

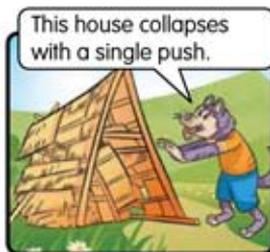
# UNIT 12

## STABILITY AND STRENGTH

Once, there were three kids that lived in a village. The kids built their own houses for shelter.



One day, a bad wolf came to destroy their houses.



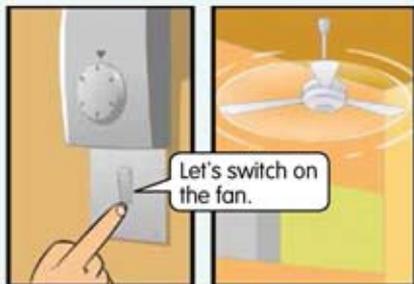
Eventually, the wolf left. Now, all the kids live together in the house of the youngest kid.

Why is a stable and strong structure important?



## Stability of Objects and Structures

Adam and Raju are playing with building blocks.



What is meant by the stability of objects and structures?

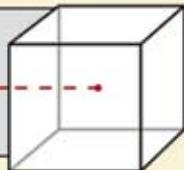


The stability of objects and structures is the ability of the objects and structures to remain stable, or for the objects and structures to return to their original positions.

### SCIENCE INFO

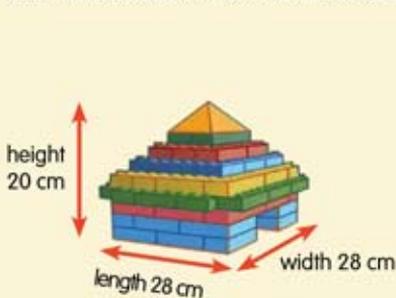
The centre of gravity is the point located at a certain height in the middle of an object. The lower the centre of gravity of an object, the more stable it is.

centre of gravity



## Factors Affecting the Stability of Objects and Structures

A stable structure does not collapse when a movement or a force is applied to it. Let us observe the structures built by Adam and Raju.

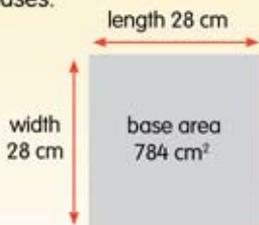


Adam's structure

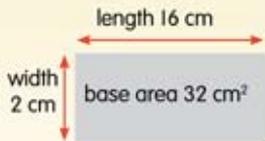


Raju's structure

The structure built by Raju is taller than the structure built by Adam. Height is a factor that affects the stability of objects and structures. As the height of an object and structure increases, the stability of the object and structure decreases.



the base area of Adam's structure



the base area of Raju's structure

Observe the pictures above. The base area of Adam's structure is bigger than the base area of Raju's structure. Base area is also a factor that affects stability of objects and structures. As the base area of an object and structure increases, the stability of the object and structure also increases.



Based on your understanding, what is meant by the stability of objects and structures? Explain the factors that affect the stability of objects and structures.

The factors affecting the stability of objects and structures are height and base area. Plan and carry out the experiments to test these factors.



## EXPERIMENT

# Height of Structures and Objects



Does a structure become more stable or less stable if its height increases?

Let's test the height of an object to determine its stability.



1. **Aim:** \_\_\_\_\_
2. **Problem Statement:** Does a structure become more stable or less stable if its height increases?
3. **Hypothesis:** \_\_\_\_\_
4. **Variables:**  
(a) manipulated: \_\_\_\_\_  
(b) responding: \_\_\_\_\_  
(c) constant: \_\_\_\_\_
5. **Apparatus and materials:**  
12 paper cups, cardboard, stopwatch

6. **Steps:**

- Put a cardboard on a table.
- Arrange the paper cups on a cardboard.
- Move the cardboard front and back repeatedly.
- Record the time taken when any of the paper cups begin to fall.
- Record your observation in a table.
- Repeat steps 6(a) to 6(e) by increasing the structural height of the paper cups.

7. **Data:** \_\_\_\_\_

8. **Interpreting Data:**

- Which model structure is more stable? Why?
- What is the relationship between the height of the model structure and its stability?

9. **Conclusion:** \_\_\_\_\_



**EXPERIMENT**

## Base Area of Structures and Objects



Does a small base area increase or decrease the stability of a structure?

Let's test the base area of a structure as a factor to determine its stability.



1. **Aim:** \_\_\_\_\_

2. **Problem Statement:** Does the stability of a structure increase or decrease if its base area decreases?

3. **Hypothesis:** \_\_\_\_\_

4. **Variables:**

(a) manipulated: \_\_\_\_\_

(b) responding: \_\_\_\_\_

(c) constant: \_\_\_\_\_

5. **Apparatus and materials:**

15 cans of the same size, cardboard, stopwatch, adhesive tape

6. **Steps:**

\_\_\_\_\_

7. **Data:** \_\_\_\_\_

8. **Interpreting Data:**

(a) Which model structure is more stable? Why?

(b) What is the relationship between the base area of the model structure and its stability?

9. **Conclusion:**

\_\_\_\_\_

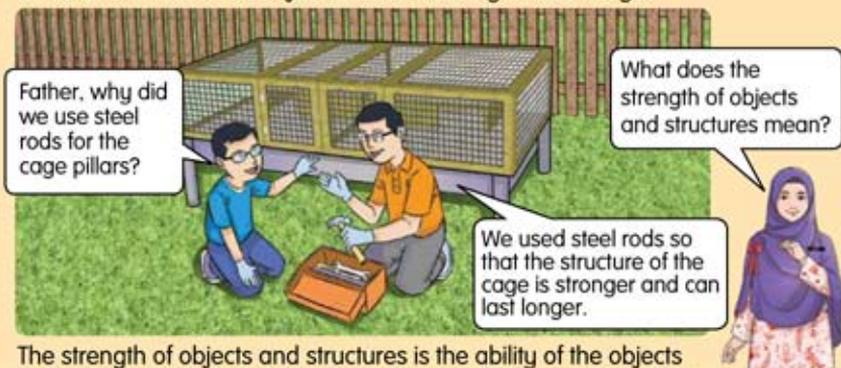
### SCIENCE INFO

Giraffes spread their front legs to make themselves stable while drinking water. This action increases their base area and lowers their height.



## Strength of Objects and Structures

Chua and his father have just finished building a rabbit cage.



The strength of objects and structures is the ability of the objects and structures to withstand a force that could damage or change their structural shapes.



What are the types of materials used to ensure the strength of built structures?

## Factors Affecting the Strength of Objects and Structures

Structures such as buildings are built using various types of materials such as concrete, steel, plastic, and wood to ensure their structural strength. Different materials have different strength.

Plastic is a material that is light and easy to shape.

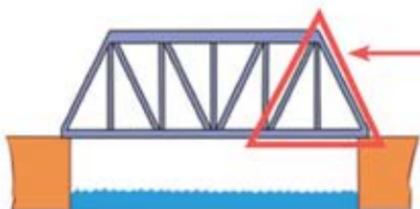
Concrete is a material that is strong, not flammable, and does not rust or rot.

Steel is a strong and durable metal.

Wood is strong, hard, and easy to cut according to size.

Observe the shapes of the objects and structures below. The shapes of objects and structures also affect their strength.

The shape of the truss is a series of poles that forms triangles. They can withstand heavy loads.



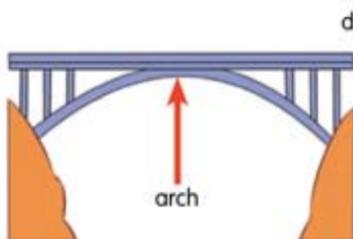
truss



The combination of several trusses in building a bridge makes the bridge stronger.

The combination of several trusses in building the roof of a house makes the roof stronger.

The arch is an example of curved structure that is used to support loads.



dome-shaped



The arch used on a bridge makes the bridge stronger and able to support loads.

The hemispherical shape of the dome makes it strong and does not require pillars for support. This structure is often used in building the roof of a stadium.

Based on your understanding, what is meant by the strength of objects and structures? Explain the factors that affect the strength of objects and structures.



Factors affecting the strength of objects and structures are the type of material and the shape of the structure. Plan and carry out the experiments to test these factors.



## EXPERIMENT

## Types of Building Materials



Does the type of material affect the strength of a model structure?



I have three types of drinking straws made from three different materials. Let's test which material is the strongest.



1. **Aim:** \_\_\_\_\_
2. **Problem statement:** Does the type of material affect the strength of an object?
3. **Hypothesis:** \_\_\_\_\_
4. **Variables:**
  - (a) manipulated: \_\_\_\_\_
  - (b) responding: \_\_\_\_\_
  - (c) constant: \_\_\_\_\_
5. **Apparatus and materials:** tripod stand, paper straw, plastic straw, steel straw, 10 units of 10 g weight
6. **Steps:**  
\_\_\_\_\_

7. **Data:** \_\_\_\_\_

8. **Interpreting Data:**

- (a) What can you observe? Give your reasons.  
(b) What is the relationship between the type of material and the strength of the object?

9. **Conclusion:** \_\_\_\_\_



## EXPERIMENT

## Shapes of the Built Structure

 Be careful when using scissors.



1. **Aim:** \_\_\_\_\_

2. **Problem statement:** Does shape affect the strength of objects and structures?

3. **Hypothesis:** \_\_\_\_\_

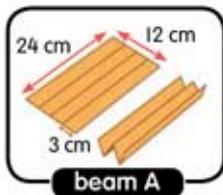
4. **Variables:**

- (a) manipulated: \_\_\_\_\_  
(b) responding: \_\_\_\_\_  
(c) constant: \_\_\_\_\_

5. **Apparatus and materials:** ruler, scissors, two desks, weight sets, manila card, adhesive tape, thread

## 6. Steps:

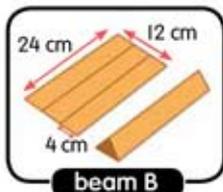
(a) Building beams for the structures.



**beam A**

### Structure of beam A:

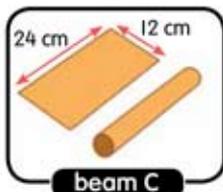
- Cut a manila card with the measurement of 24 cm x 12 cm.
- Draw four lines of 3 cm each on the manila card.
- Fold the manila card as in the picture on the left.
- Paste the folded part of the manila card using adhesive tape.



**beam B**

### Structure of beam B:

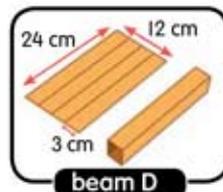
- Cut a manila card with the measurement of 24 cm x 12 cm.
- Draw three lines of 4 cm each on the manila card.
- Fold the manila card to form a triangular beam.
- Paste both ends of the manila card using adhesive tape.



**beam C**

### Structure of beam C:

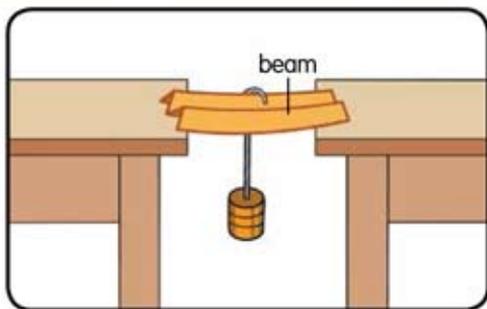
- Cut a manila card with the measurement of 24 cm x 12 cm.
- Roll the manila card to form a cylindrical beam.
- Paste both ends of the manila card using adhesive tape.



**beam D**

### Structure of beam D:

- Cut a manila card with the measurement of 24 cm x 12 cm.
- Draw four lines of 3 cm each on the manila card.
- Fold the manila card to form a cuboid beam.
- Paste both ends of the manila card using adhesive tape.



- (b) Put beam A horizontally between two desks.
- (c) Hang the hook to beam A.
- (d) Place the weight onto the hook. Add more weights until a change occurs to the beam.
- (e) Record your observations in a table.
- (f) Repeat steps 6(b) to 6(e) using beams B, C and D.

7. **Data:** \_\_\_\_\_

8. **Interpreting Data:**

- (a) What can you observe? Give your reasons.
- (b) What is the relationship between the shape of a structure and its strength?

9. **Conclusion:** \_\_\_\_\_

## SCIENCE INFO

Lighthouses are built on high areas or in the middle of the sea to help sailors to sail safely. They also help ships to dock at night. The cylindrical structure of a lighthouse enables it to reduce wind resistance. Cylindrical shape is a structural shape that is strong, durable, and does not damage easily.





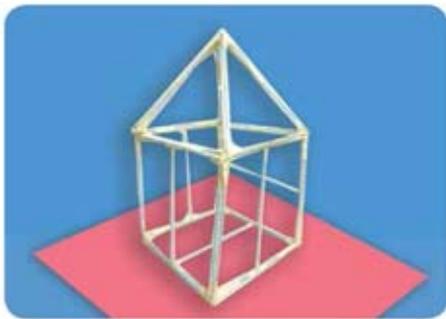
## LET'S TEST

# Stable and Strong

**Aim:** To define operationally the strength and the stability of structures



**Apparatus and materials:** straws, adhesive tape, A3-sized cardboard



example of built structure

### Steps:

1. Discuss the structure to be built by taking into consideration the factors for stability and strength.
2. Put an A3-sized cardboard on a table.
3. Build a structure using straws and adhesive tape on the A3-sized cardboard.
4. Discuss in your group the best method to test the stability and strength of the built structure.
5. Compare your group's structure with the structures built by the other groups.
6. Discuss the result of your observation in the class.

### Questions:

1. Which structure is the strongest and the most stable?
2. What is the operational definition of the stability of objects and structures?
3. What is the operational definition of the strength of objects and structures?

# The Importance of Strong and Stable Structures

Strong and stable structures are durable and sturdy.

Why are strong and stable structures important to ensure a sustainable life?



Let us observe the situations below.

## Situation 1

25 February 2010

This is the wooden bridge to my village.



25 February 2021

This wooden bridge cannot be used anymore.



## Situation 2

25 February 2010

This is the newly built steel bridge to my village.



This is the steel bridge to my village. It still remains sturdy to this day.

25 February 2021



Strong and stable structures are not easily damaged, can save maintenance cost, and are safe to be used. These structures can be used for a long time.

## Creating a Model Structure: Bottle Chair



I have collected many plastic bottles for recycling.



I suggest that all the plastic bottles to be reused by making a bottle chair that is strong and stable. Let's create the bottle chair together.

**Apparatus and materials:** scissors, 18 plastic bottles of the same size with their caps, wide adhesive tape, used towels, ribbons, cloth

### Steps:

1. Sketch the bottle chair to be built.

 Be careful when using scissors.



Cut the upper part of a bottle.



Insert the cut bottle into the upper part of an uncut bottle.



Attach the combined bottle parts using wide adhesive tape. Repeat steps 2 to 4 for the remaining bottles.



Group all the combined bottle parts. Attach them using wide adhesive tape.



Cover the top part of the combined bottles using used towels.

7. Decorate the bottle chair using cloths and ribbons.



Based on your understanding, create a model structure that is strong and stable using recycled materials. Explain the reasons for selecting those materials.



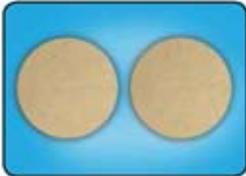
bottle chair



Using your creativity, make a basket using a pair of scissors, hot glue gun, used box, used cloth, and coir rope.

**Steps:**

Be careful when using scissors and hot glue guns.

- 

1. Make two circles to form the base of a basket using a used box.
- 

2. Paste both circles using a hot glue gun.
- 

3. Cut a piece of cloth following the shape of the base. Paste the cloth to one part of the base that will be used as an inner base of the basket.
- 

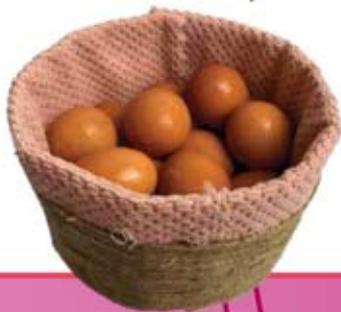
4. Cut the box to form the wall of the basket. Paste the cloth around the basket's wall.
- 

5. Paste the base and the wall together until the shape of the basket is formed.
- 

6. Decorate the basket by wrapping and pasting a coir rope around the outer part of the basket.



box basket





## MIND REFLECTION >>>

### Stability of Objects and Structures

1. The stability of objects and structures is the ability of the objects and structures to remain stable, or for the objects and structures to return to their original positions.
2. Factors affecting the stability of objects and structures are as follows:
  - height
  - base area
3. As the height of an object and structure decreases, the stability of the object and structure increases.
4. As the base area of an object and structure increases, the stability of the object and structure also increases.

### Strength of Objects and Structures

1. The strength of objects and structures is the ability of the objects and structures to withstand a force that could damage or change their structural shapes.
2. Factors affecting the strength of objects and structures are as follows:
  - type of material
  - shape of a structure
3. Different building materials have different strength. Some of the building materials are as follows:
  - Concrete is a material that is strong, not flammable, and does not rust or rot.
  - Steel is a strong and durable metal.
  - Plastic is a material that is light and easy to shape.
  - Wood is strong, hard, and easy to cut according to size.
4. Structures with the shape of trusses, arches, and domes are examples of strong structures.
5. The importance of strong and stable structures to ensure a sustainable life are as follows:
  - not easily damaged
  - save maintenance cost
  - the structure is safe to be used
  - the structure can be used for a long time



## MIND TEST

Answer all questions in the Science exercise book.

1. Observe flowerpots A and B below. Which flowerpot is more stable? Explain your answer.

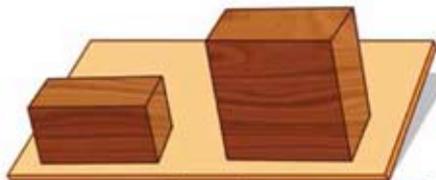


flowerpot A



flowerpot B

2. State the meaning of the:  
(a) stability of objects and structures.  
(b) strength of objects and structures.
3. State the factors affecting the stability and strength of objects and structures.
4. A group of pupils carried out an activity to test the stability of wooden blocks A and B. The blocks were placed on a thin wooden board that was tilted slowly as shown in the picture.



wooden block A

wooden block B

- (a) Which of the wooden block, A or B, will fall first?
  - (b) Give an inference for your observation in 4(a).
  - (c) Suggest one way to make the wooden block stable.
  - (d) What conclusion can you make for this activity?
5. Summarise the importance of strong and stable structures to ensure a sustainable life.