Unit 4 (Structures): See-Saw Shoe Mobile

Concept Balance of a structure relates to distribution of forces.

Content Objectives Students experiment with finding balancing points on a big mobile and draw free-body diagrams showing forces.
Students will analyze different situations that need balance and construct a shoe mobile to experiment with balance, as well as pulling and pushing forces.
Students analyze distance of an object to the fulcrum as part of balance

Language Objectives Students will write paragraphs reflecting an understanding of the concept of balance in everyday and in engineering contexts.
Students will discuss the properties of a free-body diagram in groups.
Students will write paragraphs using the words fulcrum and balanced systems.

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**
  - **2C** Construct graphic organizers using tools and current technology to organize, examine, and evaluate measured data
  - **3A** Analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing
  - **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**:
  - **3E** Share information in cooperative learning interactions [Communicative Competence]
  - **5B** Write using newly acquired basic vocabulary and content-based grade-level vocabulary
  - **5G** Narrate, describe, and explain with increasing specificity and detail to fulfill content area writing needs as more English is acquired

Tools Materials Rods or strips about 12-18” long for making group mobiles; Broomstick/ thick dowel rods; foam board or cardboard strips with holes evenly spaced; string; curtain hooks to

	hang shoes on mobile rod; children's lace up shoes; team mobile sticks (e.g. pencils, dowels, stiff rolled paper tubes, coat hanger wires); Metric rulers or yardsticks; math balance (i.e., equal arm balance numbered 0-10 in either direction from the balance point of 0.) Handouts **3.4.1-3.4.3**
Literature Conncetions	*Ten Apples on Top* by Dr. Seuss

Day 1: Engage/Explore

Teacher Says/Does	Student Says/Does	Language requirements
1. Tell students you will be investigating and discussing balance. Write the word "balance" on the board. 2. Ask if they have been on a seesaw before, and have someone draw it on the board. What are some interesting things to do on a see saw? Ask students to share a past experience with a seesaw and how balance was attained. How does something behave if it's "off-balance?" Give opportunities for two or three responses. 3. Ask whether they have examples of things that are said to be "balanced." We talk about the balance of nature, a well-balanced meal, a bank balance, and even balanced people. 4. Working in pairs, or as a whole group, distribute the handout with exploratory questions about balance **3.4.1**. Ask students to read all five paragraphs, and to write a paragraph using the word balance to answer the questions in the space provided. Give a few minutes and then ask pairs to share with the rest of the class. The pair member who didn't write should read when sharing with the rest of the class. 5. Hold up a length of a dowel rod or broomstick and challenge students to try to hold the entire rod on one finger. How can it be done? What happens if the finger is moved one way or the other? Write down their words and ideas as they describe the action of the stick leaning one way or the other. Can they find the center of balance? 6. Have student pairs discuss the different way in which the concept of balance is used with the rod or broomstick and that which they used in their paragraphs in the engage/explore part of the lesson	Students share past experiences involving balance Students read and write paragraphs about balance Students discuss the concept of balance	Vocabulary: • Balance • dowel rod • broomstick

Day 2: Explore/explain

Teacher Says/Does	Student Says/Does	Language requirements
1. Ask students if they can think of a way to make a team mobile that shows a balance of some sort. 2. Tie a broomstick or rod to a string hanging from the ceiling or a chart rack. Be sure the knot in the center is loose enough for you to slide the stick around. Have one child come up and find the right place to place the string so that the rod is balanced. 3. Give a few minutes for student pairs or teams to discuss how you decide where to put the rod, and have them share with the class. 4. When the rod is balanced (roughly), tape the string to it. 5. Ask the children to tie their shoes in different places along the rod, observing the action. Encourage them to try all different combinations of shoes, such as three shoes hanging together on one spot, or spread out along the same side of the center point. 6. Draw a sketch of the rod hanging from a string, balanced. Ask the children to come draw arrows to represent the forces of gravity pulling down and the reacting force of the string pulling up on the rod. 7. Tell them that by showing the pushing or pulling forces with arrows, they have created what engineers call "free-body diagrams," sketches that show the forces acting on a structure. 8. Have student pairs/teams discuss a free-body diagram that they might like to design.	Students discuss ways to make mobiles Students discuss free-body diagrams that they might like to design	• Free-body diagram • sketches • fulcrum • weights • advantage

Teacher Says/Does	Student Says/Does	Language requirements
9. Let the students add additional rods and shoes to the shoe-mobile. Then, have them draw, in teams, a free-body diagram. 10. Initiate a discussion with the students about balance. Show them a moveable math balance and ask them to demonstrate how you can balance something heavy such as two 10-gram weights with one-10 gram weight, depending on the distance from the fulcrum (balance point.) The numbers on the math balance make it especially useful for showing the advantage one gets by using distance from fulcrum. Ask students to show several ways they could balance a heavy shoe with two lightweight shoes (they could use a fulcrum that is closer to the heavy shoe, for example). 11. Ask student pairs or teams to examine the words on handout **3.4.2**, discuss them, and write a paragraph so that all words are used.		

Day 3 Elaborate and evaluate

Extensions into the disciplines	Student Says/Does	Language requirements
1. Let teams work on their own to draw and discuss some ideas and then make simple mobiles that are models of things in balance. 2. Provide access to construction materials and assist where necessary. Share ideas on mobiles that are models of systems in balance, like: balancing containers of ounce-capacity on one side and gallon capacity on the other side. 3. When teams have finished a mobile, they should explain: • What system they have modeled in their mobile? • Why they put fulcrums where they did? • Which items needed to be closer to fulcrums and which farther? 4. Have students discuss in pairs or teams the answers to the above questions. Then, have them write their answers by completing the sentence stems provided in handout **3.4.3**. Last, have one team read a question and then a student pair or team read the answers to the class, until all questions are addressed.	Students discuss ideas about mobiles that balance Students discuss questions about mobiles and balance	Vocabulary: ***Brick words:*** Balance Mobiles Fulcrum ***Mortar words:***

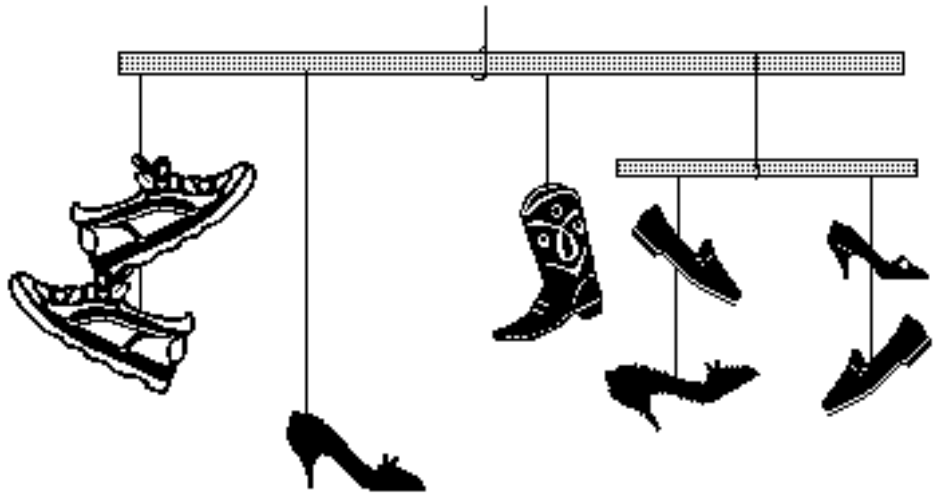
What is a balanced diet or a balanced meal? What happens if we don't eat balanced diets?

How do tight-rope walkers keep their balance? How does carrying a long pole help them? What factors can make them lose their balance?

How are designs balanced in clothes? For example, in fabric that is decorated with huge flowers, how are they spaced to give a balanced effect? Can you think of a design that is out of balance?

Have you ever used a balance beam? How about using a balanced beam with your eyes closed? How do you attain balance in a balance beam? Is it easy or difficult to have balance on a balance beam? Why or why not?

Why do you think balance important for health and for posture, and especially as one gets older?



Free-body diagram	weights	fulcrum	advantage
mobile	depending on	design	balance
_____ _____ _____			
_____ _____ _____			
_____ _____ _____			

The type of balanced system that we modeled in our mobile is_____ _____
We put the fulcrum on_____ because_____
The _____ needed to be closer to the fulcrum because_____
The _____ needed to be farther from the fulcrum because_____