1-3.7.6**

**Literature
Connections**

Motion: Push and Pull, Fast and Slow by Darlene R. Stille
Oscar and the Cricket: A Book about Moving and Rolling by Geoff Waring
Learning about the Way Things Move by Heidi Gold-Dwarkin

Teacher Says/Does	Student Says/Does	Language requirements
<ul style="list-style-type: none"> ○ Cut apart and mix up words, definitions and examples from 3.7.3. Match them back up and glue to construction paper. ○ Look through books and note pages on which linear, rotary or back and forth motions are shown. ○ Illustrate a scene showing action of a person or object and draw arrows to show the direction of movement (<i>linear, rotary, back and forth</i>). 		

Day 4: Explore/ Explain

Teacher Says/Does	Student Says/Does	Language requirements
<ol style="list-style-type: none"> 1. Show students your model of a slider-crank mechanism (Figure 12). Ask students to provide a definition of a lever, and to give examples of levers they are familiar with. Explain that levers in a series are called linkages, and that the last link, the one that goes back-and- forth, is called a slider. 2. Give students a picture of a model with a slider and linkages. Have them label the sliders and the linkages. 3. When the lever at one end of the folder is pushed down, the slider is made to travel back and forth. 4. Complete handout 3.7.6 to include a definition and illustration of each. 5. Go on a walk to find examples of sliders and slider-cranks. Many kinds of bolts are sliders, especially those found on bathroom stall doors and other enclosures. Many doors and windows have slider-cranks and linkages. 	<p>Students label parts of a model that has sliders and linkages</p>	<p>sliders slider-cranks levers linkages</p>

Day 5: Explore/ Explain

Teacher Says/Does	Student Says/Does	Language requirements
<p>1. Remind them of how to work on a Design Brief:</p> <ul style="list-style-type: none"> a. Look at the Black Box (from Day 3) as their Design Brief. b. Ask questions about what the words mean. c. When you understand what the words in the Design Brief mean, talk with your partner and plan what you might like to make. d. Make a plan for what you will make. Talk about who will do what jobs, and how you will make sure both people have interesting jobs to do. e. Draw a side-view sketch of what you will do. <p>2. Give the teams time to use trial-and-error to work with different types of mechanisms. They will find that a series of links connected together may create the input and output they want, but they will need to make some kind of guide for the slider so that it will be forced to go back and forth. Work with some teams to trouble- shoot during the process, and if several get frustrated, call the group back together to analyze what is being done in other groups that are having some success.</p> <p>3. When the teams have a completed folder to show, let them demonstrate it for the whole class, asking everyone to evaluate whether the product meets the Design Brief specifications. Ask the teams:</p> <ul style="list-style-type: none"> o What was the hardest thing about your Design Brief? o Did you stick to your original plan? If not, why? o What were some skills you and your partner used while you worked together? o Where is linear motion demonstrated in your product? (One stroke of the lever, in one direction) Where is back-and-forth motion (reciprocating) motion shown? 	<p>Students explore different types of mechanisms</p> <p>Students evaluate their design briefs</p> <p>Students, with parents, will identify linear</p>	

Teacher Says/Does	Student Says/Does	Language requirements
<ul style="list-style-type: none"> ○ How might the same folder show how linear motion can be transformed into rotational motion? (Push the slider back and forth and the link at the other side goes up and down in an arc.) <p>6. Also, ask the rest of the class what questions they have for the team that is presenting.</p> <p>7. When each team has completed its presentation, let them display their folder in the Design Gallery along with their side-view sketches of the inside of their folder and a written explanation of how their product changed from their original plan, if it did</p>		



DTEEL 3.7.1 Linear and Back and Forth Motion

Engage/Explore

Brushing your teeth	What kind of movement	Why?
A car going on a highway		
A child moving on a swing		
A child moving on a swing		
A sewing machine		
Planets moving around the sun		
Opening a door knob		
Clock handle moving		

Concepts about Motion:

Type of motion	Definition	Example
Linear motion	Motion in one direction	Pushing a lever forward
Reciprocating motion	Linear motion that goes back and forth	Pushing and pulling a lever back and forth the piston in an engine moving up-and-down
Rotary motion	Motion in a circle	The hands of a clock moving, or a wheel on an axle
Oscillating motion	Circular or arc-motion back and forth	The swing of a pendulum or the turning and release of a doorknob

What is it?

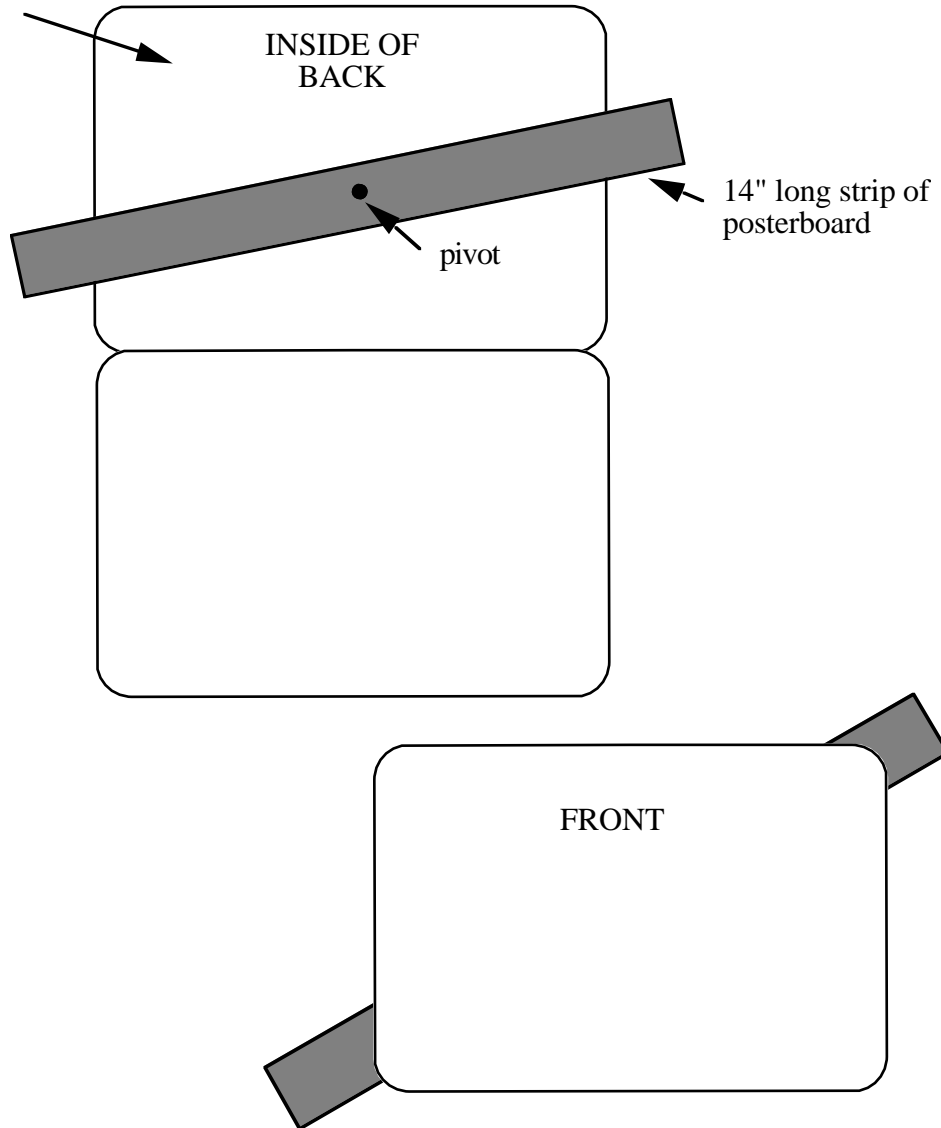
Description

Word

Jig Saw Activity

Examples

HIDDEN LEVER SYSTEM MODEL



Examples of reciprocating motion in the school		Describe the reciprocating motion
Example	Drawing	
Example	Drawing	Describe the reciprocating motion

Picture of a slider	Picture of a linkage
Picture of a lever	Picture of a slider-crank