Vision Empower & XRCVC

Teacher Instruction KIT

Motion and Time

Syllabus: NCERT
Subject: Science
Grade: 7
Textbook Name: NCERT- Science Textbook for class VII
Chapter Number & Name: 13. Motion and Time

1. OVERVIEW

1.1 OBJECTIVES AND PREREQUISITES

Objective

- To define speed.
- To calculate speed using its formula and state the units
- To study the technique of measuring time using periodic movements.
- To represent motion of objects in a distance-time graph.
- To study the motion of objects using distance time graph

Prerequisite Concept

- Types of motion, Grade 6 – chapter 10; Motion and Measurement of Distance
- Measure distance and length Grade 6 –chapter 10; Motion and Measurement of Distance
- Conversion of km to m and hours to seconds, Grade 6- chapter 10; Motion and Measurement of Distance

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*Kindly Note: Activities marked with * are mandatory*

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2. LEARN

2.1 KEY POINTS

Types of motion: Motion can be of three types- along a straight line, circular or periodic. For e.g.: car on a straight road, movement of the earth, swing respectively.
Slow or fast motion: Some vehicles move fast while some move slowly. A vehicle moving fast takes lesser time to cover certain distance compared to the slow vehicle
Speed -The distance covered by an object in a unit time is called speed. If a car is said to move at 50 km/h, it means that it will cover 50 km distance in one hour.
Average speed – If the vehicle is not moving at a constant speed, then the average speed is calculated using the formula $= \frac{\text{Total distance covered}}{\text{Total time taken}}$

Uniform and non-uniform motion-

If the speed of an object moving along a straight line keeps changing, its motion is said to be non-uniform motion.

An object, moving along a straight line with a constant speed is said to be in uniform motion. In this case, the average speed is the same as the actual speed.

Measurement of time -watches and clocks are the common devices used to measure the time. In ancient times, people used to measure time based on periodic motions in nature. For example, the time interval between one sunrise and the next was called a day. A year was the time taken for one revolution of the earth. Sundials, sand clock and water clock were some of the devices used to measure time.

Simple Pendulum

A simple pendulum consists of a small metal ball called bob which is suspended by a long thread from rigid support. The to and fro motion of a simple pendulum is an example of periodic or oscillatory motion.

The pendulum completes one oscillation when its bob moves from one extreme position to the other extreme position and comes back to origin. So, the time taken by the pendulum to complete one oscillation is called its time period. The time period of a pendulum depends on its length. Galileo was the first person to study the motion of a pendulum. He found that a pendulum of a given length takes the same time to complete one oscillation.

Units of Time and speed

Second is the basic unit (or standard unit) of measuring time and it is represented by symbol s. The larger units of time are minute and hour. The unit of time is used based on the events.

Speed is distance / time therefore, the basic unit of speed is m/s. Km/h or m/min. cm/s are other units of speed.

Calculating distance- If we know the speed of an object, we can calculate the distance covered in a certain time by using the formula.

Distance covered =Speed x time taken

Speedometer and Odometer

The speedometer is an instrument on a vehicle's dashboard which indicates the speed of the vehicle when it is moving. The speed is indicated in **kilometers per hour**.

An instrument which is used for measuring the **distance** travelled by a vehicle is known as an odometer. This instrument measures the distance in **kilometres.**

Graphical Representation of Motion

By drawing the distance-time graph, the motion of an object can be represented in diagram form. A distance-time graph represents how the distance travelled by a moving object changes with time.

Bar graph and pie chart

A bar graph represents data using a series of bars (thin rectangles) across two axes.

Pie charts are circular graphs that display percentages of a whole as if they were slices of a pie. The whole circle represents 100%

2.2 LEARN MORE
None

3. ENGAGE

3.1 INTEREST GENERATION ACTIVITY

Interest generation activity

Activity 1: Types of motion

Materials Required: None

Prerequisites: None

Activity Flow

- Divide the students in a group.
- Ask the students to stand one behind the other and place their hands on the shoulder of the student in front of them.
- Tell the first student to lead others by marching forward by 10 steps.
- Now ask the students to hold hands and form a circle. Tell them to move in the circle (play music if available)
- Ask the students to stand in a straight line and swing the right arm shoulder level and straight down.
- Lead the discussion so that the students recall the motion in a straight line, circular motion and oscillatory motion. Elicit more examples related to the three types of motion from everyday life like motion of a car in a straight road, motion of earth, the motion of the swing**.**

3.2 CONCEPT INTRODUCTION ACTIVITIES

Slow or Fast

Activity 2: Slow or fast

Materials Required: Toy models of car, auto, bullock cart, and a walking man / tactile diagram showing the motion of some vehicles.

Prerequisites: None

Activity Flow

- Let all the models be arranged in a straight line.
- Ask the students to imagine that the vehicles start moving at the same time. Now let them arrange the models to show the position of each based on their speed.

- The expected arrangement would be car at the farthest point from the origin and man at the nearest point
- Let them explain the reason for arranging the vehicles in that order. They may answer that the car moves faster than the man.
- While leading the discussion, explain that the distance moved by the objects in a same amount of time can help us decide which one is faster or slower.
- The faster vehicle has higher speed. For example, in a 100 m race, the student with the highest speed will cover the specified distance in the shortest time.
- Elicit more examples of fast- and slow-moving objects from everyday life.(speed of rocket , speed of tortoise)

Speed

Activity 3: Speed

Materials Required: data of distance covered and time taken by the cars A and B.
Prerequisites: None

Activity Flow

- Ask the student to guess from the given data as which car is faster. To find that we have to compare the distance travelled by both the cars in unit time.
- The distance covered by the object in a unit time is called speed.
- If a car moves with 50 km/h, it indicates that it covers 50 km in one hour.
- For uniform and non uniform motion, give them the following example- a car or cycle which is moving at a steady speed (uniform motion) and a bus which keeps stopping and starting on the way to pick up / drop passengers(non uniform motion).
- Speed is calculated using the formula, Speed = $\frac{\text{Total distance covered}}{\text{Total time taken}}$
- Help the students calculate the speed of car A and B by using the data of distance covered and time taken.
- The speed calculated is the **average speed**. The average speed of an object with uniform motion is the same as actual speed.

Measurement of Time

Activity 4: Measurement of time

Materials Required: Tactile models of pendulum clock, table clock, digital clock, and calendar.
Prerequisites: Knowledge to read time

Activity Flow

- Ask the students how they are on time for the class. Lead the discussion to bring out the devices used to tell time.
- While discussing the devices used for telling the time and date, explain that ancestors noticed periodic events in nature like the rising of sun, moon etc. Based on these they defined day, month, year etc.
- Let the students try to read the time in the tactile models and identify the pendulum clock, digital, and table clock.
- Tell the students that these clocks work on some periodic motion like the motion of a pendulum.

Activity 5: Time period of oscillation

Materials Required: rigid stand, thread, metal ball/ stone, tactile diagram showing different position of the bob of an oscillating simple pendulum

Prerequisites: None

Activity Flow

- Let the students feel the simple pendulum. Explain that the simple pendulum is made of a metal ball or stone suspended from a rigid stand.
- Ask the students to move the simple pendulum and comprehend the oscillatory motion. Tell them it is similar to the to and fro motion of a swing.
- With the help of a tactile diagram, explain the terms oscillation, end points, mean position and time period etc. Mark the end points as A and B and mean position as O. Tell them that when the bob moves from one extreme position A to another extreme position B and comes back to the original position it completes one oscillation.
- Ask the students if the bob moves from the mean position O to position A, to B and back to O, can it be called as one oscillation.
- The time taken to complete one oscillation is called time period.
- Now gently set the bob in motion. Tell the students that the teacher will indicate the completion of each oscillation with a sound. Ask them to count till 20 oscillations. Let them note the time taken for 20 oscillations using a braille clock or the teacher can give them the time taken using a stop clock or a wrist watch.
- By dividing the time taken for 20 oscillations by 20, we can calculate the time taken for one oscillation. This is the time period of the pendulum.
- The process can be repeated a few more times. Ask the students to study the time period obtained in all the cases. They will note that the time period remains the same in all the repetitions.
- Inform them that these days quartz is used to give a more accurate time.

Units of Time and Speed

Activity 6: Units of time and speed

Materials Required: Models of sand clock, water clock, sun dial
Prerequisites: None

Activity Flow

- Ask the students' questions like their age, the duration of the class, time taken to reach school and the time taken for the earth to complete one revolution.
- Based on the answers, lead the discussion to emphasize that different units like days, year, hours, minutes, seconds are used depending on the need.
- The basic unit of time is second.
- To understand the duration of one second, ask the students to say aloud 'two thousand and one'. This is approximately one second.
- Ask them to hold the wrist of their left hand with their right hand and feel for the pulse. Let them count 72 beats, this gives a duration of approximately one minute.
- Smaller units like microsecond (one millionth of a second) and nanosecond (one billionth of a second) are used for scientific research while times of historical events are stated in centuries and millennium.
- With the help of models of sand clock, water clock and sundials, explain how these devices were used to measure time before pendulum clocks became popular.
- The basic unit of speed is m/s because speed is given as distance/ time.
- The other units used for expressing speed are m/min, km/h

NOTE: The symbols of units are always written in singular**.**

Activity 7: Calculating speed
Materials Required: Marble, adapted meter stick, ruler with a groove for marble to roll in, stopwatch, several books
Prerequisites: None

Activity Flow

- Place 2 books on one end of a table /desk and place the grooved ruler leaning on the books.
- Place one book and a metal strip at the end of the table to stop the marble. Students can hear the sound when the marble hits the desk after rolling on the ruler. If a metal piece is kept in front of the book at the end of the table, the sound of marble hitting the metal piece can be taken as the end point.
- Measure the distance from the end of the ruler to the book at the other end of the desk.
- With a help of a stopwatch, note the time taken for the marble to reach the end of the table.
- Speed of the marble can be calculated using the formula

  Speed = distance / time

- Repeat two more times. Calculate the average speed.
- The activity can be repeated using 4 books instead of 2. (Note: each group can conduct this activity with a different number of books.)
- Speed can be calculated in cm/ min in this case.

Measuring speed

Activity 8: Measuring speed

Materials Required: Tactile models of speedometer and odometer
Prerequisites: None

Activity Flow

- Ask questions to help the students recall that 1 km =1000m and 1 hour = 3600s.
- Therefore, the speed can be converted from km/h to m/s

  For e.g., 56 km/h= $\frac{56 \times 1000}{60 \times 60}$ m/s

  $= 56 \times 5/18$ m/s

- Help the student calculate the speed of animals in m/ s from the following data:
  - Falcon: 320km/hr
  - Cheetah: 112km/hr
  - Rabbit: 56km/hr
  - Squirrel: 19km/hr
  - Human: 40km/hr
  - Snail: 0.05km/hr
- Ask the students whether one can find how fast the rocket with a speed of 8m/s is when compared to a tortoise with the speed 8cm/s.
- Tell them that it is possible to find the distance covered by both in a given time using the formula
- Distance travelled =speed x time taken
- Lead the discussion to help the students comprehend that time taken can also be calculated using the formula

  Time taken = speed x distance
- With the help of tactile models, explain that Speedometer is the device which records the speed in km/h and **odometer** measures the distance in km. These devices are placed on the dash boards of vehicles like cars, buses, etc.

Distance-Time Graph

Activity 9: Distance-time graph

Materials Required: Tactile diagram of bar graph, pie chart and graph, tactile graph with elevated grids.

Prerequisites: None

Activity Flow

- Ask the students to visualise how a pizza is sliced. Do they get the whole pizza or a portion? Each portion is a part of the pizza. Pie charts are circular graphs that display percentages of a whole as if they were slices of a pie. The full circle represents 100%.
- A bar graph is another form of graph representing data using a series of bars (thin rectangles) across two axes.
- A line graph is drawn between two perpendicular lines-horizontal line XOX' known as the x-axis and vertical line YOY' known as the Y-axis The two lines intersect at O. Let the students identify these in the tactile diagram.
- The two quantities are represented along the axes. Since the positive values will be taken, only the OX and OY portion will be used in the distance time graph.
- Tell the students that they will study the distance time line graph.
- The time is represented by the x axis and distance by y axis. First a scale has to be decided; 1 cm on the axis represents a particular value.
- To mark the data (table 13.6), the scale can be taken as
  X axis Time 1 min=1 cm
  Y axis Distance 1km = 1cm
- Mark the points as 1 min, 2 min, 3min ……. on X axis and 1km,2km,3km……. on Y axis.
- The first value being 0, 0 it is marked at the origin. The car has moved through a distance of 1 km in 1 min. From 1 min point on X axis a line parallel y axis is drawn. Then draw a line parallel to X axis from the point corresponding to 1 km on Y axis. The point where these two lines intersect represents the set of values.
- Similarly, all the sets are marked. If the points are joined it is a straight line showing the motion of the car. If the distance-time graph is a straight line, it indicates that the object is moving with constant speed.
- Ask the students what type of graph they will expect if the object is not moving with constant speed.

Activity 10: Advantages of distance-time graph over the table data
Materials Required: Tactile graph showing the motion of a bus based on table 13.5
Prerequisites: None

Activity Flow

- Ask the students to touch the tactile graph. Ask them to identify the shape of the graph. Is it a straight-line graph? What type of motion does this graph indicate?
- Tell them that the scale taken here is different from the previous graph.
- Here the scale is y axis 1 cm=10 km and x axis 1 cm =15min

- Emphasize that to choose the scale of the graph the following factors have to be considered
  a) Difference between the highest value and the lowest value of each quantity
  b) The intermediate values of each quantity, so that with the scale chosen it is convenient to mark the values on the graph
  c) To utilise the maximum part of the graph paper given.
- The table gives the information about the distance travelled by the bus at definite time intervals but from the distance time graph, the distance moved by the bus at any instant can be calculated.
- If we have to calculate the distance covered at 8:15 am, draw a line from that point (A) parallel to the y-axis to meet the graph. Let the point be T. From T, draw a line parallel to the x axis. This intersects y axis at point B. The length of OB gives the distance covered by the bus at 8:15 am. Explain this with the help of a tactile graph.

3.3 LET'S DISCUSS: RELATE TO DAILY LIFE*

- Ask the students how they go to school? Which will be faster- going to school by walk, cycle or bus? Why? Lead the discussion to bring out the difference in the speed in each case. The distance from their house to school will be the same but the time taken will be different in each case.
- Also, the time taken by their friends to reach school may be different. Ask them to calculate the speed and compare.

4. EXERCISES & REINFORCEMENT

4.1 EXERCISES & REINFORCEMENT

Reinforcement

Activity 11: Story –Galileo and the lamp

Materials Required: None

Prerequisites: None

Activity Flow

Read the story: Galileo and the lamp

In Italy about three hundred years ago there lived a young man whose name was Galileo. Like Archimedes he was always thinking and always asking the reasons for things. He invented the thermometer and simple forms of the telescope and the microscope. He made many important discoveries in science.

One evening when he was only eighteen years old he was in the cathedral at Pisa at about the time the lamps were lit. The lamps—which burned only oil in those days—were hung by long rods from the ceiling. When the lamplighter knocked against them, or the wind blew through the cathedral, they would swing back and forth like pendulums. Galileo noticed this. Then he began to study them more closely.

He saw that those which were hung on rods of the same length swung back and forth, or vibrated, in the same length of time. Those that were on the shorter rods vibrated much faster than those on the longer rods. As Galileo watched them swinging to and fro he became much interested. Millions of people had seen lamps moving in this same way, but not one had ever thought of discovering any useful fact connected with the phenomenon.

When Galileo went to his room he began to experiment. He took a number of cords of different lengths and hung them from the ceiling. To the free end of each cord he fastened a weight. Then he set all to swinging back and forth, like the lamps in the cathedral. Each cord was a pendulum, just as each rod had been.

He found after long study that when a cord was 39 1/10 inches long, it vibrated just sixty times in a minute. A cord one fourth as long vibrated just twice as fast, or once every half second. To vibrate three times as fast, or once in every third part of a second, the cord had to be only one ninth of 39 1/10 inches in length. By experimenting in various ways Galileo at last discovered how to attach pendulums to timepieces as we have them now.

Thus, to the swinging lamps in the cathedral, and to Galileo's habit of thinking and inquiring, the world owes one of the commonest and most useful of inventions, —the pendulum clock.

You can make a pendulum for yourself with a cord and a weight of any kind. You can experiment with it if you wish; and perhaps you can find out how long a pendulum must be to vibrate once in two seconds.

4.2 IMPORTANT GUIDELINES*

Exercise Reading

It is very important that the children practice their learnings as well as their reading. Hence have the children read out the newly learned concepts from their textbooks or other available resources.

Perform Textbook Activity

It is good practice to have the children perform the textbook activities. Your textbook activities might not be accessible hence go through this resource to learn how to make textbook content accessible

Provide Homework

To evaluate their understanding and to help the student revise and implement the new learnt concept ensure to provide them with homework. Students should perform one or two of the questions mentioned above or from the textbook exercises with the teacher in

Class and the remaining may be given for homework. Also, ensure that the student knows their special skills linked to independently using their accessible books as it will be critical to doing homework independently

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