

(ENG) Balance the Kinetic sculpture!



Introduction

Step 1 - Motivational Stage

Step 2 - Investigational Stage

Step 3 - Consolidation Stage

Introduction



#In-class activity #Experimental learning #Gamified learning

A mobile is a hanging art sculpture constructed to take advantage of the principle of equilibrium. You might have had such a mobile in your room when you were little. These mobiles hang from the ceiling and are usually made up of many layers of rods to which lots of differently shaped objects are attached with strings.

The objects hanging from the strings balance each other, so that the rods remain more or less horizontal. Each rod hangs from only one string, which gives it the freedom to rotate about the string. An ensemble of these balanced parts hang freely in space, by design without coming into contact with each other. You are about to construct your own mobile sculpture and find out how it stays balanced.

Learning Objectives

- ☐ understand that forces work in pairs; every force leads to an equal and opposite force
- ☐ identify whether forces are balanced or unbalanced
- ☐ clarify the term net force and determine its value in given situations using simple actions
- ☐ use diagrams to evaluate balanced and unbalanced forces
- ☐ recognize that unbalanced forces lead to a change in motion

ACTIVITY DETAILS

Activity Details

Connection of the activity with Art —

Cutting and sticking



Link to local, national School Curriculum —

Forces/ Balance of forces



Equipment required —

- Heavy construction paper or cardstock, ideally various colors (Alternative: sea cells, wood sticks, small rocks)
- Hole punch
- Pen
- Markers
- Scissors
- Tape
- String
- Straws, at least 10

- Ceiling or door frame to hang the mobile from
- Optional: Scale with 0.1 g precision



Duration of activity —

45 minutes



Sources —

Step 1 - Motivational Stage



You can ask a motivational question to encourage brainstorming in class



“When two or more forces are balanced?”

Then bring up an example from everyday life:

Example 1	Example 2
<p data-bbox="272 451 743 583">Humans pushing a wall. A force applied against a brick wall is a balanced force.</p> <p data-bbox="235 640 781 1075">This is because when we push against the wall with the slightest or most intense force, the wall remains in its original state. Since there is no displacement in the wall as a result of the force applied, we can assume that the same magnitude of the force is being applied by the wall against us as well.</p>	<p data-bbox="852 415 1377 583">A tug-of-war in which neither of the teams seems to move at all. What happens in such a situation?</p> <p data-bbox="846 682 1386 1108">The two forces acting from either side are of the same magnitude. When the two forces are equal, they cancel each other out and their vector sum is zero. As a result, neither team moves, nor the balanced force is created.</p>

Step 2 - Investigational Stage



Pupils will investigate the balance of forces with the use of a mobile. Pupils might have observed that if you do not attach the string to the very center of the straw, it will pull down on one side more than on the other.



“What is the condition that should be met in order for the mobile to be balanced?”

The weight pulling down on each of its sides must be exactly the same (this is only true if the string is in the center of the straw). When you attached one shape to the straw, the weight of the shape should have pulled the straw down on the side it was attached to.

Then, you can ask students (or let them investigate through inquiry).



“What will happen if another shape to the other side of the straw will be attached?”

Parameters that should be considered

- shape and size of attached shapes
- pivot point (or centre) of the straw
- length of the string (does not affect the balance of the straws very much, as the string itself is not very heavy, though helps prevent objects from bumping into each other when it starts moving)
- air movement

STUDENTS' TASKS

Task 1

Ask students to draw ten different shapes that they want to attach to their mobile on the construction paper. Ideally, the shapes should vary in shape and size.

Next, they cut out the different shapes with scissors. Alternatively, they can use small pieces of wood, rocks or sea cells.

Then, ask them to decorate as they please (to paint or add any other object).

2

Task 2

Next, tell the students to use an appropriate tool to make hole into each of the objects they use.

3

Task 3

Students attach a piece of string to each shape by threading it through the punched hole and tying a knot. They try to vary the length of string attached to each shape so that they are not all the same.

4

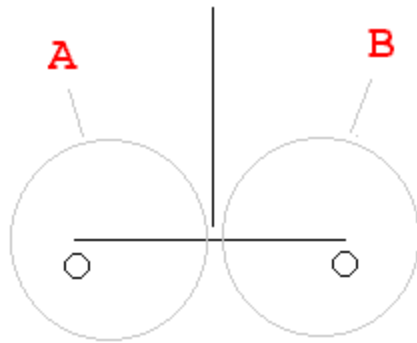
Task 4

They start with one layer of their mobile, attaching a piece of string to the centre of one of their straws. They hold the straw by the string so it hangs freely in the air.

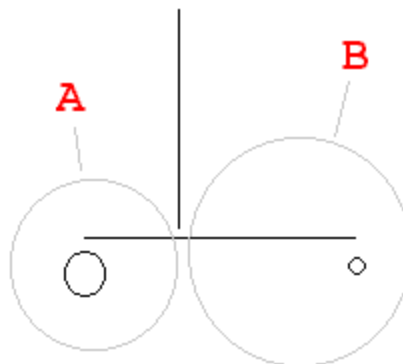
They then try different weights and distances for various artistic outcomes (see below)



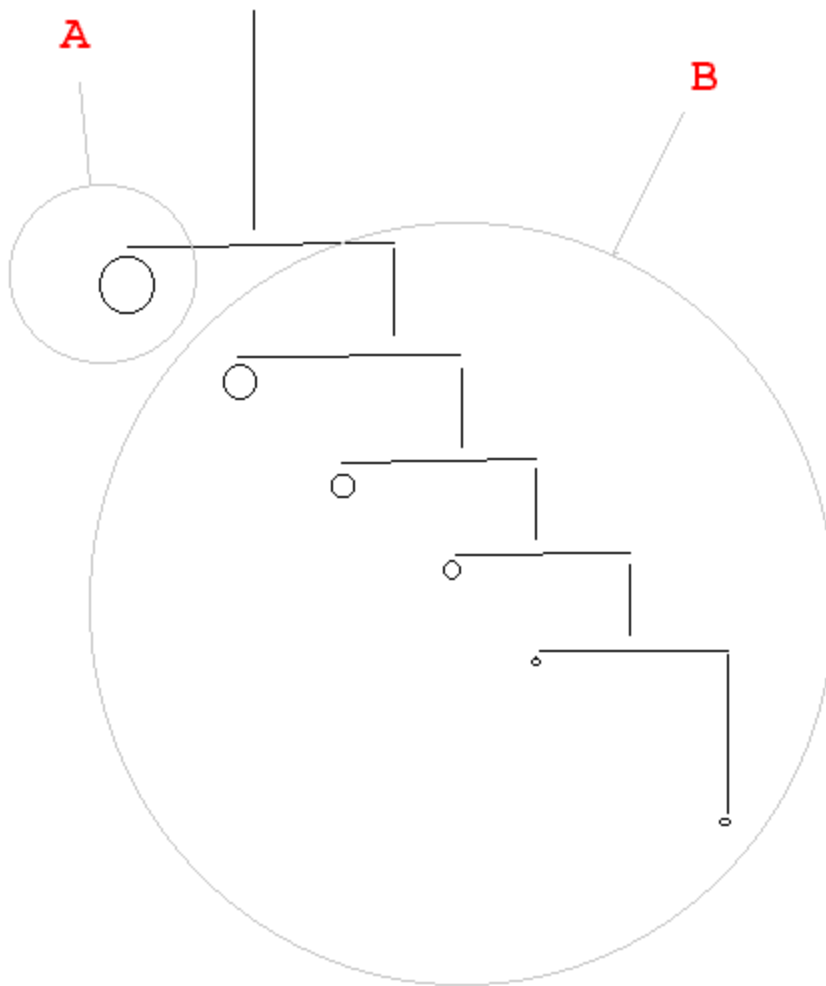
“Is the straw hanging horizontally? If not, what do you have to do to make it hang horizontally?”



Same weight



Different weights, balance is succeeded by different distance



Balance the objects by different weight and distance

5

Task 5

Once the straw is balanced, they need to tie their first shape to one end of the straw. Again, they hold the straw up in the air by its string.



“What do you notice happens to the straw?”

6

Task 6

Afterwards, they should tie a second shape to the straw's other end and hold it up in the air again.



“Is the straw balanced? Why or why not?”

7

Task 7

Students balance the straw by moving one of the shapes along the straw.



“Can you find a position on the straw where both shapes are balanced?”

8

Task 8

Students use a second straw and two more shapes to build another balanced structure.

They repeat the previous step until they have used up all their cut-out shapes.

Now, they put all the pieces together to create a multi-layered mobile. They use strings to attach all the straws they made to one another until the mobile is balanced. They might want to use different lengths of the string, so the shapes and straws are not bumping into each other.



“Are you able to balance all the forces within your mobile? How easy or difficult is it to balance all the pieces?”

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Task 9

Once they have successfully balanced their mobile, they can use tape or string to hang it from the ceiling or a door frame.



“When it hangs freely, does your mobile move?”

10

Task 10

Finally, ask the students to carefully blow on one of the shapes hanging from the mobile. Ask them the following question:



“What do you observe?”

Step 3 - Consolidation Stage



Mobiles are free-hanging sculptures that are able to move in the air.

You can give your students feedback on:

- The artistic outcome
- The balance of the mobile

Pupils should be able to connect their observations with Newton's first law of motion. This law states that an object will not change its motion unless it is acted on by an external force. This means that a balanced mobile will be at rest as long as no additional forces are acting on its structure.

Specification Question



“What additional forces cause the mobile to move?”

The answer is that the air causes it to move. When air moves, it pushes on the objects hanging from the mobile. This creates a ripple effect throughout the whole mobile structure because all of its pieces are connected. Thus, to balance out the external forces, the whole mobile structure moves until the forces acting on it are balanced out again.

Evaluation

Ask students to choose randomly 5 of their classmates and play a game of tug-of-war. Since those 5 students won't be equal in size or strength, ask the students:



“How do you think that this game can result even and how do you think this is a fair way to split up teams? Explain your answer.”

End of the activity

EXIT