Exploring Science

An activity based approach

Teacher's Guide 7

Kavita Krishna

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Teacher's Guide for Class 7

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Preface

Exploring Science is a set of books and workbooks for classes six and seven which have emerged out of a science programme initiated at the Rishi Valley Rural Education Centre. Until then, like in most other schools in India, science teaching had been confined to the classroom with the blackboard and the textbook being the only available resources. In 2007, we began the process of changing this.

Our aim was to create a more relevant and engaging approach to learning science in the middle school. We wanted to shift the focus of learning science from rote memorisation to a meaningful and contextually-relevant approach. We wanted to communicate that science was not merely a collection of facts to be learnt, but an exciting way of studying and understanding the natural world.

This process took several years. Writing child-friendly material in Telugu, illustrating it, testing it in the classroom, incorporating teachers' and students' feedback, and training rural teachers was a demanding yet an exciting venture.

Many of the features of this series evolved in response to the realities of teaching first-generation learners in a rural classroom. One of the issues that we had to address early on was the inability of most students to read and comprehend science texts. This led us to embed literacy instruction into the science classroom.Through exercises in the workbooks, helpful illustrations and scaffolded vocabulary activities, the material develops a student's facility with academic language at an age-appropriate level.

Another feature of the series is the emphasis on developing the skills essential to doing science. The questions and exercises in the accompanying workbooks guide students in observing, recording, inferring, reading and writing.

One of the aims of this programme is to help students apply what they have learnt in the contexts of their own lives and communities. There is a focus on deepening students' connection with their natural surroundings and appreciating the the science of everyday things. Activities engage students with local environmental issues and solutions.

The Telugu material that we used in the rural school was in the form of booklets and accompanying worksheets for each unit. This version in English is a compilation of that material into a set of textbooks and workbooks. Parts of these have been used successfully in the Rishi Valley School since 2008. We hope you enjoy using them as much as we have enjoyed creating them!

Although I have tried to weed out all errors, some would have inadvertently remained. Please do let me know about those that come to your notice. I would be grateful for your suggestions and feedback for improving these books.

Kavita Krishna Rishi Valley April, 2015

How to use these books

Exploring Science takes an activity-based approach to learning science. Students learn from first-hand experiences in their local environment. They develop the skills of systematic observation and analysis, using easily available material. There is a textbook and accompanying workbook for Class 6 and Class 7.

This teacher's guide provides suggestions and tips to help you in using *Exploring Science* effectively. It is meant to supplement your own experience as a teacher.

Using the textbook

The units in each textbook are divided into two levels. Units are organized so that there is a gradual increase in complexity, both in content as well as in skills at each of the four levels in classes 6 and 7. Each unit contains a series of numbered activities and texts. The contents of each unit are listed at the beginning of the unit. Students can use the contents to track their progress through the unit.

This logo in the contents indicates activities, which are difficult or impractical for students to do on their own, and need to be demonstrated by the teacher. The teacher would also need to discuss or review some concepts with the whole class. This logo in the contents indicates such activities.

This logo indicates several types of activities - experiments, field observations, making models or playing games. Students can follow the instructions and work together in small groups to do these activities. The exercises in the accompanying worksheets guide students in observing and recording. You may need to support them whenever necessary.

This logo indicates texts which are to be read independently by students. The texts are related to the activities and explain concepts and their applications. The exercises in the worksheets support students in reading and comprehending what they read.

Review questions at the end of each unit help students to consolidate what they have learnt. Students should answer these questions independently. They can refer to the textbook as well as their own workbooks as they do this.

Using the workbook

The workbook contains numbered worksheets which students can complete as they do the activities given in the textbook.

The exercises in the workbook have several purposes:

- To guide the student in observing, recording and inferring.
- To guide the student in reading and comprehending science texts.
- To develop the student's writing and drawing skills.
- To continuously assess the student's progress.
- To provide prompt feedback to the student.

The activities in this series expect independent observation and inference by students. This needs to be supported by classroom discussion which can be done before, during or after an activity. Suggestions for classroom discussions are given in the teacher's guide based on our own experience in using these materials.

Using the teacher's guide

The teacher's guide is designed to support you as you teach these units as well as to clarify the purpose of each unit. The teaching notes could be used while preparing to teach a unit. The teaching notes for each unit include:

- **An introduction** which outlines the aims of the unit, how it is linked to other units and indicates the amount of classroom time the unit would take to complete.
- **The objectives** of the unit, which give specific details of what students are expected to learn from the activities. These objectives are intended to help you assess the progress of your students as well as the effectiveness of the material and your teaching.
- **The new vocabulary** that is introduced in the unit.
- **The material required** in the classroom for students to do the activities as well as for you to conduct demonstrations.
- **A lesson plan** which shows the order of the activities and describes the purpose of each activity. The material needed for each activity as well as suggestions for ways in which a teacher may need to support students are also indicated in the lesson plan.
- **Suggestions** for conducting a discussion or demonstration.
- **Ideas for projects** and activities related to this unit which students can do.

Additional assessment worksheets for each unit are included at the end of the teacher's guide which can be used as required.

Assessment

Continuous assessment and prompt feedback are an intrinsic part of this material. They help the teacher and the student identify gaps in learning and address them promptly.
There are several forms of assessment in this material:

- Classroom observation of students work by the teacher.
- Assessment and feedback during discussions.
- Worksheets which are corrected and marked regularly.
- Review questions which are done at the end of each unit.
- Assessment worksheets which can be done as tests.

Some questions and answers

Getting started

How long will it take to introduce these materials?

The materials embody ideas that may be new to many students and teachers. Students who are used to a more traditional way of learning science may find it challenging to work collaboratively in groups as well as independently. We have found that students adapt readily and enthusiastically to this approach with some support from the teacher. This may take a few weeks.

Teachers may find it challenging to manage the materials, time, space and students in an activity based classroom. With some planning and preparation, this approach works as smoothly as the traditional classroom. Some suggestions on how to prepare your classroom and students for this approach are given in this guide.

Isn't it a lot of extra work?

Any new approach in the classroom is extra work initially. Sourcing material, organizing the classroom, establishing classroom processes and orienting students can be demanding as you begin. Once the initial planning and organization is done, the work begins to go smoothly. We have found that once this approach is established, students learn more enthusiastically and more efficiently. This makes teaching easier and more satisfying.

Can't the teacher demonstrate all the experiments and activities to save time and trouble and material?

There are several reasons why it is essential that students do activities themselves as far as possible. The skills of handling equipment and material, observation, recording and inference which are so intrinsic to science, are developed only as students make their own mistakes and learn from them. Students are also motivated and enthusiastic when they do experiments and activities themselves. So even though it may seem 'easier' to demonstrate the experiments, an essential aspect of learning science is lost if students are not allowed to do the activities themselves.

Isn't it very expensive to provide material for all students?

Most of the material used in the activities are easily available and reusable. If you want to save further on cost, there are many local sources of free material that you can access. For example, the local health centre can be the source of used syringes, bottles and tubes. Old plastic bottles can be cut to make beakers. Discarded electrical appliances can provide wires.

Managing the classroom

We don't have a separate lab for science. How can we do these activities?

All the activities (except the ones that involve field work) can be done in the classroom.

Here are a few suggestions that can help you organize and manage activity based learning in your classroom:

- Timetable a 'block period' or two continuous periods for science. This ensures that students have adequate time to set up the classroom, do the activities and clear up afterwards.
- Plan where you will display material and how the furniture is to be arranged. This can help students work together effectively in groups as well as minimize unnecessary movement around the room.
- Keep equipment and materials ready in trays or boxes before class starts. This includes the material students will use and material that you may need for demonstrations and discussions.
- Enlist students' help and participation in setting up, managing and clearing up the classroom. You can allocate duties to students. For example, rearranging furniture, displaying equipment, clearing up at the end are all tasks that can be done by students.
- Ensure that students know who is responsible for collecting and returning material. Make sure that students know how to maintain material.

We have found, that with some planning and practice, our students are able to set up a 'lab' in the classroom in 5 to 10 minutes.

How do I manage so much material?

Since a variety of materials are used in an activity based approach, managing the material is critical to its success. Again, planning and preparation are essential. This includes organizing the material as well as training students in how to handle it. Here are some suggestions based on our experience:

- Have adequate material. Make sure that there is one set for each group of students.
- Organize the materials needed for a unit in one place. For example, each group of students can have a plastic tray with all the material needed for a unit. This can be collected at the beginning of the class by a student.
- Store all the material for related units in a box when they are not in use. For example, you could store all the material needed for the units on ‘Light’ together. This helps to locate and display material efficiently.
- Instruct students on how to collect and put back material in its right place. Ensure that they follow these instructions until it becomes a part of the classroom routine.
- Keep one or two students in charge of checking material at the end of class and ensuring that it is all in good order.
- Demonstrate the use of unfamiliar equipment to students. Make sure they know how to handle materials correctly and safely.
- Maintain a stock register of all materials. Take stock periodically (at the beginning of a term or year) so that you can procure things which are needed.

How do I manage students in an activity based classroom?

Establishing and maintaining order in an activity based classroom is essential so that students can work without disturbance or confusion. Following rules and processes can go a long way in creating a safe and productive classroom environment.

Here are a few suggestions:

- Discuss and communicate the rules of expected behaviour clearly. These could include rules like not running in the classroom, handling material carefully, remaining with your own group etc. It is useful to write these down and display them on a poster. This can be used to remind students of the rules whenever necessary.
- Be consistent in enforcing the rules especially at the beginning. This goes a long way in minimizing confusion and disorder.
- Many of the activities are designed to engage students in small group activities. If students are not accustomed to working in a group they may have to learn to share responsibilities, take turns and listen to each other. You can help students do this by giving clear instructions, helping them delegate tasks within a group, and showing them how to listen respectfully to others.
- You may have to organize the groups so that students work harmoniously.
- Move around the classroom while students are working and observe what they are doing. If there are doubts or problems that students seem to be having, clarify them to the whole class.
- Allow students to make mistakes and work with each other together to correct them.

Doesn't the class become very noisy?

When students are engaged in collaborative work, some level of noise in the class is to be expected. Students may need to be reminded to talk softly so as not to disturb others. They can be asked to move furniture or material quietly. Good classroom management can ensure that the noise remains at the low level characteristic of students engaged in purposeful and productive work.

Sequencing

Can I do the units in any order?

The units have been organized into four levels based on how the concepts in each unit relate to others. Students will need familiarity with the concepts in earlier units to understand the concepts in later units.

The relationship of a unit to others is mentioned in the introduction to the unit. If you choose to do the units in a different order, make sure your students are familiar with the concepts that are required to understand the unit.

Can I do activities within a unit in any order?

We have found that the correct sequencing of activities is very important in helping students develop an understanding of concepts. The initial activities in a unit introduce a new concept or set the context. The activities that follow develop the concept further. Later activities are usually for the consolidation or application of concepts. If you want to change the order in which you do the activities, refer to the objectives of each activity which are specified in the lesson plan. Notice the relationship between them. This can help you decide whether to change the order in which you do the activities.

Is it alright to modify the activities or introduce new ones?

These activities have been tested in the classroom and revised so that they 'work'. We recommend that you use them as they are until you feel confident that you have understood the purpose of the activity and where it fits into the lesson plan. Then you can use your creativity as well as suggestions from students to modify activities, develop them further or introduce new ones.

Meeting individual needs

How do I handle students who are very slow and lag behind the class?

One of the advantages of this approach is that students of different abilities can be supported. While the class is working on different activities you will have time to spend with the slower students. Certain activities and texts could also be made optional for students who are lagging behind. Since the purpose of each activity is clearly specified, you can choose those that you feel are essential. Many students who struggle with reading and writing are very competent at doing practical work or oral work. There are many activities in this material which such students would benefit from and enjoy.

What should students who finish ahead of the others in the class do?

There are several ideas in the 'Going Further' section of the teaching notes for additional activities. You can add ideas of your own. Here are some more suggestions for what students who need more challenge, can do in the classroom:

- Keep books, magazines and newspaper articles on topics related to science in the classroom. Students could read these and make a short presentation to their classmates.
- Collect or make puzzles or games related to the topic being studied. Crosswords, word searches and card games are simple examples. Students could also be asked to make these for their classmates to try.
- Provide paper and drawing material for students to create posters and charts on topics of interest to them.

Assessment and evaluation

Why are there worksheets for every activity and reading?

The exercises in the worksheets guide students in doing the activities as well as support them in reading and writing independently. The worksheets also provide a continuous record of a students progress. We have found that students are more engaged and focused when they have a worksheet as a tangible record of their work.

How often do I need to correct the worksheets?

Worksheets should be corrected frequently so that students get prompt feedback on their work. This also helps you become aware of potential misconceptions and difficulties that students have which are revealed in their written work. Ideally a worksheet should be corrected before a student begins on the next activity although this may not always be feasible.

Chemical Changes

Introduction

In this unit students learn about chemical changes. They are introduced to the difference between physical and chemical changes. They observe different chemical changes and learn how to recognize that a chemical change is taking place. They also learn about some commonly observed chemical changes like burning, rusting and the browning of vegetables.

This unit develops ideas introduced in "Solids, Liquids and Gases" and "Mixing and Separating". It lays the foundation for further work in "Acids and Bases", "Heat" and "Properties of Water".

This unit would take about 6 hours of class time.

Objectives

This unit will help students to:

- Differentiate between a chemical and a physical change.
- Give examples of physical changes.
- Recognize that a chemical change results in the formation of new substances.
- Recognize that a chemical change is taking place by observing changes in colour, formation of new substances, evolution of a gas etc.
- Give examples of fast and slow chemical changes.
- Write a word equation to describe a chemical change.
- Give examples of common chemical changes occurring in their surroundings.

New Vocabulary

Chemical change, physical change, word equation, chemical equation, rusting.

Materials Required

For each group of students: Test tube stand, test tubes, vinegar, baking soda, lemon juice, paper, stick, copper sulphate solution, plastic piece, iron nail.

For the teacher: Matchbox, paper, spirit lamp.

Lesson Plan

Discussion

T1 Introducing Changes

Task

Discussion to introduce physical and chemical changes.

Key learning

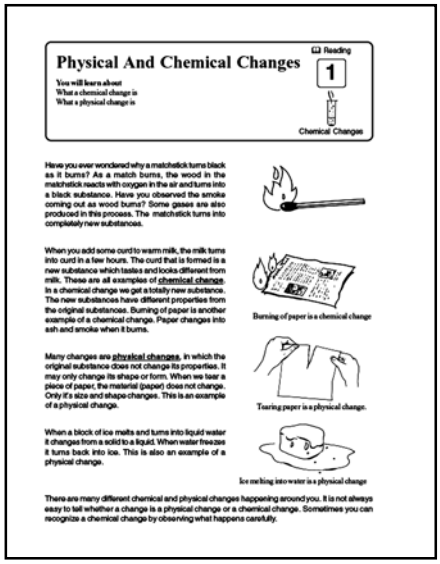
In a physical change the substance does not change.
In a chemical change new substances are formed.

Materials needed

Matchbox, paper.

Teacher's role

Explain the difference between physical and chemical changes using familiar examples.



Reading 1

Physical And Chemical Changes

You will learn about
What a chemical change is
What a physical change is

Chemical Changes

Have you ever wondered why a matchstick turns black as it burns? As a match burns, the wood in the matchstick reacts with oxygen in the air and turns into a black substance. Have you observed the smoke coming out as wood burns? Some gases are also produced in this process. The matchstick turns into completely new substances.

When you add some curd to warm milk, the milk turns into curd in a few hours. The curd that is formed is a new substance which tastes and looks different from milk. These are all examples of chemical change. In a chemical change we get a totally new substance. The new substances have different properties from the original substances. Burning of paper is another example of a chemical change. Paper changes into ash and smoke when it burns.

Burning of paper is a chemical change

Many changes are physical changes, in which the original substance does not change its properties. It may only change its shape or form. When we tear a piece of paper, the material (paper) does not change. Only it's size and shape changes. This is an example of a physical change.

Tearing paper is a physical change.

When a block of ice melts and turns into liquid water it changes from a solid to a liquid. When water freezes it turns back into ice. This is also an example of a physical change.

Ice melting into water is a physical change

There are many different chemical and physical changes happening around you. It is not always easy to tell whether a change is a physical change or a chemical change. Sometimes you can recognize a chemical change by observing what happens carefully.

1 Physical And Chemical Changes

Task

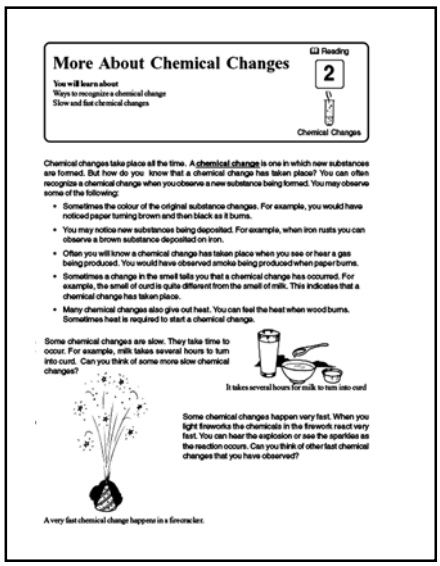
Reading about physical and chemical changes.

Key learning

In a physical change the substance does not change.
In a chemical change new substances are formed.

Teacher's role

Provide assistance with reading tasks and review new vocabulary if required.



Reading 2

More About Chemical Changes

You will learn about
Ways to recognize a chemical change
Slow and fast chemical changes

Chemical Changes

Chemical changes take place all the time. A chemical change is one in which new substances are formed. But how do you know that a chemical change has taken place? You can often recognize a chemical change when you observe a new substance being formed. You may observe some of the following:

- Sometimes the colour of the original substance changes. For example, you would have noticed paper turning brown and then black as it burns.
- You may notice new substances being deposited. For example, when iron rusts you can observe a brown substance deposited on iron.
- Often you will know a chemical change has taken place when you see or hear a gas being produced. You would have observed smoke being produced when paper burns.
- Sometimes a change in the smell tells you that a chemical change has occurred. For example, the smell of curd is quite different from the smell of milk. This indicates that a chemical change has taken place.
- Many chemical changes also give out heat. You can feel the heat when wood burns. Sometimes heat is required to start a chemical change.

Some chemical changes are slow. They take time to occur. For example, milk takes several hours to turn into curd. Can you think of some more slow chemical changes?

It takes several hours for milk to turn into curd

Some chemical changes happen very fast. When you light fireworks the chemicals in the firework react very fast. You can hear the explosion or see the sparkles as the reaction occurs. Can you think of other fast chemical changes that you have observed?

A very fast chemical change happens in a firecracker.

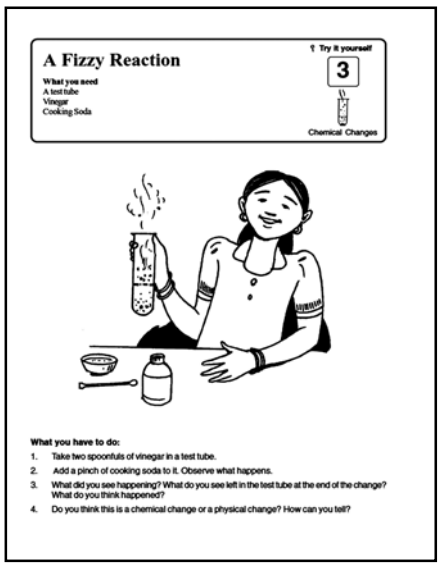
2 More About Chemical Changes

Task

Reading about how to recognize chemical changes.

Key learning

Chemical changes can be fast or slow. Some ways in which a chemical change can be recognized.



A Fizzy Reaction

Try it yourself 3

What you need
A test tube
Vinegar
Cooking Soda

Chemical Changes

What you have to do:
1. Take two spoonfuls of vinegar in a test tube.
2. Add a pinch of cooking soda to it. Observe what happens.
3. What did you see happening? What do you see left in the test tube at the end of the change? What do you think happened?
4. Do you think this is a chemical change or a physical change? How can you tell?

3 A Fizzy Reaction

Task

Experiment to observe the reaction between vinegar and baking soda.

Key learning

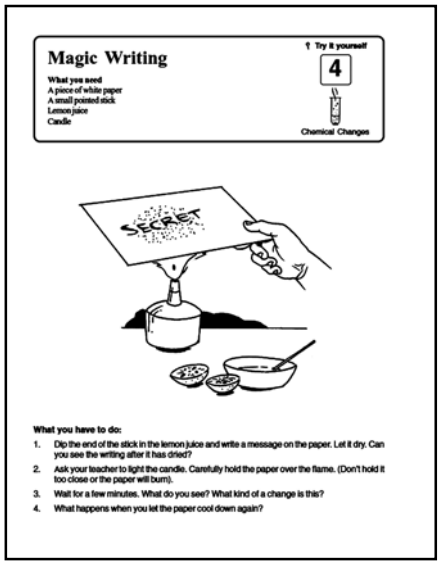
A gas being produced indicates a chemical change is taking place.

Materials needed:

Vinegar, baking powder, test tube, test tube stand.

Teacher's role

Provide assistance with reading tasks and review new vocabulary if required.



Magic Writing

Try it yourself 4

What you need
A piece of white paper
A small pointed stick
Lemon juice
Candle

Chemical Changes

What you have to do:
1. Dip the end of the stick in the lemon juice and write a message on the paper. Let it dry. Can you see the writing after it has dried?
2. Ask your teacher to light the candle. Carefully hold the paper over the flame. (Don't hold it too close or the paper will burn).
3. Wait for a few minutes. What do you see? What kind of a change is this?
4. What happens when you let the paper cool down again?

4 Magic Writing

Task

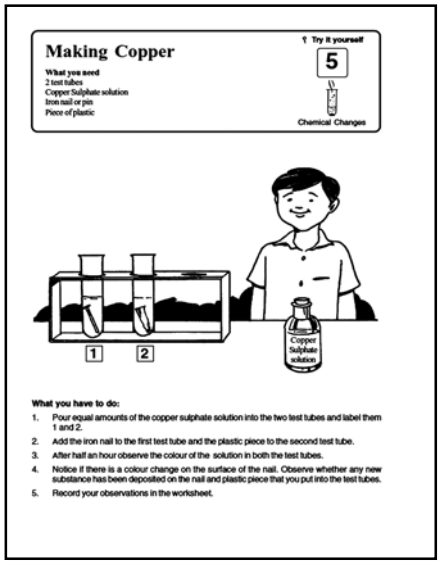
Experiment to observe lemon juice burning.

Key learning

A change in colour may indicate a chemical change is taking place.

Materials needed:

Lemon juice, stick, paper, spirit lamp.



Making Copper

Try it yourself 5

What you need
2 test tubes
Copper Sulphate solution
Iron nail or pin
Piece of plastic

Chemical Changes

What you have to do:
1. Pour equal amounts of the copper sulphate solution into the two test tubes and label them 1 and 2.
2. Add the iron nail to the first test tube and the plastic piece to the second test tube.
3. After half an hour observe the colour of the solution in both the test tubes.
4. Notice if there is a colour change on the surface of the nail. Observe whether any new substance has been deposited on the nail and plastic piece that you put into the test tubes.
5. Record your observations in the worksheet.

5 Making Copper

Task

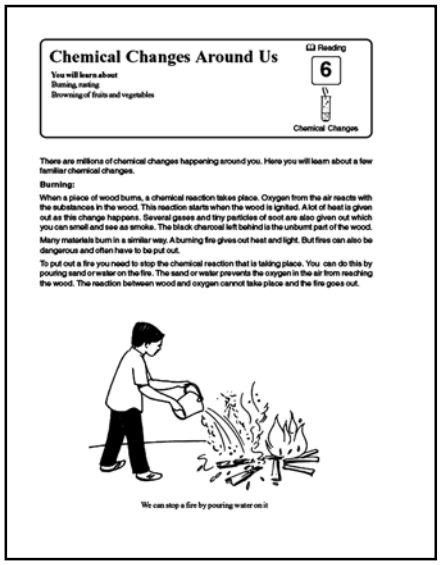
Experiment to observe the reaction between iron and copper sulphate.

Key learning

A change in colour may indicate a chemical change is taking place.

Materials needed:

Test tubes, test tube stand, copper sulphate solution, plastic, iron pieces.



Chemical Changes Around Us

Reading 6

You will learn about
Burning, rusting
Browning of fruits and vegetables

Chemical Changes

There are millions of chemical changes happening around you. Here you will learn about a few familiar chemical changes.

Burning:

When a piece of wood burns, a chemical reaction takes place. Oxygen from the air reacts with the substances in the wood. This reaction starts when the wood is ignited. A lot of heat is given out as this change happens. Several gases and tiny particles of soot are also given out which you can smell and see as smoke. The black charcoal left behind is the unburnt part of the wood.

Many materials burn in a similar way. A burning fire gives out heat and light. But fires can also be dangerous and often have to be put out.

To put out a fire you need to stop the chemical reaction that is taking place. You can do this by pouring sand or water on the fire. The sand or water prevents the oxygen in the air from reaching the wood. The reaction between wood and oxygen cannot take place and the fire goes out.

We can stop a fire by pouring water on it

6 Chemical Changes Around Us

Task

Reading about some common chemical changes.

Key learning

Burning, rusting and colour change in vegetables are examples of chemical change.

Teacher's role

Provide assistance with reading tasks and review new vocabulary if required.

Discussion: Introducing Changes

T1

In this discussion the difference between physical and chemical changes is introduced using familiar examples. The concept of a chemical change as one in which new substances are produced is highlighted.

What you need

Matchbox.
Piece of paper.

Ideas to talk about

- *"We are going to look at the way many substances change into completely new ones."*
- Strike a match and show the children the match stick burning. Ask *"What do you see coming out as the match stick burns?"* **(Smoke.)**
- Allow the matchstick to burn down towards its wooden stem. Show the burnt matchstick and ask *"What has the wood in the matchstick turned into?"* Elicit the fact that the wood has turned into a black substance. **(Burnt wood/charcoal.)**
- Ask *"Can we get the wood back from this?"* **(No.)**
- Tell the children that *"The wood in the matchstick burned and changed into burnt wood. Burnt wood is a totally different material. It has different properties from the wood we started with. This kind of a change, in which we get a totally new substance, is called a chemical change."*
- Tell the children that when we make curd, the milk changes to curd which is a new substance.
- Say, *"This is also an example of a chemical change."*
- Ask the children, *"Suppose we took a match stick and broke it, do we get a new material?"* **(No.)**
- Ask ,*"Has the matchstick changed?"* **(Yes.)** *"In what way?"* **(Size and shape.)**
- *"Is a new substance formed?"* **(No.)** Tell the children that this kind of a change, in which no new substances are formed, is called a physical change.
- Tear or fold a piece of paper. You can ask *"Has the material of the paper changed?"* **(No.)**
- Ask *" Is it a chemical change or a physical change? Why?"* **(It is a physical change because the material, paper, remains the same. Only it's shape or size has changed.)**
- Burn a piece of paper. You can ask *"Has the material of the paper changed?"* **(Yes.)**
- You could tell the children that when we burn paper it changes into black burnt paper and smoke. *"This is a chemical change because we can see new substances being formed."*
- *"Do you know why the match lights up when we strike it against the side of the match box?"*
- Point to the black tip of an unburnt matchstick and say *"There is some black chemical substance here."* Then point to the brown substance on the side of the matchbox. *"There is a different chemical substance here. When we rub these two substances together they react (or get together) and start burning. This is what lights up the matchstick. This change is also a chemical reaction."*
- *"In this unit you are going to learn more about chemical changes."*

Going Further

Ideas for More Activities

Experiments and Investigations

- Observing different changes and determining whether they are physical or chemical changes.
- Observing a variety of fast and slow chemical changes.
- Identifying reversible and irreversible changes in cooking food.

Notes

Acids And Bases

Introduction

In this unit students learn about classifying substances as acidic, basic and neutral. They use different indicators to test and classify solutions as acidic, basic or neutral . They make indicators with locally available substances. They also begin to explore neutralization reactions and their applications in familiar contexts. Students are also introduced to new chemicals and laboratory techniques.

This unit uses ideas developed in the unit on “Chemical Changes” and the unit on “Materials”.

This unit would take approximately 8 hours of class time.

Objectives

This unit will help students to:

- Name some common acidic and basic substances.
- Name some common neutral substances.
- Describe some physical properties of acids and bases (taste, texture).
- Explain what an indicator is.
- Name some commonly used indicators.
- Test and classify solutions as acidic, basic or neutral, using indicators.
- Describe some everyday uses of acids and bases.
- Explain and demonstrate a neutralization reaction.
- Name the products of a neutralization reaction.
- Name some salts.
- Write the word equation for a neutralization reaction.
- Describe some applications of neutralization: improving acidic soils, indigestion, insect bites.

New Vocabulary

Acid, base, acidic, basic, neutral, salt, neutralization, indicator.

Materials Required

For each group of students: Test tubes, test tube stand, red and blue litmus paper, filter paper, turmeric, phenolphthalein, vinegar, detergent, cooking soda, sugar, salt, dilute HCl, sodium hydroxide.

For the teacher: Common acidic substances (lemon, tamarind), common basic substances (detergent, toothpaste), test tubes, test tube stand, phenolphthalein, dilute HCl, sodium hydroxide.

Discussion

T1 What Is An Acid? What Is A Base?

Task

Discussion to introduce acidic and basic substances.

Key learning

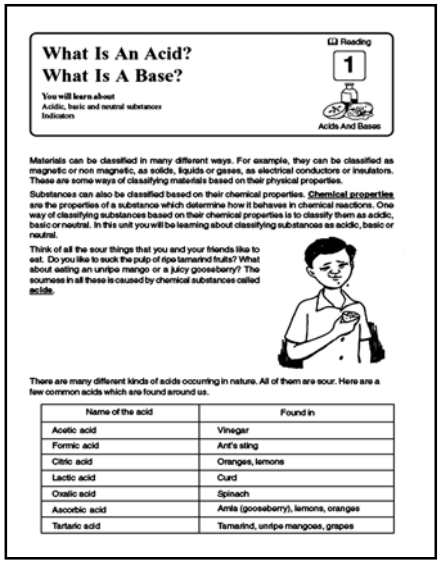
Classifying substances based on a chemical property.
Common acidic and basic substances.
Testing using indicators.

Materials needed

Acidic substances: lemon, tamarind.
Basic substances: detergent, toothpaste etc.

Teacher's role

Explain how substances can be classified as acidic, basic and neutral.



Reading 1

What Is An Acid?
What Is A Base?

You will learn about
Acidic, basic and neutral substances
Indicators

Acids And Bases

Materials can be classified in many different ways. For example, they can be classified as magnetic or non magnetic, as solids, liquids or gases, as electrical conductors or insulators. These are some ways of classifying materials based on their physical properties.

Substances can also be classified based on their chemical properties. Chemical properties are the properties of a substance which determine how it behaves in chemical reactions. One way of classifying substances based on their chemical properties is to classify them as acidic, basic or neutral. In this unit you will be learning about classifying substances as acidic, basic or neutral.

Think of all the sour things that you and your friends like to eat. Do you like to suck the pulp of ripe tamarind fruits? What about eating an unripe mango or a juicy gooseberry? The sourness in all these is caused by chemical substances called acids.

There are many different kinds of acids occurring in nature. All of them are sour. Here are a few common acids which are found around us.

Name of the acid	Found in
Acetic acid	Vinegar
Formic acid	Ant's sting
Citric acid	Oranges, lemons
Lactic acid	Curd
Oxalic acid	Spinach
Ascorbic acid	Amla (gooseberry), lemons, oranges
Tartaric acid	Tamarind, unripe mangoes, grapes

1 What Is An Acid? What Is A Base?

Task

Reading about acidic, basic and neutral substances.

Key learning

Classifying substances based on a chemical property.
Common acidic and basic substances.
Testing using indicators.

Teacher's role

Provide assistance with reading tasks and review new vocabulary if required.

Try it yourself 2

Is It An Acid Or A Base?

What you need
Solutions of : detergent, sodium hydroxide
Cooking salt, sugar, vinegar, dilute hydrochloric acid
Blue litmus paper (two strips)
Red litmus paper (two strips)
Droppers
Red and blue colour pencils

Acids And Bases

In this activity you will be using an indicator called litmus to find out if a substance is acidic, basic or neutral. Litmus changes it's colour when it is in contact with an acidic or basic substance. A neutral substance has no effect on the colour of litmus.

Litmus is a purple dye which is extracted from a plant called lichen which grows on wood and rocks. The dye is used to colour strips of paper and make them red or blue. These are called red and blue litmus paper. These are the most common indicators used to test for acids and bases.

2 Is It An Acid Or A Base?

Task

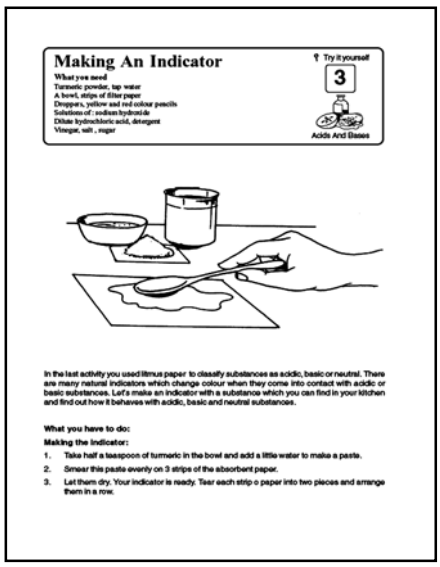
Experiment to test different substances using litmus paper.

Key learning

Acidic substances turn litmus paper red.
Basic substances turn litmus paper blue.

Materials needed

Test tubes, test tube stand, red and blue litmus paper, vinegar, detergent, cooking soda, sugar, salt, dilute HCl, sodium hydroxide.



Making An Indicator

Try it yourself 3

What you need
Turmeric powder, tap water
A bowl, strips of filter paper
Droppers, yellow and red colour pencils
Solutions of : sodium hydroxide
Dilute hydrochloric acid, detergent
Vinegar, salt , sugar

Acids And Bases

In the last activity you used litmus paper to classify substances as acidic, basic or neutral. There are many natural indicators which change colour when they come into contact with acidic or basic substances. Let's make an indicator with a substance which you can find in your kitchen and find out how it behaves with acidic, basic and neutral substances.

What you have to do:

Making the indicator:

1. Take half a teaspoon of turmeric in the bowl and add a little water to make a paste.
2. Smear this paste evenly on 3 strips of the absorbent paper.
3. Let them dry. Your indicator is ready. Tear each strip o paper into two pieces and arrange them in a row.

3 Making An Indicator

Task

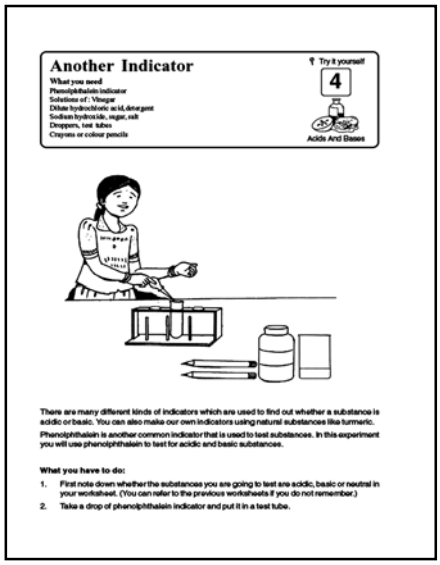
Experiment to use turmeric as an indicator.

Key learning

Basic substances turn turmeric red.

Materials needed:

Test tubes, test tube stand, filter paper, turmeric, vinegar, detergent, cooking soda, sugar, salt, dilute HCl, sodium hydroxide.



Another Indicator

Try it yourself 4

What you need
Phenolphthalein indicator
Solutions of : Vinegar
Dilute hydrochloric acid, detergent
Sodium hydroxide , sugar, salt
Droppers, test tubes
Crayons or colour pencils

Acids And Bases

There are many different kinds of indicators which are used to find out whether a substance is acidic or basic. You can also make our own indicators using natural substances like turmeric.

Phenolphthalein is another common indicator that is used to test substances. In this experiment you will use phenolphthalein to test for acidic and basic substances.

What you have to do:

1. First note down whether the substances you are going to test are acidic, basic or neutral in your worksheet. (You can refer to the previous worksheets if you do not remember.)
2. Take a drop of phenolphthalein indicator and put it in a test tube.

4 Another Indicator

Task

Experiment to use phenolphthalein to test substances.

Key learning

Basic substances turn phenolphthalein red.

Materials needed:

Test tubes, test tube stand, phenolphthalein, vinegar, detergent, cooking soda, sugar, salt, dilute HCl, sodium hydroxide.

Demonstration

T2 Neutralization Reaction

Task

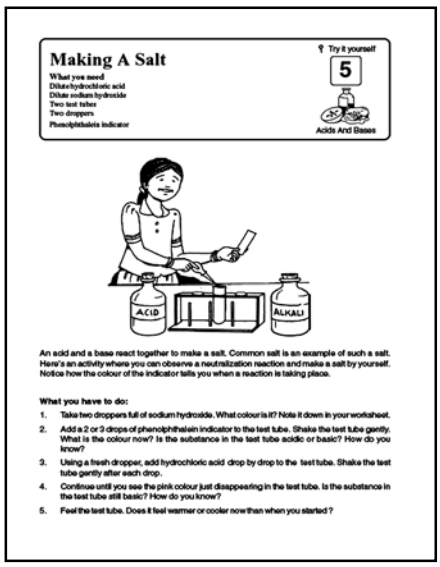
Demonstration of a neutralization reaction.

Key learning

An acid and a base react to form a salt and water in a neutralization reaction. Heat is given out.

Materials needed

Test tubes, test tube stand, phenolphthalein, dilute HCl, sodium hydroxide.



Making A Salt

Try it yourself 5

Acids And Bases

What you need
Dilute hydrochloric acid
Dilute sodium hydroxide
Two test tubes
Two droppers
Phenolphthalein indicator

An acid and a base react together to make a salt. Common salt is an example of such a salt. Here's an activity where you can observe a neutralization reaction and make a salt by yourself. Notice how the colour of the indicator tells you when a reaction is taking place.

What you have to do:

1. Take two droppers full of sodium hydroxide. What colour is it? Note it down in your worksheet.
2. Add a 2 or 3 drops of phenolphthalein indicator to the test tube. Shake the test tube gently. What is the colour now? Is the substance in the test tube acidic or basic? How do you know?
3. Using a fresh dropper, add hydrochloric acid drop by drop to the test tube. Shake the test tube gently after each drop.
4. Continue until you see the pink colour just disappearing in the test tube. Is the substance in the test tube still basic? How do you know?
5. Feel the test tube. Does it feel warmer or cooler now than when you started ?

5 Making A Salt

Task

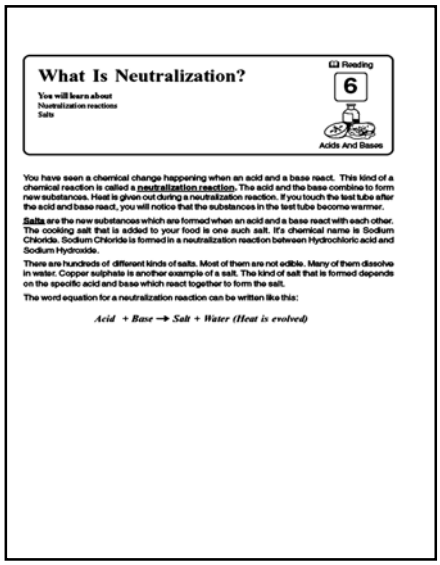
Experiment to observe the reaction between an acid and a base.

Key learning

An acid and a base react to form a salt and water in a neutralization reaction. Heat is given out.

Materials needed:

Test tubes, test tube stand, phenolphthalein, dilute HCl, sodium hydroxide.



What Is Neutralization?

Reading 6

Acids And Bases

You will learn about
Neutralization reactions
Salts

You have seen a chemical change happening when an acid and a base react. This kind of a chemical reaction is called a neutralization reaction. The acid and the base combine to form new substances. Heat is given out during a neutralization reaction. If you touch the test tube after the acid and base react, you will notice that the substances in the test tube become warmer.

Salts are the new substances which are formed when an acid and a base react with each other. The cooking salt that is added to your food is one such salt. It's chemical name is Sodium Chloride. Sodium Chloride is formed in a neutralization reaction between Hydrochloric acid and Sodium Hydroxide.

There are hundreds of different kinds of salts. Most of them are not edible. Many of them dissolve in water. Copper sulphate is another example of a salt. The kind of salt that is formed depends on the specific acid and base which react together to form the salt.

The word equation for a neutralization reaction can be written like this:

Acid + Base → Salt + Water (Heat is evolved)

6 What Is Neutralization?

Task

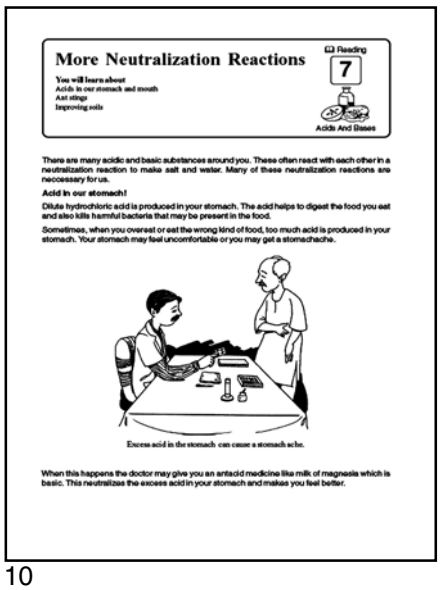
Reading about neutralization.

Key learning

An acid and a base react to form a salt and water in a neutralization reaction. Heat is given out.

Teacher's role

Provide assistance with reading tasks if required.



More Neutralization Reactions

Reading 7

Acids And Bases

You will learn about
Acids in our stomach and mouth
Ant stings
Improving soils

There are many acidic and basic substances around you. These often react with each other in a neutralization reaction to make salt and water. Many of these neutralization reactions are necessary for us.

Acid in our stomach!

Dilute hydrochloric acid is produced in your stomach. The acid helps to digest the food you eat and also kills harmful bacteria that may be present in the food.

Sometimes, when you overeat or eat the wrong kind of food, too much acid is produced in your stomach. Your stomach may feel uncomfortable or you may get a stomachache.

Excess acid in the stomach can cause a stomach ache.

When this happens the doctor may give you an antacid medicine like milk of magnesia which is basic. This neutralizes the excess acid in your stomach and makes you feel better.

7 More Neutralization Reactions

Task

Reading about some applications of neutralization.

Key learning

Neutralization reactions can be used in everyday life.

Teacher's role

Provide assistance with reading tasks if required.

Discussion: What Is An Acid And A Base? T1

In this discussion the idea of classifying substances based on chemical properties is introduced. Familiar acidic, basic and neutral substances and the use of indicators to classify substances is discussed with examples.

What you need

Samples (or pictures) of some acidic substances : lemon, tamarind.
Samples (or pictures) of some basic substances : detergent, toothpaste, slaked lime (used with betel leaves).

Ideas to talk about

- Say *"We have classified materials and substances based on different properties like whether they are magnetic or not. Can you think of other ways of classifying substances?"*
- Elicit different ways that the children have already classified materials in earlier units (electrical conductors and insulators, solids, liquids gases etc).
- *"These are all ways of classifying materials based on their physical properties"*.
- Say, *"In the unit on chemical changes you have seen some chemical reactions. We can also classify substances based on their chemical properties or how they behave in chemical reactions. One way of doing this is to classify them as acidic, basic or neutral substances."*
- *"Some substances are acidic. Here are a few substances that we eat that are acidic."* Show the children the lemon, tamarind.
- Ask, *"Do they both have a similarity in taste? What is it?"* Elicit the fact that they are both sour.
- Say, *"Acidic substances generally taste sour. Can you think of other acidic substances?"* Elicit other examples like amla, sour curd, etc
- *"There are other substances which are basic substances. Basic substances usually feel soapy. Here are a few basic substances."* Show the basic substances like detergent, toothpaste etc.
- *"Can you think of other basic substances?"* You can elicit examples of other cleaning materials like shampoos, etc.
- *"Some substances are neither acidic nor basic. They are called neutral substances. Water, sugar and salt are examples of neutral substances."*
- *"There are many other acids, bases and neutral substances around us. Many are used to make different materials and substances."*
- *"What happens when an acidic substance like lemon juice goes inside your eye?"* **(It burns.)**
- *"What about when a basic substance like soap water goes into your eyes?"* **(It also burns.)**
- *"Both acidic and basic substances can make our eyes burn. Lemon juice is a weak acid. Soap water is a weak base. But some acids and bases are much stronger. They are very dangerous to touch. They can burn our skin if we touch them."*
- *"If we want to classify substances as acidic or basic, we need a safe and reliable way to test them. We cannot taste them or touch them. We have special substances called indicators which help us do this. "*
- *"Here is one indicator called litmus paper that helps us to test whether a substance is acidic, basic or neutral. We will be using indicators like this to test substances and see whether they are acidic or basic."*

Demonstration: Neutralization Reaction

T2

A neutralization reaction between sodium hydroxide and hydrochloric acid is is demonstrated. Phenolphthalein is used as an indicator to show when the reaction has taken place.

What you need

Dilute HCl, NaOH solution. (To be able feel the heat generated during the reaction, make sure the solutions are not too dilute.)
Test tubes, droppers.
Phenolphthalein indicator.

Ideas to talk about

- Take quarter test tube full of NaOH solution. Show it to the children and tell them it is NaOH solution. Ask them *"Is it acidic or basic?"* **(Basic.)** Ask the children *"What happens to phenolphthalein indicator when we add it to a base?"* **(It turns pink.)** Add 2 or 3 drops of indicator to the test tube and show the children that it turns pink.
- Say, *"Let's see what happens when we add some acid to this base. I'll add some Hydrochloric acid which we know is an acid."*
- Add a few drops of HCl to the NaOH solution drop by drop (until the pink colour just disappears). Shake gently after every drop.
- Show the children and ask *"Is the colour changing?"* **(Yes, the pink colour will begin to disappear).**
- Say *"Is the solution in the test tube still basic now? How do you know?"* **(It is not basic. We know because the phenolphthalein indicator has turned colourless.)**
- Ask them why they think the colour changed. Ask them to give reasons for their answers. Listen to their answers and encourage them to give reasons for their conclusions.(A correct answer is not necessarily expected at this time.)
- Tell them that the few drops of acid (HCl) that was added reacted with the base (NaOH solution) and made a new substance which is called a salt and is neutral. There is no NaOH solution or HCl left in the test tube. The indicator turns colourless because we now have a neutral substance.
- Ask *"Is this a chemical change? Why?"***(Yes, because we can sense that a new substance is being formed as we see the colour changing.)**
- Say, *"This kind of a chemical reaction between an acid and a base is called neutralization."*
- Say, *"Shall we add some more base ?"* Add 2 or 3 drops of soap solution to the test tube.
- Show the children the colour again.
- Ask *"Why is it pink again?"* **(Because the substances in the test tube are basic again since we added more NaOH solution.)**
- You could add a few drops of HCl and show the colour disappearing again.
- You can repeat the above process (adding NaOH solution and HCl alternately) a few more times. Each time remember to ask *"Why"* the colour appears or disappears. Reinforce the word *"neutralization reaction"* whenever appropriate.
- Ask the students to touch the test tube. It will feel warm. Ask the *"Can you feel that the test tube has become warm? During a neutralization reaction, heat is given out. That's another way we can make out that a chemical reaction has taken place"*.

Going Further

Ideas for More Activities

Experiments and Investigations

- Testing different substances around the house and school.
- Testing the soil to see if it is acidic or basic.
- Testing water to see if it is acidic, basic or neutral.

Making and Doing

- Making indicators with different flower or plant extracts : Hibiscus, beetroot etc.

Notes

Electricity At Work

Introduction

In this unit students learn about the heating and magnetic effects of electricity. They observe several common appliances which use the heating effect of electricity. They observe the magnetic effect of electricity by constructing a simple electromagnet.

This unit follows earlier work on the "Magnetic Attractions" and "Electric circuits".

The unit would take about 6 hours of class time.

Objectives

This unit will help students to:

- Recognize that electricity flowing through a wire causes it to heat up.
- Explain how the heating effect of electricity is useful and list some familiar appliances that use this effect.
- Explain the function and working of a fuse.
- Recognize that electricity flowing through a wire causes a magnetic field.
- Demonstrate the magnetic effect of current through simple experiments.
- Explain what an electromagnet is.
- List some uses of electromagnets.

New Vocabulary

Electromagnet, fuse, heating element, heating effect, magnetic effect.

Materials Required

For each group of students: A torch bulb, a cell, bulb holder, wires, switch, sandpaper, iron nail, compass, empty match box, iron pins.

For the teacher: Fuse, Iron or Heater.

Discussion

T1 Heating With Electricity

Task

Discussion to introduce the heating effect of electricity.

Key learning

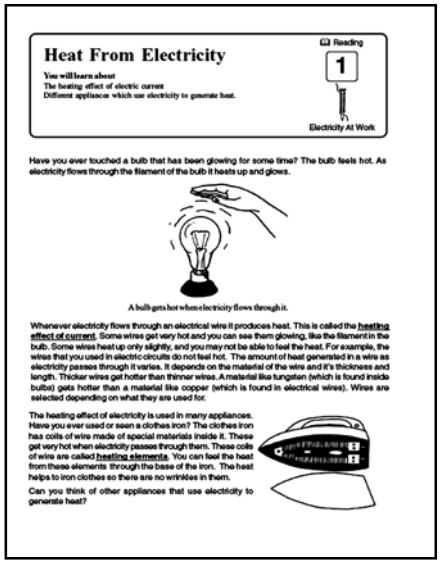
An electric current generates heat. Many familiar appliances are based on the heating effect of electricity.

Materials needed

Iron or Heater.

Teacher's role

Introduce the the heating effect using familiar examples.



Reading 1

Heat From Electricity

You will learn about
The heating effect of electric current
Different appliances which use electricity to generate heat.

Electricity At Work

Have you ever touched a bulb that has been glowing for some time? The bulb feels hot. As electricity flows through the filament of the bulb it heats up and glows.

A bulb gets hot when electricity flows through it.

Whenever electricity flows through an electrical wire it produces heat. This is called the heating effect of current. Some wires get very hot and you can see them glowing, like the filament in the bulb. Some wires heat up only slightly, and you may not be able to feel the heat. For example, the wires that you used in electric circuits do not feel hot. The amount of heat generated in a wire as electricity passes through it varies. It depends on the material of the wire and it's thickness and length. Thicker wires get hotter than thinner wires. A material like tungsten (which is found inside bulbs) gets hotter than a material like copper (which is found in electrical wires). Wires are selected depending on what they are used for.

The heating effect of electricity is used in many appliances. Have you ever used or seen a clothes iron? The clothes iron has coils of wire made of special materials inside it. These get very hot when electricity passes through them. These coils of wire are called heating elements. You can feel the heat from these elements through the base of the iron. The heat helps to iron clothes so there are no wrinkles in them.

Can you think of other appliances that use electricity to generate heat?

1 Heat From Electricity

Task

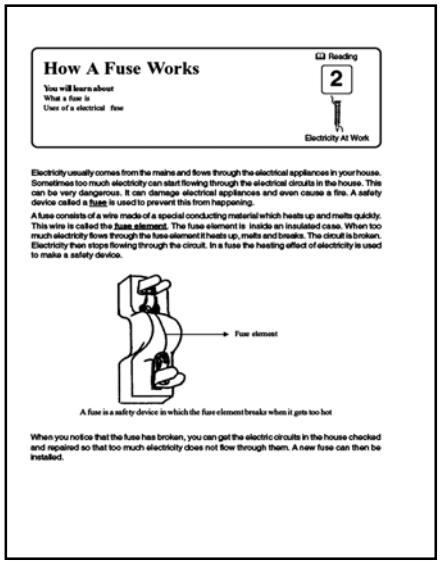
Reading about the heating effect of electricity.

Key learning

An electric current generates heat. Many familiar appliances are based on the heating effect of electricity.

Teacher's role

Provide assistance with reading tasks and review new vocabulary if required.



Reading 2

How A Fuse Works

You will learn about
What a fuse is
Uses of a electrical fuse

Electricity At Work

Electricity usually comes from the mains and flows through the electrical appliances in your house. Sometimes too much electricity can start flowing through the electrical circuits in the house. This can be very dangerous. It can damage electrical appliances and even cause a fire. A safety device called a fuse is used to prevent this from happening.

A fuse consists of a wire made of a special conducting material which heats up and melts quickly. This wire is called the fuse element. The fuse element is inside an insulated case. When too much electricity flows through the fuse element it heats up, melts and breaks. The circuit is broken. Electricity then stops flowing through the circuit. In a fuse the heating effect of electricity is used to make a safety device.

Fuse element

A fuse is a safety device in which the fuse element breaks when it gets too hot

When you notice that the fuse has broken, you can get the electric circuits in the house checked and repaired so that too much electricity does not flow through them. A new fuse can then be installed.

2 How A Fuse Works

Task

Reading about how a fuse works.

Key learning

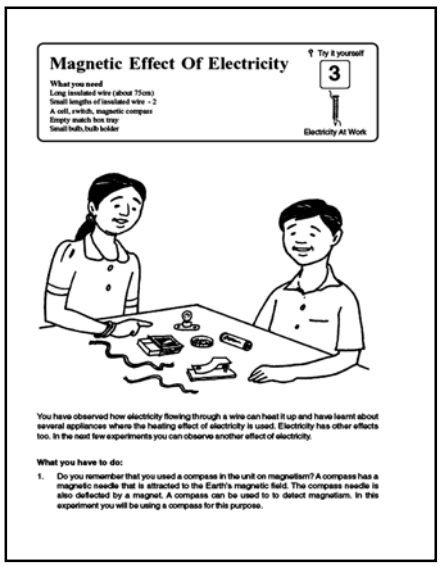
The function and working of a fuse.

Materials needed

Fuses.

Teacher's role

Show different kinds of fuses.



Magnetic Effect Of Electricity

Try it yourself 3

What you need
Long insulated wire (about 75cm)
Small lengths of insulated wire - 2
A cell, switch, magnetic compass
Empty match box tray
Small bulb, bulb holder

Electricity At Work

You have observed how electricity flowing through a wire can heat it up and have learnt about several appliances where the heating effect of electricity is used. Electricity has other effects too. In the next few experiments you can observe another effect of electricity.

What you have to do:

1. Do you remember that you used a compass in the unit on magnetism? A compass has a magnetic needle that is attracted to the Earth's magnetic field. The compass needle is also deflected by a magnet. A compass can be used to to detect magnetism. In this experiment you will be using a compass for this purpose.

3 Magnetic Effect Of Electricity

Task

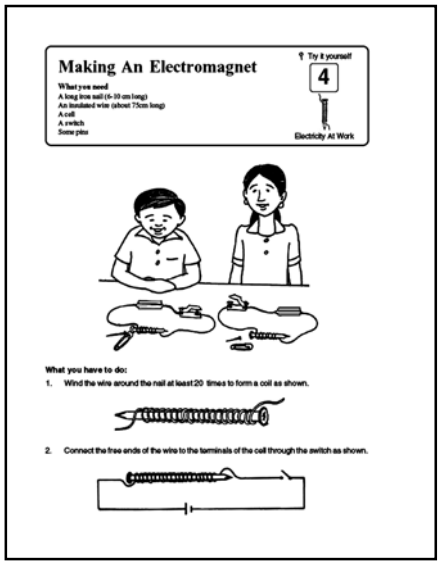
Experiment to observe the magnetic effect of electric current.

Key learning

There is a magnetic field generated around a current carrying wire.

Materials needed

A torch bulb, a cell, bulb holder, wires, switch, compass, empty match box.



Making An Electromagnet

Try it yourself 4

What you need
A long iron nail (5-10 cm long)
An insulated wire (about 75cm long)
A cell
A switch
Some pins

Electricity At Work

What you have to do:

1. Wind the wire around the nail at least 20 times to form a coil as shown.

2. Connect the free ends of the wire to the terminals of the cell through the switch as shown.

4 Making An Electromagnet

Task

Experiment to make an electromagnet.

Key learning

Electromagnets are temporary magnets due to current flowing through a coil.

Materials needed

A cell, wires, switch, iron nail, iron pins.

Discussion: Heating With Electricity

T1

In this discussion the heating effect of electricity is introduced using familiar examples.

What you need

Bulb in a circuit (optional).
A electric immersion heater (or iron).

Ideas to talk about

- *"In the earlier unit we learnt how to connect a bulb in an electric circuit. What did the electricity flowing through the bulb do?"* **(Made it light up.)**
- *"We saw electricity making light. Have you ever felt a bulb after it has been glowing for some time? It feels warm."*
- You can demonstrate this, if required, by switching on the bulb for a few minutes and letting students feel it after you switch it off.
- *"The electricity flowing through the filament of the bulb also generates heat. This is because of the heating effect of electricity."*
- *"Whenever electricity flows through a wire it generates heat. The amount of heat generated depends on the type of wire we use and the amount of electricity flowing through it."*
- *"Sometimes we can feel the wire heating up like we did in the bulb. Sometimes we cannot feel any change in the temperature because very little heat is generated."*
- *"Many electrical appliances use this heating effect of electricity. Can you name some appliances which you have seen which use electricity and make heat?"* **(Clothes, iron, heater, geyser etc.)**
- *"Here is one of them."* Show the immersion heater. *"This immersion heater has a wire made of a special metal which gets very hot as electricity flows through it. We use the heat it produces to heat up bath water."*
- Let students name other appliances based on the same effect.
- You can introduce the fuse. *"This is a fuse. Do you know what it is used for?"*
- Explain that sometimes there is too much electricity flowing through the wires inside buildings. This can damage equipment or cause fires. We use a fuse to stop this from happening.
- *"A fuse has a special wire which gets very hot, melts and breaks when there is too much electricity flowing through it. This breaks the circuit and electricity stops flowing. This prevents damage."* Show the fuse element.
- *"When a fuse melts, we can find the cause of the problem, repair it and then install a new fuse."*

Going Further

Ideas for More Activities

Experiments and Investigations

- Looking at different kinds of fuses and finding out how they work.
- Varying the number of coils in a electromagnet and see how many pins it picks up.
- Looking inside an electric bell and finding out how it works.

Making and Doing

- Making an electric motor.
- Making a working model of a railway signal.

Notes

Reflection In Mirrors

Introduction

In this unit students learn about the reflection of light by plane and curved mirrors. They observe the differences in images formed by plane, convex and concave mirrors. They distinguish between real and virtual images and learn about some uses of curved mirrors.

This unit builds on ideas learnt in "Light And Shadows". The unit on "Magnifiers" follows this unit.

This unit would take about 7 hours of class time.

Objectives

This unit will help students to:

- Explain how a plane mirror shows us a virtual, laterally inverted image.
- Explain the nature of reflection of light from a plane mirror.
- Recognize an incident ray, a reflected ray, the angle of incidence and the angle of reflection.
- Explain the relationship between the angle of incidence and the angle of reflection.
- Observe and explain multiple reflections with 2 plane mirrors.
- Predict how many reflections will be visible when two mirrors are inclined at 30, 45, 60, 90 and 120 degrees.
- Recognize convex and concave mirrors.
- Predict the images formed by a convex mirror (smaller, virtual images).
- Predict the images formed by a concave mirror with the object at different distances.
- Explain some uses of curved mirrors.

New Vocabulary

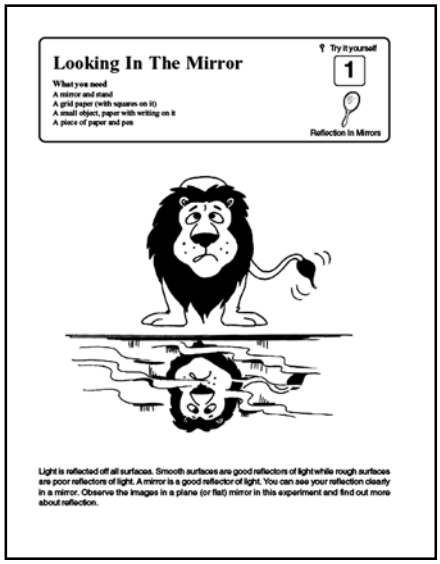
Real image, virtual image, lateral inversion, convex mirror, concave mirror, incident ray, reflected ray, normal, angle of incidence, angle of reflection.

Materials Required

For each group of students: Plane mirrors, grid paper, a large, shiny curved spoon or ladle, kaliedoscope.

For the teacher: Plane mirror, laser light, convex mirror, concave mirror, candle, screen, objects which use curved mirrors – rear view mirror, shaving mirror, torch etc.

Lesson Plan



Looking In The Mirror

Try it yourself 1

What you need
A mirror and stand
A grid paper (with squares on it)
A small object, paper with writing on it
A piece of paper and pen

Reflection In Mirrors

Light is reflected off all surfaces. Smooth surfaces are good reflectors of light while rough surfaces are poor reflectors of light. A mirror is a good reflector of light. You can see your reflection clearly in a mirror. Observe the images in a plane (or flat) mirror in this experiment and find out more about reflection.

1 Looking In The Mirror

Task

Experiment to observe the image formed in a plane mirror.

Key learning

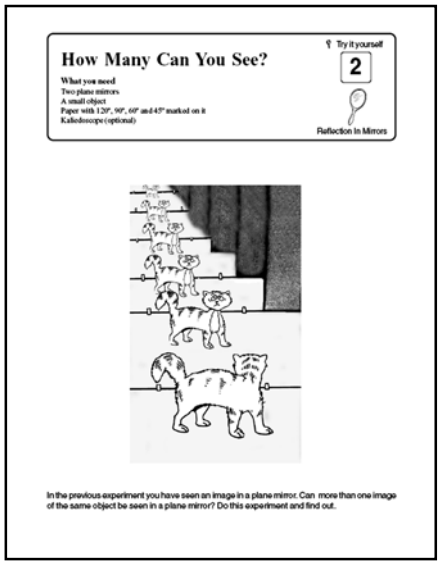
The image in a plane mirror is virtual and laterally inverted.

Materials needed

A plane mirrors, grid paper, small object.

Teacher's role

Review what lateral inversion and a virtual image are.



How Many Can You See?

Try it yourself 2

What you need
Two plane mirrors
A small object
Paper with 120°, 90°, 60° and 45° marked on it
Kaliedoscope (optional)

Reflection In Mirrors

In the previous experiment you have seen an image in a plane mirror. Can more than one image of the same object be seen in a plane mirror? Do this experiment and find out.

2 How Many Can You See?

Task

Observing multiple images formed by two mirrors.

Key learning

The number of images formed by two mirrors depends on the angle between them.

Materials needed

Two plane mirrors, small object, kaliedoscope.

Teacher's role

Encourage students to discover the relation between number of images seen and angle between the mirrors.

Demonstration

T1 Reflection By A Plane Mirror

Task

Experiment to show the laws of reflection.

Key learning

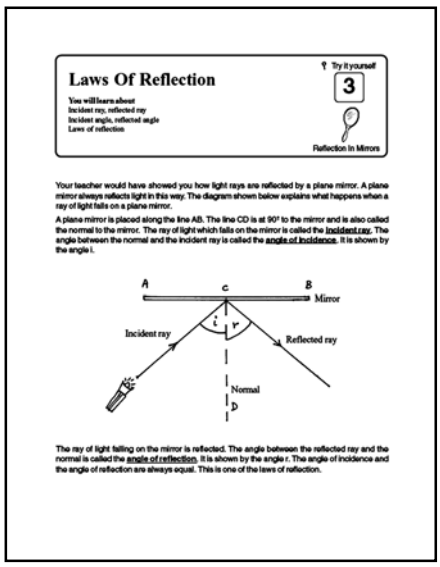
The angle of incidence and the angle of reflection are equal.

Materials needed

Plane mirror, laser light.

Teacher's role

Show the relationship between the incident ray and reflected ray.



Laws Of Reflection

Try it yourself 3

Reflection In Mirrors

You will learn about
Incident ray, reflected ray
Incident angle, reflected angle
Laws of reflection

Your teacher would have showed you how light rays are reflected by a plane mirror. A plane mirror always reflects light in this way. The diagram shown below explains what happens when a ray of light falls on a plane mirror.

A plane mirror is placed along the line AB. The line CD is at 90° to the mirror and is also called the normal to the mirror. The ray of light which falls on the mirror is called the incident ray. The angle between the normal and the incident ray is called the angle of incidence. It is shown by the angle i.

The ray of light falling on the mirror is reflected. The angle between the reflected ray and the normal is called the angle of reflection. It is shown by the angle r. The angle of incidence and the angle of reflection are always equal. This is one of the laws of reflection.

3 Laws Of Reflection

Task

Reading about the laws of reflection.

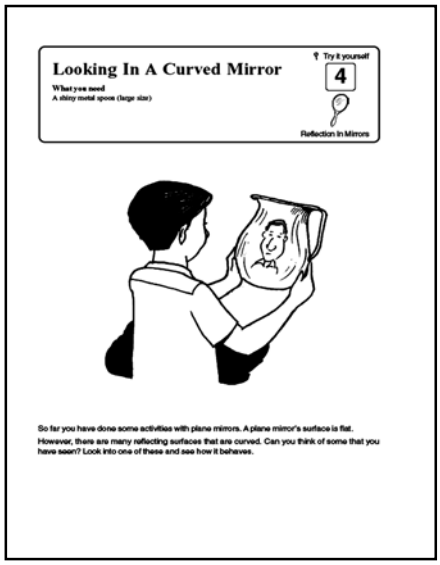
Key learning

Incident ray and reflected ray.

The angle of incidence and the angle of reflection are equal.

Teacher's role

Review new vocabulary if required.



Looking In A Curved Mirror

Try it yourself 4

Reflection In Mirrors

What you need
A shiny metal spoon (large size)

So far you have done some activities with plane mirrors. A plane mirror's surface is flat.

However, there are many reflecting surfaces that are curved. Can you think of some that you have seen? Look into one of these and see how it behaves.

4 Looking In A Curved Mirror

Task

Experiment to observe the reflections in a convex and concave surface.

Key learning

Convex and concave surfaces create different images.

Materials needed

Shiny curved spoon or ladle.

Teacher's role

Review new vocabulary if required.

Demonstration

T2 Reflection By Curved Mirrors

Task

Demonstration of reflection by curved mirrors.

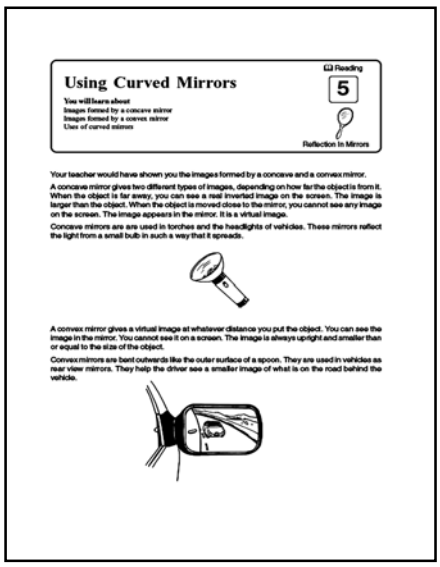
Key learning

A convex surface gives a smaller upright image.

A concave surface gives different images depending on the position of the object.

Materials needed

Convex mirror, concave mirror, candle, screen.



Reading

Using Curved Mirrors

5

You will learn about

Images formed by a concave mirror
Images formed by a convex mirror
Uses of curved mirrors

Reflection In Mirrors

Your teacher would have shown you the images formed by a concave and a convex mirror.

A concave mirror gives two different types of images, depending on how far the object is from it. When the object is far away, you can see a real inverted image on the screen. The image is larger than the object. When the object is moved close to the mirror, you cannot see any image on the screen. The image appears in the mirror. It is a virtual image.

Concave mirrors are are used in torches and the headlights of vehicles. These mirrors reflect the light from a small bulb in such a way that it spreads.

A convex mirror gives a virtual image at whatever distance you put the object. You can see the image in the mirror. You cannot see it on a screen. The image is always upright and smaller than or equal to the size of the object.

Convex mirrors are bent outwards like the outer surface of a spoon. They are used in vehicles as rear view mirrors. They help the driver see a smaller image of what is on the road behind the vehicle.

5 Using Curved Mirrors

Task

Reading about the uses of curved mirrors.

Key learning

Curved mirrors are used in many familiar objects.

Materials needed

Objects which use curved mirrors – rear view mirror, shaving mirror, torch etc.

Teacher's role

Show different objects which use curved mirrors and explain how they are useful.

Demonstration: Reflection By A Plane Mirror T1

Review the nature of an image formed by a plane mirror. A demonstration of how a ray of light is reflected by a plane mirror to show the laws of reflection follows.

What you need

A mirror.
Laser light.
Large protractor.
Paper.

Ideas to talk about

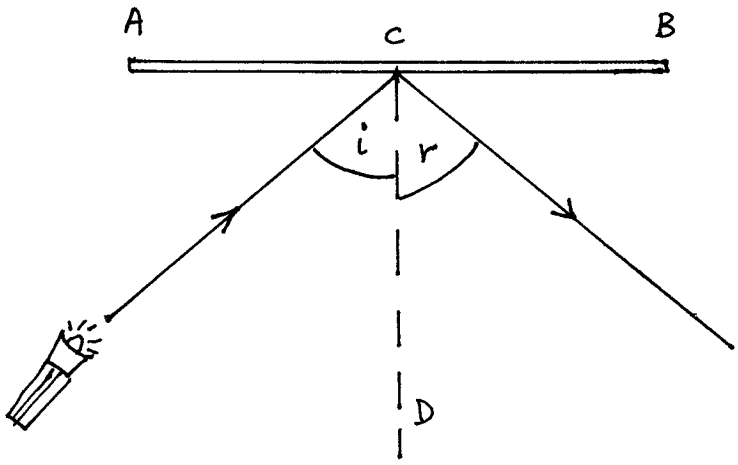
Review:

- Ask questions to review concepts about images and shadows and the difference between them. This could include questions about what they look like, how they are formed etc.
- Ask questions to review the differences between real and virtual images.

Demonstration of Laws of Reflection:

- Use a plane mirror and a laser light to demonstrate the reflection of a light ray by a mirror.
- Stand the mirror on the paper on a flat surface. Switch on the laser light and point it so that the ray of light falls on the mirror along the surface of the paper.
- *"This ray which comes from the laser light and falls on the mirror is called the incident ray."*
- Point to the reflected ray. *"Can you see another ray of light coming from the mirror? This is the reflected ray of light."*
- *"Let's observe the way the light ray is reflected more closely."*
- Stand the mirror on the large protractor such that the mirror is along the base of the protractor. Point to the line normal to the mirror (the line on the protractor which is at 90º degrees). *"We call this line the normal to the mirror."*
- Shine a ray of light along a line on the protractor which is at 30º to the normal. Ask students where the reflected ray is. (It will be at 30º to the normal on the other side from the incident ray.)
- *"The angle that the incident ray makes with the normal is called the angle of incidence. The angle that the reflected ray makes with the normal is called the angle of reflection."*
- *"The angle of incidence and the angle of reflection are equal."*
- Repeat by shining the incident ray at 60º to the normal. The reflected ray will be at 60º to the normal on the other side.
- You can ask some students to come and try.
- You can also illustrate this on the blackboard. Draw a straight line AB to represent the reflecting surface of the mirror. Draw another straight line CD at 90 degrees to AB in it's middle at C. *"AB is the mirror. This line CD is the normal to the mirror"*.
- Draw a line from C to the left of the normal as shown. These could be at 30º from the normal. Number this line 1. *"This is the incident ray."*

- Do the same on the right of the normal. Number this line 2. *"This is the reflected ray."*
- Show the angle of incidence and the angle of reflection. *"The angle between the normal and the incident ray is called the angle of incidence .The angle between the normal and the reflected ray is called the angle of reflection."*
- *"The angle of incidence is equal to the angle of reflection."*
- Explain and show how to draw the incident and reflected rays and how to measure the incident and reflected angles.



Demonstration: Reflection By Curved Mirrors T2

Review the images students saw in the convex and concave surfaces of the spoon. Then demonstrate the images formed by a convex and concave mirror when the object is placed at different distances from them.

What you need

Concave mirror.
Convex mirror.
Stands for mirrors.
Candle.
Screen.

Ideas to talk about

Demonstration of Reflection from a Concave Mirror:

- *"Do you remember looking into the inner surface of the spoon? What kind of images did you see?"* **(Smaller, virtual, inverted when the spoon was at a distance and larger, virtual, erect when it was close up.)**
- *"What do we call the surface which is bent inwards?"* **(Concave.)**
- *"Let's see whether we can get any images with a concave on a screen."*
- Put the concave mirror in it's stand and put the lighted candle about 50cm from it.
- Try to get a sharp image of the candle on the screen by moving the screen on the other side of the candle. Show it to the students.
- *"Can you see the image of the candle on the screen? What kind of an image is it?"* **(Inverted, larger.)** *"We call an image that we can get on a screen a real image. Do you remember you saw a real image on the screen of the pin hole camera?"*
- *"Let's see if we get the image when we move the candle closer to the mirror?"*
- Move the candle closer and get the image on the screen each time. When the candle is closer than the focal length of the mirror you will not be able to get the image on the screen.
- *"When the candle is too close to the mirror we cannot get a real image. We can see the virtual image in the mirror. We call an image that we cannot get on a screen a virtual image."*
- Ask the children to note down their observations in the worksheet.

Demonstration of Reflection from a Convex Mirror:

- Repeat the experiment with the convex mirror. (A convex mirror will not give a real image at any distance.) Show this to the children by putting the screen at different positions as you try to get a image on the screen.

Going Further

Ideas for More Activities

Experiments and Investigations

- Identify different objects in the surroundings that use mirrors.

Making and Doing

- Making a kaliedoscope.
- Making a periscope.

Notes

Magnifiers

Introduction

In this unit students learn about lenses. They observe the images formed by convex and concave lenses and their applications. They learn about how the eye works.

This unit uses builds on ideas developed in the unit "Light And Shadows" and the unit "Reflection In Mirrors".

This unit would take approximately 4 hours of class time.

Objectives

This unit will help students to:

- Recognize that objects appear different when seen through a curved transparent media eg: water drop, glass of water.
- Recognize, name and describe a convex lens.
- Recognize, name and describe a concave lens.
- Recognize different lenses used in common objects (spectacles, magnifying glass, telescope, binoculars etc).
- Describe the image formed by a convex lens (gives a magnified virtual image when held close to the object, real and inverted in other cases).
- Describe the image formed by a concave lens (always gives a erect, virtual and smaller than the object).
- Name the different parts of the eye (pupil, lens, retina).
- Explain the working of the human eye.
- Explain the functions of the pupil, lens and retina.

New Vocabulary

Lens, concave lens, convex lens, magnify, pupil, retina.

Materials Required

For each group of students: Flat piece of clear glass, concave lens, convex lens, magnifying glass, clear plastic sheet.

For the teacher: A piece of clear glass, magnifying glass, concave and convex lenses, stands for lenses, candle, screen, microscope, telescope, binoculars, spectacles (or illustrations).

Lesson Plan

Discussion

T1 Looking Through Objects

Task

Discussion to introduce lenses.

Key learning

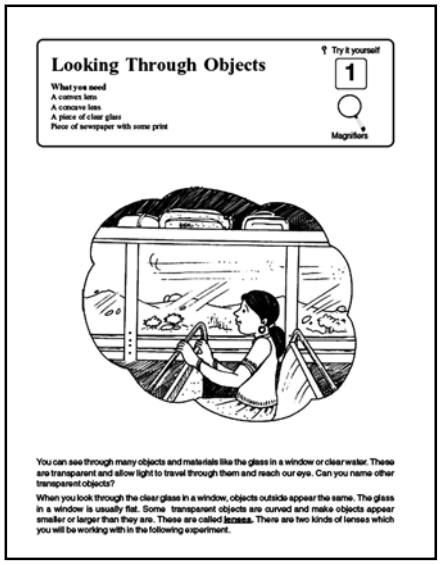
A lens makes objects look different.

Materials needed

A piece of clear glass, magnifying lens, concave lens, convex lens.

Teacher's role

Explain what a lens is.



Looking Through Objects

Try it yourself 1

What you need
A convex lens
A concave lens
A piece of clear glass
Piece of newspaper with some print

Magnifiers

You can see through many objects and materials like the glass in a window or clear water. These are transparent and allow light to travel through them and reach our eye. Can you name other transparent objects?

When you look through the clear glass in a window, objects outside appear the same. The glass in a window is usually flat. Some transparent objects are curved and make objects appear smaller or larger than they are. These are called lenses. There are two kinds of lenses which you will be working with in the following experiment.

1 Looking Through Objects

Task

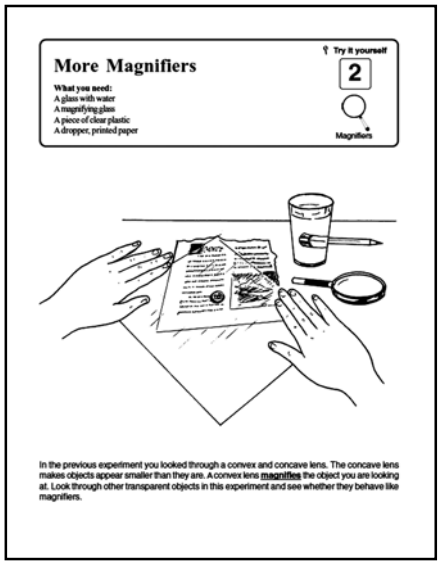
Experiment to observe the images formed by convex and concave lenses.

Key learning

Convex lenses act like magnifiers.
Concave lenses make objects look smaller.

Materials needed

A piece of clear glass, concave lens, convex lens.



More Magnifiers

Try it yourself 2

What you need:
A glass with water
A magnifying glass
A piece of clear plastic
A dropper, printed paper

Magnifiers

In the previous experiment you looked through a convex and concave lens. The concave lens makes objects appear smaller than they are. A convex lens magnifies the object you are looking at. Look through other transparent objects in this experiment and see whether they behave like magnifiers.

2 More Magnifiers

Task

Experiments to look through drop of water, glass of water.

Key learning

Curved transparent media act like lenses.

Materials needed

Plastic sheet, water.

Teacher's role

Draw attention to the similarity in shape between a convex lens and a drop of water.

Lesson Plan

Demonstration

T2 Convex And Concave Lenses

Task

Demonstration to observe the images formed by lenses.
Discussion about different uses of lenses: spectacles, binoculars, magnifying glass, cameras etc.

Key learning

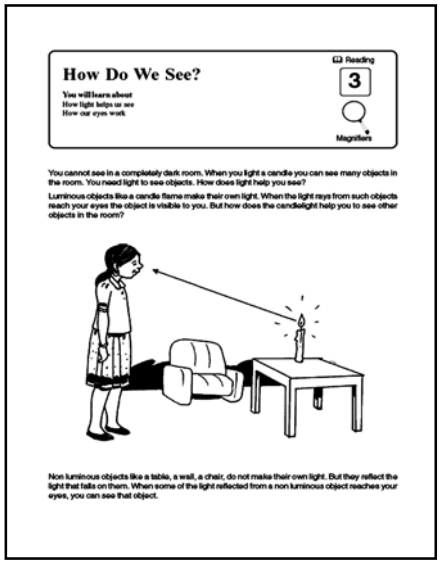
Convex lens gives a real and inverted or a magnified virtual image depending on it's position from the object.
Concave lens gives a smaller virtual image always.
Lenses are used in many instruments we use.

Materials needed

Concave lens, convex lens, stands for lenses, candle, screen, microscope, telescope, binoculars, spectacles (or illustrations).

Teacher's role

Demonstrate image formation by lenses.



How Do We See?

Reading 3

You will learn about
How light helps us see
How our eyes work

Magnifiers

You cannot see in a completely dark room. When you light a candle you can see many objects in the room. You need light to see objects. How does light help you see?

Luminous objects like a candle flame make their own light. When the light rays from such objects reach your eyes the object is visible to you. But how does the candlelight help you to see other objects in the room?

Non luminous objects like a table, a wall, a chair, do not make their own light. But they reflect the light that falls on them. When some of the light reflected from a non luminous object reaches your eyes, you can see that object.

3 How Do We See?

Task

Reading about the parts of the eye (pupil,lens, retina) and how they work.

Key learning

The pupil and retina act like the pinhole and screen in a pinhole camera.
Lens creates a inverted real image on the retina.

Teacher's role

Provide assistance with reading tasks and review new vocabulary if required.

Discussion: Looking Through Objects

T1

In this discussion concepts about transparent and opaque objects are reviewed. A convex lens is introduced and its ability to make objects look larger is demonstrated.

What you need

A piece of clear glass.
A magnifying glass.
A concave lens.
A convex lens.

Ideas to talk about

- Show the piece of glass and ask *"What is this?"* **(A piece of glass.)** *"Can we see through it?"***(Yes)**
- *"What do we call materials we can see through?"* **(Transparent materials.)**
- *"Can you name some more transparent objects?"* **(Clear water, window pane, etc.)**
- *"When you look through this piece of glass do the things you look at look the same or different?"* **(The same.)**
- Introduce the magnifying glass (if students are not familiar with it already).
- *"This is called a magnifying glass. It has a piece of glass inside it. But there is something special about this piece of glass. Can you tell me what's special?"*
- Let one or two students look through it and tell you. **(It makes objects appear larger.)**
- *"The piece of glass in the magnifying glass makes objects appear larger. It is called a convex lens."*
- Show the convex lens. *"This is a convex lens like the one in the magnifying glass. It has a special shape. It bulges out in the middle."*
- *"There are other kind of lenses too, which make objects appear different. This one is called a concave lens."* Show the concave lens.
- *"A concave lens has a depression in the middle. You are going to find out how things look through this too."*

Demonstration: Concave And Convex Lenses T2

In this demonstration the images formed by convex and concave lenses are observed. The uses of concave and convex lenses are discussed.

What you need

Concave lens, convex lens, stands for lenses, candle, screen.
Microscope, telescope, binoculars, spectacles (or illustrations).

Ideas to talk about

Images with a convex lens:

- Show the convex lens to the students and ask them what it is.
- Say, *"Let's see what kind of images this lens makes."*
- Take a convex lens and fix it on a stand and place it on the table.
- Place a lighted candle beyond the focal length of the lens.
- Try to obtain the image of the candle on the paper screen placed on the other side of the lens. Try to get a sharp image by moving the screen back and forth. You will get a inverted image on the screen.
- Ask the students *"What kind of an image do you see?"* **(Real, inverted. The image will be smaller or larger than the object depending on where the candle is.)**
- Vary the distance of the candle from the lens and try to obtain an image on the screen each time. Ask the same question as above each time.
- When the candle is very close to the lens (closer than the focal length) you will not be able to get an image on the screen.
- Ask the students *"What kind of an image do you see?"* **(The image is virtual, erect and magnified.)**
- Tell the students *"This is how a convex lens is used as a magnifying glass."*

Images with a concave lens:

- Do the same experiment with the concave lens. Ask the students questions about what kind of image they see each time.
- A concave lens will never give a real image on the screen. You will always get a virtual, erect image which is smaller in size than the object.

Discussion on where lenses are used:

- *"Lenses are present in many instruments we use. Can you think of some places where you have seen lenses being used?"* Let students answer. Two common examples they would have seen are spectacles and a magnifying glass.
- *"There are other instruments too."* Show pictures or real examples of binoculars, camera, telescope, microscope etc.
- *"We use lenses to see distant objects clearly using the binoculars and telescope."* Ask *"What kind of distant objects could these instruments help in seeing?"* Elicit, answers like 'birds and animals, the moon, stars etc'.
- *"We use lenses to make small objects appear bigger in a microscope and a magnifying glass."*

- Ask, *"What kinds of objects might you want to see in more detail?"* Tell them that scientists look at animal and plant specimens, at rocks and soils, and at various kinds of natural and man-made materials using microscopes.
- Allow students to handle the instruments if possible and use them to observe objects which interest them.

Going Further

Ideas for More Activities

Experiments and Investigations

- Using a telescope.
- Using a microscope.
- Using binoculars.
- Using a camera.
- Burning paper with a magnifying glass and finding the focus of a lens.

Making and Doing

- Optical illusions of the eye.
- Making a a telescope.
- Making a model of the eye.

Notes

Properties Of Water

Introduction

In this unit students learn about some commonly observed properties of water. They learn about water as a solvent, how water flows, capillary action and the three states of water (solid, liquid and gas). They explain common phenomena that are observed in nature based on these properties. The significance of these properties to life on earth and the water cycle are examined.

This unit builds on concepts covered in "Solids, Liquids And Gases' and "Mixing And Separating". The unit on "Using Water' uses ideas developed in this unit.

This unit would take about 5 hours of class time.

Objectives

This unit will help students to:

- Recognize that water is present all around - in living things, in the air, in water bodies, under the ground etc.
- Identify some properties of water : it can flow, dissolve substances, change its state and creep upwards through spaces in solids.
- Explain how water is an excellent solvent and dissolves many substances: minerals from rocks, oxygen from the atmosphere etc.
- Observe that water can creep up through spaces in solids (capillary action) and explain common phenomena where capillary action is observed (water reaching plant roots, water absorbed by a cloth etc).
- To know that water can exist in three states : as solid (ice), as a liquid and as a gas (water vapour).
- Recognize the different stages and changes that take place in the Water Cycle.
- Describe each of these stages in the water cycle: evaporation, condensation, precipitation, transpiration, clouds, run-off, percolation, groundwater, surface water.

New Vocabulary

Dissolve, solvent, water cycle, evaporation,transpiration, condensation, clouds, precipitation, run off, percolation, groundwater.

Materials Required

For each group of students: A beaker or glass, some dry soil to fill the beaker, a stick of chalk, a flat saucer or plate, a watch or clock.

For the teacher: A shallow pan to heat water in, water, spirit lamp, tripod stand, metal plate, pictures of polar icecaps, glaciers, ice cubes, a closed bottle to keep them in, chart showing the water cycle.

Discussion

T1 Water Everywhere

Task

Introductory discussion about water and its properties.

Key learning

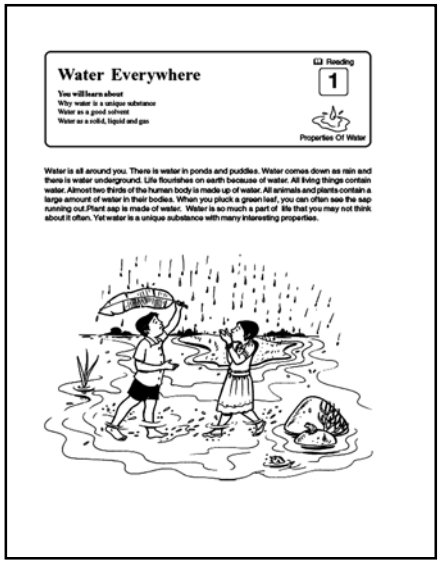
Water is all around us. It has many unique properties.

Materials needed

Pictures of water in rivers, waterfalls, fish in water etc.
A juicy fruit like a tomato or lemon, salt and water in a glass.

Teacher's role

Discuss how the properties of water enable life.



Water Everywhere

Reading 1

You will learn about
Why water is a unique substance
Water as a good solvent
Water as a solid, liquid and gas

Properties Of Water

Water is all around you. There is water in ponds and puddles. Water comes down as rain and there is water underground. Life flourishes on earth because of water. All living things contain water. Almost two thirds of the human body is made up of water. All animals and plants contain a large amount of water in their bodies. When you pluck a green leaf, you can often see the sap running out.Plant sap is made of water. Water is so much a part of life that you may not think about it often. Yet water is a unique substance with many interesting properties.

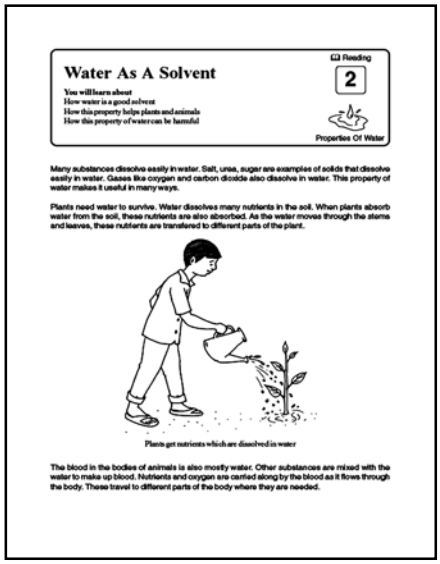
1 Water Everywhere

Task

Reading about water and its properties.

Key learning

Water is all around us. It has many unique properties.



Water As A Solvent

Reading 2

You will learn about
How water is a good solvent
How this property helps plants and animals
How this property of water can be harmful

Properties Of Water

Many substances dissolve easily in water. Salt, urea, sugar are examples of solids that dissolve easily in water. Gases like oxygen and carbon dioxide also dissolve in water. This property of water makes it useful in many ways.

Plants need water to survive. Water dissolves many nutrients in the soil. When plants absorb water from the soil, these nutrients are also absorbed. As the water moves through the stems and leaves, these nutrients are transfered to different parts of the plant.

Plants get nutrients which are dissolved in water

The blood in the bodies of animals is also mostly water. Other substances are mixed with the water to make up blood. Nutrients and oxygen are carried along by the blood as it flows through the body. These travel to different parts of the body where they are needed.

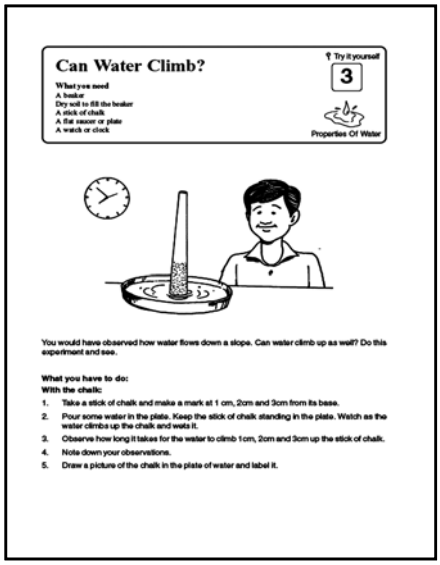
2 Water As A Solvent

Task

Reading about water as a solvent.

Key learning

Water is an excellent solvent. Applications of this property: living things, pollution, dissolved salts in water.



Can Water Climb?

Try it yourself 3

What you need
A beaker
Dry soil to fill the beaker
A stick of chalk
A flat saucer or plate
A watch or clock

Properties Of Water

You would have observed how water flows down a slope. Can water climb up as well? Do this experiment and see.

What you have to do:
With the chalk:

1. Take a stick of chalk and make a mark at 1 cm, 2cm and 3cm from its base.
2. Pour some water in the plate. Keep the stick of chalk standing in the plate. Watch as the water climbs up the chalk and wets it.
3. Observe how long it takes for the water to climb 1cm, 2cm and 3cm up the stick of chalk.
4. Note down your observations.
5. Draw a picture of the chalk in the plate of water and label it.

3 Can Water Climb?

Task

Experiment to observe capillary action.

Key learning

Water creeps up between tiny spaces in a solid.

Materials needed

Beaker, soil, chalk, plate.

Teacher's role

Explain capillary action and its applications.

Demonstration

T2 Changing Water

Task

To demonstrate evaporation and condensation and relate these to the water cycle.

Key learning

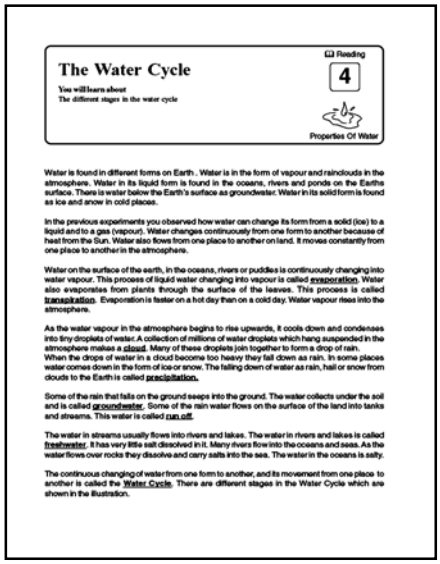
Stages and changes that take place in the water cycle.

Materials needed

A shallow pan to heat water in water, spirit lamp, tripod stand metal plate.

Teacher's role

Explain the stages in the water cycle.



The Water Cycle

Reading 4

You will learn about
The different stages in the water cycle

Properties Of Water

Water is found in different forms on Earth. Water is in the form of vapour and raindlouds in the atmosphere. Water in its liquid form is found in the oceans, rivers and ponds on the Earthe surface. There is water below the Earth's surface as groundwater. Water in its solid form is found as ice and snow in cold places.

In the previous experiments you observed how water can change its form from a solid (ice) to a liquid and to a gas (vapour). Water changes continuously from one form to another because of heat from the Sun. Water also flows from one place to another on land. It moves constantly from one place to another in the atmosphere.

Water on the surface of the earth, in the oceans, rivers or puddles is continuously changing into water vapour. This process of liquid water changing into vapour is called evaporation. Water also evaporates from plants through the surface of the leaves. This process is called transpiration. Evaporation is faster on a hot day than on a cold day. Water vapour rises into the atmosphere.

As the water vapour in the atmosphere begins to rise upwards, it cools down and condenses into tiny droplets of water. A collection of millions of water droplets which hang suspended in the atmosphere makes a cloud. Many of these droplets join together to form a drop of rain.
When the drops of water in a cloud become too heavy they fall down as rain. In some places water comes down in the form of ice or snow. The falling down of water as rain, hail or snow from clouds to the Earth is called precipitation.

Some of the rain that falls on the ground seeps into the ground. The water collects under the soil and is called groundwater. Some of the rain water flows on the surface of the land into tanks and streams. This water is called run off.

The water in streams usually flows into rivers and lakes. The water in rivers and lakes is called freshwater. It has very little salt dissolved in it. Many rivers flow into the oceans and seas. As the water flows over rocks they dissolve and carry salts into the sea. The water in the oceans is salty.

The continuous changing of water from one form to another, and its movement from one place to another is called the Water Cycle. There are different stages in the Water Cycle which are shown in the illustration.

4 The Water Cycle

Task

Reading about the water cycle.

Key learning

Stages and changes that take place in the water cycle.

Teacher's role

Review new vocabulary.

Information For The Teacher:

Children would have played with and observed water since they were very young. This unit focuses on some unique properties of water and links them to commonly observed phenomena.

Water dissolves many substances easily. Plants and animals rely on this property of water in many ways. Nutrients are transported inside plants and animals by fluids which are largely composed of water. Plant sap in plants and blood in human beings are two examples of this. Aquatic plants and animals are able to survive in water because of the oxygen that is dissolved in water.

Another interesting property of water is it's ability to creep up through tiny spaces in a solid or through tiny tubes (called capillaries). This property of water is because of its surface tension and is called capillary action. Surface tension in water arises when the force pulling water and the solid material of the capillary is stronger than the internal force holding water molecules together. It is this property that enables water to rise up through soil into wells and that enables plants to get water through their roots.

Water is one of the few substances that we can see as solid, liquid and gas in nature around us. The ability of water to change its form upon heating and cooling is the basis for the water cycle. Water is constantly changing its form and moving around between the atmosphere, land and its water bodies and the oceans.

Discussion: Water Everywhere

T1

This introductory discussion focuses on some properties of water and how these enable life on earth. Write new words on the blackboard as you introduce and explain them.

What you need

Pictures of water in rivers, waterfalls, fish in water etc.
A juicy fruit like a tomato or lemon.
Salt and water in a glass.

Ideas to talk about

- *"Can you name some places that you can see water?"* **(Tap, pond, puddle etc.)**
- *"Water is all around us. We can see it in rivers, lakes and puddles. When it rains water comes down from the clouds in the sky. There is water everywhere on Earth."*
- *"Have you seen any water inside living things?"* **(Juice, plant sap etc.)**
- You can cut open a fruit and show the students. *"The juice inside this fruit is also mostly made up of water."*
- *"Can you name other juicy fruits which are mainly water? What about other parts of plants where we can see watery substances oozing out when we squeeze them?"* **(Leaves and stems.)**
- *"Our bodies are also made up of mostly water. Blood and other fluids in our body are mainly water with other substances mixed in."*
- *"Water is present inside all living things."*
- *"Water has many special properties. Lets look at some which make it so useful and necessary for living things."*
- *"Have you ever seen water flowing? Where?"* **(Down a slope, in a stream.)**
- *"Water can **flow** easily. As it does it can carry along many substances and objects with it. Have you observed the water washing away sticks and mud as it flows downhill after the rains?"*
- *"The fluids in all living things are made up of water. These fluids flow around inside a plant or animal and carry nutrients. Blood carries nutrients and oxygen as it flows through our body. Plant sap carries nutrients through the plant."*
- *"This tells us about another property of water. Water **dissolves** many substances easily. It is a good **solvent**."*
- *"Look at how easily the water in this glass dissolves this salt."* Dissolve the salt in the water and show students.
- *"Where did the salt go? How do we know it is still in the water?"* **(The water tastes salty.)**
- *"Fish are able to live in water because there is oxygen dissolved in water. Fish breathe this oxygen."*
- *"Water has another special property. We can see it existing as a solid, a liquid and gas. It can change it's form from one state to the other."*
- *"What is solid water called?"* **(Ice.)**
- *"What happens when the ice melts?"* **(It turns into a liquid.)**
- *"What happens to water when we boil it?"* **(We can see steam coming out. It turns into a gas.)**
- *"Water is constantly changing it's form and it's place on Earth. We will study about all these properties of water in this unit."*

Demonstrations: Changing Water

T2

Students observe how water changes its state from liquid to gas and gas to liquid in the first demonstration. In the second demonstration they observe how water vapour in the air condenses on to a cold surface. They relate these observations to the water cycle. They learn about the different stages in the water cycle and the different forms that water takes as it moves around the earth and atmosphere.

Demonstration 1: Making Water Vapour

What you need

A shallow pan to heat water in.
Water, spirit lamp, tripod stand, metal plate.
Pictures of polar icecaps, glaciers.

Ideas to talk about

- *"You've read about how water has a very special property which makes it useful to all living things. What property have you read about?"* **(It dissolves many substances easily.)**
- *"Water has another unique property that we can observe. Water exists as a solid, liquid and a gas around us. It can change it's form easily from one to the other."*
- *"Do you know what water is called in it's solid form?"* **(Ice.)**
- *"Have you ever seen ice? We can see it in ice cubes and ice lollies. In fact, large parts of the earth which are very cold are covered with ice."* (Show a picture of ice covered regions, glaciers etc.)
- *"What happens when it is warm? The solid ice **melts** and turns into liquid water. This is the liquid we see all around us: in rivers, oceans, wells and taps. Water in it's liquid form is most useful to us."*
- *"What happens if we heat this liquid water?"* **(It turns into steam which is a gas.)**
- *"Watch how this happens in this experiment."*

What you need to do

- Fill the test tube one fourth full with water.
- Hold the test tube with the holder and heat the water in the test tube over the spirit lamp.
- Ask the students to observe the water in the test tube carefully. *"What can you observe?"* Initially a few bubbles will rise from inside the water. Draw their attention to these and tell them that it is the oxygen dissolved in the water which is coming out.
- Ask the students to observe what happens as it is heated further and later when the water starts boiling. First water vapour starts coming out gradually. Later the liquid water changes rapidly into steam.
- *"We call this process of liquid water turning into water vapour **evaporation.**"* Write this on the blackboard.
- Hold the metal plate close to the mouth of the test tube and keep it there for a minute. *"What do you see on the plate?"* **(Drops of water.)**
- *"This process by which water vapour which is a gas turns into liquid water is called **condensation.**"* Write the word on the blackboard.

Discussion:

- *"We've seen water turning into vapour very quickly as we heat it. In a similar way water in a puddle turns into vapour on a hot day. It takes longer to evaporate than when we heat it over a fire."*
- *"We can't see the water vapour as it evaporates from a puddle, since it is invisible and the process happens slowly."*
- *"How do wet clothes dry when you hang them in a sunny place?* **(The water in them evaporates.)**
- *"Where does all this water vapour go?"* **(It goes into the air.)**
- *"What happens when you water plants?* **(The plants absorb some of the water. The rest remains in the soil and percolates down.)**
- *"Why does the soil dry up?"* **(The water evaporates and goes into the air.)**
- *"What happens when we wipe a blackboard with a wet cloth?"* **(After a while it dries up.)**
- *"Where does the wetness go?"* **(The water evaporates and goes into the air.)**
- *"There is always water vapour in the air around us. In dry weather there is less water vapour. In humid, rainy weather there is more water vapour in the air."*

Demonstration 2: Making Water Vapour

What you need

Ice cubes, a closed bottle to keep them in.
Illustration of the water cycle.

What you need to do

- Show the ice cubes to the students. *"Here is ice, the solid form of water. What will happen when it melts?"* **(It will turn into a liquid.)**
- *"I am going to put this ice into a closed bottle and see what happens."* Place the ice inside a bottle and close it tightly. Ask, *"Can water come out of this bottle now?"* **(No.)**
- Wait for a few minutes. We can see tiny droplets of water on the outside surface of the bottle. *"Where did these water droplets come from?"* **(The water vapour in the air condensed onto the bottle because the bottle is cold.)**

Discussion:

- *"This is similar to the way water vapour in the air turns into liquid droplets of rain which make up clouds."*
- *"Water from puddles, ponds and rivers evaporates and turns into water vapour."* Show illustration of water cycle and point out evaporation.
- *"Water which is inside plants also evaporates from them after rising up to the leaves. This is called transpiration."* Show illustration and point out transpiration.
- *"When the air with the water vapour rises upwards, it cools down. The water vapour then turns back into tiny liquid droplets like you saw on the cold bottle."*
- *"Millions of these droplets form a cloud. These droplets join together to form drops of rain."*Show illustration of water cycle and point out clouds and rain.

- *"We all wait eagerly for the rain that falls onto the Earth. Some of this rain water seeps into the ground. This is called <u>percolation</u>."* Show illustration. *"It goes into the ground and collects below the surface as <u>groundwater</u>."* Show illustration.
- *"Some of the water flows on the surface. This is called <u>run off.</u> This water flows into ponds, rivers, streams and finally the ocean."* Show illustration.
- *"This whole process of liquid water on the earth turning into vapour and then back into liquid rain and moving from one place to another on land is called the water cycle."*
- *"There are many stages in the water cycle. Water is constantly changing its form and moving from one stage to the other."*

Going Further

Ideas for More Activities

Experiments and Investigations

- Investigating surface tension.
- Investigating floating and sinking.
- Finding out how much water a leaf or fruit contains.

Making and Doing

- Making a poster or model about the water cycle.

Reading and Writing

- Writing stories about water.
- Collecting songs, poems, myths and stories about rain and the water cycle.

Notes

Using Water

Introduction

This is the second unit on water. In this unit the focus is on water as a natural resource that humans depend on. Students learn about the distribution of water on earth and on how much of this water is available for human use. There is an emphasis on understanding groundwater as it is a local source of water in many areas. Students learn about water quality and how it can be improved. They learn about ways in which this natural resource can be conserved. Many activities in this unit involve studying water resources in the neighbourhood. This unit is best done in the rainy season when water sources (rainwater, tanks,wells etc) in the community can be observed.

This unit is based on concepts covered in the units on 'Properties of Water' and 'Soil'.

This unit will take about 9 hours of class time.

Objectives

This unit will help students to:

- Distinguish between sea water and freshwater and know their relative abundance.
- Identify different sources of freshwater: rivers, lakes, groundwater and icecaps.
- Compare the relative amounts of each of these sources in a qualitative way.
- Become aware about their own water usage and water usage in their school and community.
- Recognize that usable water is becoming a scarce resource which needs to be managed collectively.
- Explain what groundwater is and how groundwater collects underground.
- Explain what an aquifer is.
- Explain what happens to groundwater when it is polluted or overused.
- Explain what water quality is.
- Distinguish between hard and soft water (qualitative understanding).
- Describe ways in which water can be purified to make it drinkable.
- Choose an appropriate way of purifying water depending on its source and its end use.
- Describe different ways of conserving water: reducing wastage, rainwater harvesting, drip irrigation, etc.

New Vocabulary

Freshwater, icecaps, aquifer, recharge, water quality, hard water, soft water, rainwater harvesting, check dam, percolation tank, conservation, contamination, water pollution, drip irrigation.

Materials Required

For the teacher: Small bucket, a transparent container, two small dishes, measuring cylinder, teaspoon, a globe, pictures of icecaps, oceans and other water bodies, a glass, a mug, a bucket, a large transparent container (1 litre capacity), two small beakers, red ink, long dropper (or straw), gravel, sand, mud, water.

Lesson Plan

Discussion

T1 Where Is All The Water?

Task

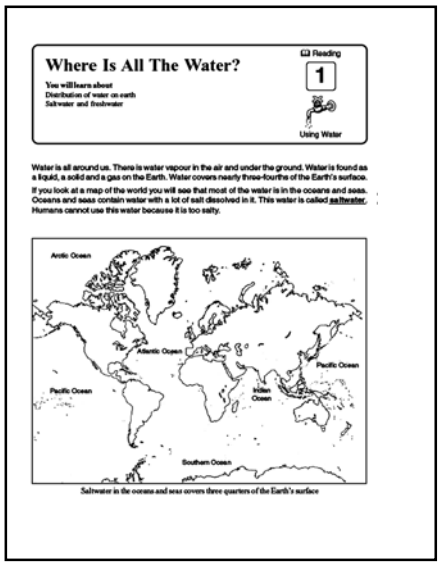
Discussion about water distribution on earth.

Key learning

Water covers 3/4ths of the earth.
Relative abundance of saltwater and freshwater. Distribution of freshwater in rivers, lakes, groundwater and icecaps.

Materials needed

Small bucket, a transparent container, two small dishes, measuring cylinder, teaspoon, a globe, pictures of icecaps, oceans and other water bodies.



Where Is All The Water?

Reading 1

You will learn about
Distribution of water on earth
Saltwater and freshwater

Using Water

Water is all around us. There is water vapour in the air and under the ground. Water is found as a liquid, a solid and a gas on the Earth. Water covers nearly three-fourths of the Earth's surface.

If you look at a map of the world you will see that most of the water is in the oceans and seas. Oceans and seas contain water with a lot of salt dissolved in it. This water is called saltwater. Humans cannot use this water because it is too salty.

Saltwater in the oceans and seas covers three quarters of the Earth's surface

1 Where Is All The Water?

Task

Reading about water distribution on earth.

Key learning

Relative abundance of saltwater and freshwater. Distribution of freshwater in rivers, lakes, groundwater and icecaps.

Teacher's role

Provide assistance with reading tasks.

Demonstration

T2 Groundwater

Task

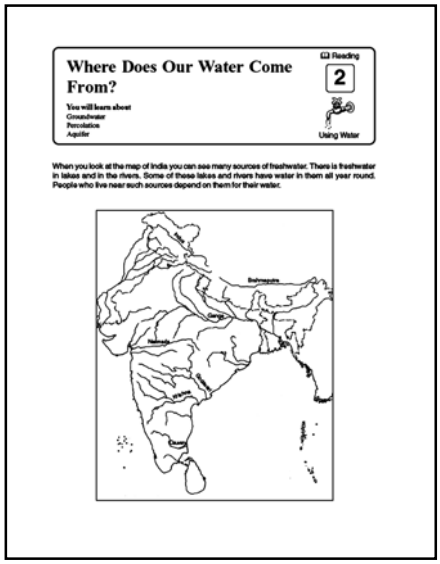
Explanation about groundwater.

Key learning

Water seeps through soil and collects underground in the aquifer. This is called recharge.
Groundwater can be contaminated by pollutants seeping in.

Teacher's role

Demonstrate how the aquifer gets recharged and the working of a borewell using a model.



Where Does Our Water Come From?

Reading 2

You will learn about
Groundwater
Percolation
Aquifer

Using Water

When you look at the map of India you can see many sources of freshwater. There is freshwater in lakes and in the rivers. Some of these lakes and rivers have water in them all year round. People who live near such sources depend on them for their water.

2 Where Does Our Water Comes From?

Task

Reading about groundwater.

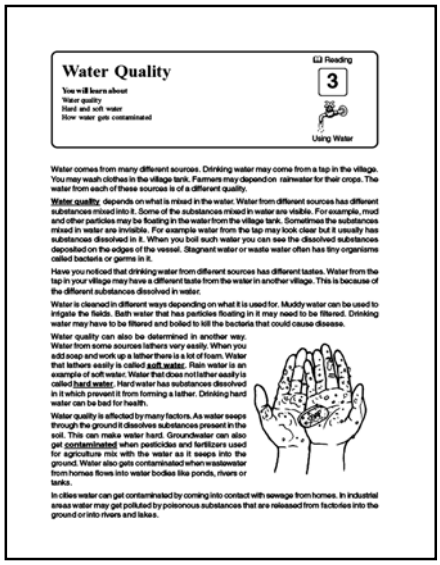
Key learning

Water seeps through soil and collects underground in the aquifer. This is called recharge.

Groundwater can be contaminated by pollutants seeping in.

Teacher's role

Provide assistance with reading tasks.



Water Quality

Reading 3

You will learn about
Water quality
Hard and soft water
How water gets contaminated

Using Water

Water comes from many different sources. Drinking water may come from a tap in the village. You may wash clothes in the village tank. Farmers may depend on rainwater for their crops. The water from each of these sources is of a different quality.

Water quality depends on what is mixed in the water. Water from different sources has different substances mixed into it. Some of the substances mixed in water are visible. For example, mud and other particles may be floating in the water from the village tank. Sometimes the substances mixed in water are invisible. For example water from the tap may look clear but it usually has substances dissolved in it. When you boil such water you can see the dissolved substances deposited on the edges of the vessel. Stagnant water or waste water often has tiny organisms called bacteria or germs in it.

Have you noticed that drinking water from different sources has different tastes. Water from the tap in your village may have a different taste from the water in another village. This is because of the different substances dissolved in water.

Water is cleaned in different ways depending on what it is used for. Muddy water can be used to irrigate the fields. Bath water that has particles floating in it may need to be filtered. Drinking water may have to be filtered and boiled to kill the bacteria that could cause disease.

Water quality can also be determined in another way. Water from some sources lathers very easily. When you add soap and work up a lather there is a lot of foam. Water that lathers easily is called soft water. Rain water is an example of soft water. Water that does not lather easily is called hard water. Hard water has substances dissolved in it which prevent it from forming a lather. Drinking hard water can be bad for health.

Water quality is affected by many factors. As water seeps through the ground it dissolves substances present in the soil. This can make water hard. Groundwater can also get contaminated when pesticides and fertilizers used for agriculture mix with the water as it seeps into the ground. Water also gets contaminated when wastewater from homes flows into water bodies like ponds, rivers or tanks.

In cities water can get contaminated by coming into contact with sewage from homes. In industrial areas water may get polluted by poisonous substances that are released from factories into the ground or into rivers and lakes.

3 Water Quality

Task

Reading about water quality.

Key learning

Water quality depends on what is mixed in the water.

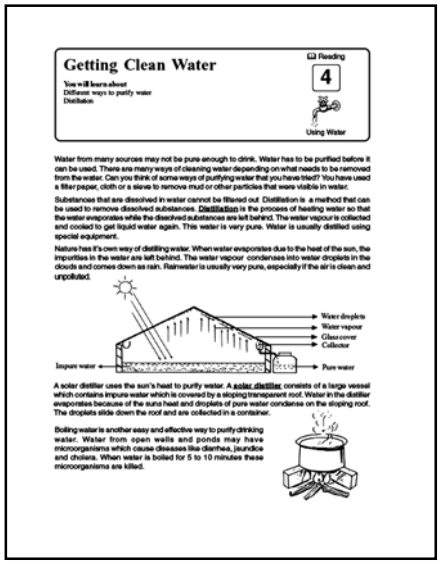
Materials needed

Rainwater, hard water, soap.

Teacher's role

Show how water foams with soft water but not with hard water.

Provide assistance with reading tasks.



Getting Clean Water

Reading 4

You will learn about
Different ways to purify water
Distillation

Using Water

Water from many sources may not be pure enough to drink. Water has to be purified before it can be used. There are many ways of cleaning water depending on what needs to be removed from the water. Can you think of some ways of purifying water that you have tried? You have used a filter paper, cloth or a sieve to remove mud or other particles that were visible in water.

Substances that are dissolved in water cannot be filtered out. Distillation is a method that can be used to remove dissolved substances. Distillation is the process of heating water so that the water evaporates while the dissolved substances are left behind. The water vapour is collected and cooled to get liquid water again. This water is very pure. Water is usually distilled using special equipment.

Nature has it's own way of distilling water. When water evaporates due to the heat of the sun, the impurities in the water are left behind. The water vapour condenses into water droplets in the clouds and comes down as rain. Rainwater is usually very pure, especially if the air is clean and unpolluted.

Water droplets
Water vapour
Glass cover
Collector
Impure water
Pure water

A solar distiller uses the sun's heat to purify water. A solar distiller consists of a large vessel which contains impure water which is covered by a sloping transparent roof. Water in the distiller evaporates because of the suns heat and droplets of pure water condense on the sloping roof. The droplets slide down the roof and are collected in a container.

Boiling water is another easy and effective way to purify drinking water. Water from open wells and ponds may have microorganisms which cause diseases like diarrhea, jaundice and cholera. When water is boiled for 5 to 10 minutes these microorganisms are killed.

4 Getting Clean Water

Task

Reading about water purification.

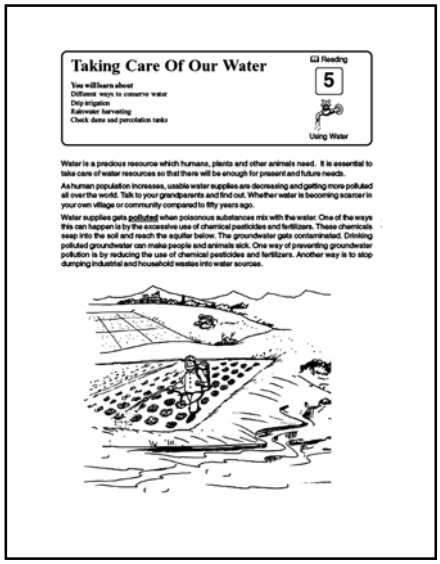
Key learning

The water quality needed depends on what the water is used for.

Different methods of purifying water.

Teacher's role

Provide assistance with reading tasks.



Taking Care Of Our Water

Reading 5

You will learn about
Different ways to conserve water
Drip irrigation
Rainwater harvesting
Check dams and percolation tanks

Using Water

Water is a precious resource which humans, plants and other animals need. It is essential to take care of water resources so that there will be enough for present and future needs.

As human population increases, usable water supplies are decreasing and getting more polluted all over the world. Talk to your grandparents and find out. Whether water is becoming scarcer in your own village or community compared to fifty years ago.

Water supplies gets polluted when poisonous substances mix with the water. One of the ways this can happen is by the excessive use of chemical pesticides and fertilizers. These chemicals seep into the soil and reach the aquifer below. The groundwater gets contaminated. Drinking polluted groundwater can make people and animals sick. One way of preventing groundwater pollution is by reducing the use of chemical pesticides and fertilizers. Another way is to stop dumping industrial and household wastes into water sources.

5 Taking Care Of Our Water

Task

Reading about water conservation.

Key learning

Different ways of conserving water – drip irrigation, rainwater harvesting, percolation tanks.

Teacher's role

Provide assistance with reading tasks.

Discussion

T3 Preparing For A Water Survey

Task

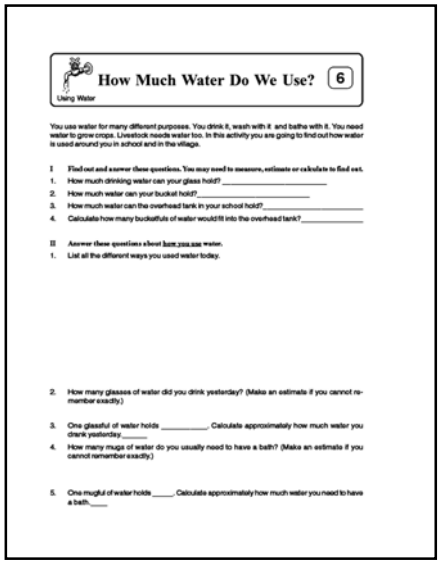
Giving instructions for a water survey.

Key learning

How to measure and estimate water quantities.

Teacher's role

Give instructions on how to measure and estimate water quantities.



How Much Water Do We Use? 6

Using Water

You use water for many different purposes. You drink it, wash with it and bathe with it. You need water to grow crops. Livestock needs water too. In this activity you are going to find out how water is used around you in school and in the village.

I Find out and answer these questions. You may need to measure, estimate or calculate to find out.

1. How much drinking water can your glass hold? _____
2. How much water can your bucket hold?_____
3. How much water can the overhead tank in your school hold?_____
4. Calculate how many bucketfuls of water would fill into the overhead tank?_____

II Answer these questions about how you use water.

1. List all the different ways you used water today.

2. How many glasses of water did you drink yesterday? (Make an estimate if you cannot remember exactly.)

3. One glassful of water holds _____. Calculate approximately how much water you drank yesterday._____

4. How many mugs of water do you usually need to have a bath? (Make an estimate if you cannot remember exactly.)

5. One mugful of water holds _____. Calculate approximately how much water you need to have a bath.____

6 How Much Water Do We Use?

Task

Survey of water usage in the school and community.

Key learning

Understanding water usage patterns.

Teacher's role

Provide assistance in collecting information in the school and community.

Discussion: Where Is All The Water? T1

This discussion focuses on the distribution of water on earth and highlights how a very small proportion of the earth's water is suitable and available for human use. A simple demonstration simulates the distribution of water.

What you need

Small bucket, a transparent container, two small dishes.
Measuring cylinder, teaspoon.
A globe.
Pictures of icecaps, oceans and other water bodies.

Ideas to talk about

- *"We find water almost everywhere on Earth. Can you think of places on earth where there is water?"* **(Oceans, rivers, lakes, underground.)**
- *"Let's look at the different sources of water on Earth and how much water there is in each source."*
- Ask a student to measure about 2200 ml of water and pour it into the bucket.
- *"Let's assume that this water in the bucket represents all the water on Earth. This water is in all the different places like rivers, lakes, oceans, icecaps and under ground."*
- *"Most of this water is salty. It is found in the oceans and seas. Can we use saltwater?"* **(No.)**
- Measure out 12 teaspoons of water into a small transparent container. *"This is the total freshwater on earth. This includes water found in all the lakes, rivers, icecaps and groundwater. Freshwater is not salty. Most land living plants and animals like us can only use freshwater."*
- Point to the water left in the bucket. *"This water is in the oceans and seas which cover most of the Earth."* Show a globe and point out all the areas covered by oceans and seas.
- *"Is there more saltwater or more freshwater on Earth?"* **(Saltwater.)** *"But only the freshwater is usable by us."*
- From the water in the small container let a student measure out 2 teaspoons into a dish. *"This is the water found under the ground. It is called groundwater."*
- Take out half a spoonful of water from the small container and put it in a second dish. *"This represents the water that we have in the lakes and rivers on Earth."*
- *"The water left in the small container represents the water that is stored in the icecaps. Icecaps cover large areas of the Earth where it is very cold and the water is frozen. We find enormous icecaps near the poles of the Earth."* Point out the polar regions on the globe.*"There is also a lot of ice and snow in cold high mountains."* Show pictures of snow covered mountains and polar icecaps.
- *"Where is there the most freshwater?"* **(Icecaps.)** *" Can we use it?"* **(No.)**
- *"We cannot use the water in the icecaps because it is solid ice. It is also found in very cold, inaccessible places on Earth."*
- *"Where is there the least freshwater?"* **(Rivers and lakes.)**

- *“Out of all this water on Earth which are the water sources that human beings can actually use?”* **(Rivers, lakes, underground.)**
- *“We can only use the freshwater that is available in rivers, lakes and underground. So although most of the Earth is covered by water, we can use only a very small part of it. That is why we often have a shortage of water we can use when we are not careful about how we use it. Water is a precious resource which we need to take care of.”*

Demonstration: Groundwater

T2

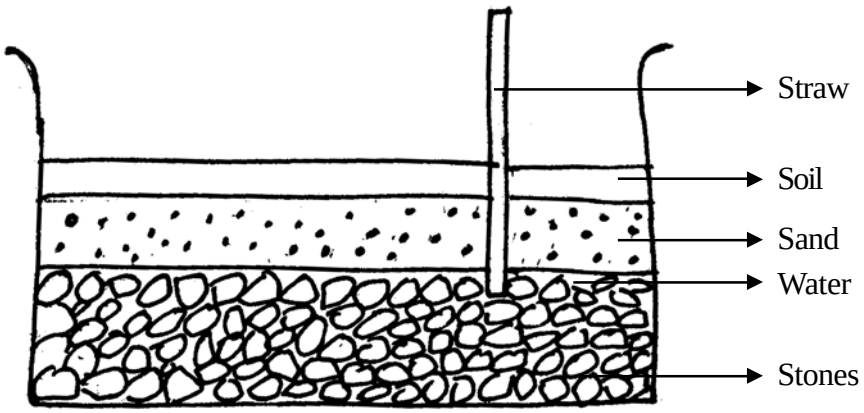
In this discussion students learn about groundwater, an important source of water in most of India. They learn about how water collects in the aquifer and how borewells work. A model of an aquifer is used to explain these processes.

What you need

A large beaker (1 litre capacity) or large transparent container,
Two small beakers with water, red ink, long dropper (or straw),
gravel (small stones), sand, topsoil or mud, water.

Making a groundwater model: Keep this ready before the class starts

- Take the large transparent container and put a layer of gravel about 7 to 8 cms deep at the bottom.
- Pour some water over the gravel till it is about 2 cms high from the bottom. This represents groundwater.
- Stick the long dropper or straw into the gravel with it's opening in the water.
- Pour a layer of sand about 4cms in depth.
- Add a layer of top soil about 2cm thick on top.
- The stones at the bottom represent the aquifer. The sand and soil represent the upper layers of soil through which water percolates. The dropper represents a bore well.
- Add a few drops of red ink to a small beaker of water and keep this ready. This represents contaminated water.
- Keep another beaker of plain water ready. This represents surface water from rain etc.



Ideas to talk about

- Talk about how we depend on groundwater and rainwater for all our needs. These are the only freshwater sources we have.
- *"We learnt about how rainwater reaches us when we studied the water cycle. Now let us find out more about groundwater."*

Groundwater model:

- Write all new words on the board as you introduce them.
- *"I'm going to show you a model of how we get groundwater."*
- Show the model and point out the different layers. Students would be familiar with them from the unit on soil.

- *"These are the various layers of soil that are beneath us. The topmost layer is the top soil."*
- *"The base of the container represents the **bedrock**. It is impermeable. Water cannot flow through it"*
- *"This layer of small rocks and sand at the bottom has spaces in it which can hold water. This layer is called the **aquifer**. An aquifer is a layer of soil and rock which is soaked with water. This is where we get our water from."*
- *"This dropper represents a bore well."* Use the dropper or straw to draw out some water from the bottom.
- *"When we draw water out of a bore well we are using this groundwater."*
- *"What will happen if we draw out all the water in this aquifer?"* **(If we take out too much water the aquifer will dry up and our bore well goes dry.)**
- *"Groundwater is a limited resource just like the water in a pond or tank."*
- *"Sometimes a bore well will go dry when too many people have dug bore wells nearby. Can you see why this happens?"* **(Each bore well is drawing water out of the aquifer. The ground water will run out.)**
- *"When we take water out of the aquifer we are drawing water from a common pool of groundwater. If one person draws out too much water other people will not have enough for their needs. It is important to share this limited resource carefully and fairly."*
- *" Usually bore wells don't go dry. When it rains, water falls on the land and some of it soaks through the soil and reaches the aquifer."* Pour some clear water from the beaker and let students watch how the water level in the aquifer goes up.
- *"This is called **recharge**. The aquifer gets refilled."*
- *"Why do you think our bore wells go dry in a year when there is little rain?"* **(If there is not enough rain there is not enough water to recharge the aquifer.)**
- *"After the rains, it takes some time (weeks or months) for bore wells to recharge. Why does it take so long?"* **(It takes time for the surface water to seep through the upper layers of soil.)**
- *"Do you think groundwater is a limited or unlimited source of water?"* **(It is limited.)**
- *"Here is another thing that can happen to groundwater. Substances on the surface can percolate into the groundwater. Watch what happens."* Pour some of the red coloured water onto the surface.
- *"This represents contaminated water. Water can get contaminated by pesticides and fertilizers that we spray on the soil and crops. It can also get contaminated by chemicals from factories and homes, whenever these are let out as waste."*
- After some time the red water will colour the water in the aquifer showing pollution of ground water. Draw students attention to this.
- *"Can we clean up groundwater easily once it is contaminated?"***(No.)**
- *"Borewells are owned by farmers. But who owns the water that is pumped out of each borewell?"* Let students answer. Point out that water from all borewells in an area are getting water from the same groundwater source.
- *"We cannot see groundwater, but it is a resource we need to take care of since we all depend on it and we all share it."*

Discussion: Preparing For A Water Survey

T3

Review how to measure the volume of water. Discuss and demonstrate how the volume of water can be estimated.

What you need

A measuring cylinder,
A glass (steel tumbler),
Mug, a bucket used in the school bathroom.

Ideas to talk about

- *"We can measure the amount of water in a container in millilitres or in litres."* Show the measuring cylinder. *"This cylinder holds 1000 ml of water, which is the same as 1 litre. It has markings on the sides to show how much water it holds upto a particular level."*
- *"How much water can your drinking water glass hold?"* Let students guess and answer.
- *"Let's measure it exactly and see."* Show students how to measure a glass of water using a measuring cylinder.
- *"How much water does this mug hold?"* Let students estimate. And then help them measure it using the measuring cylinder.
- Show them the bucket and tell them how much water it can hold. You can show them how to estimate the volume by measuring how many mugs you can pour in. Some buckets have the volume marked on them too. You could show this to the students.
- *"In the next activity you are going to estimate and find out how much water you use everyday. You can also find out how much water is used in your school and in your village."*
- *"You may know some of the information you need. You may have to go and find out some information from different people in school and in your village."*
- *"Sometimes you may have to measure. But often you can estimate the amounts of water used."*
- You can give them a few examples of how we could estimate how much water is there in different containers by relating it to the measures of water they already know eg: glassful, mugful, bucketful.

Going Further

Ideas for More Activities

Experiments and Investigations

- Testing water from different sources.

Making and Doing

- Building a simple solar water distiller.
- Making a water filter with local materials.
- Making a groundwater model.

Going outdoors

- Studying a drip irrigation system in the neighbourhood.
- Interviewing village elders about water sources that were used in the past.
- Interviewing village elders about traditional water conservation systems.
- Studying local water conservation systems.

Notes

Making Sounds

Introduction

In this unit students learn that sounds are produced by vibrations and that these vibrations travel from the source through a variety of materials. Different objects are used to illustrate a range of ways of producing sounds (plucking, striking, blowing etc). Two characteristics of sound - pitch and loudness are introduced and students learn how to distinguish between the two. Familiar musical instruments are introduced and classified as stringed, percussion and wind instruments. Students learn how sounds are produced when we speak and about noise pollution.

This unit would take approximately 10 hours of class time.

Objectives

This unit will help students to:

- Generalize that sounds are produced when something vibrates.
- Recognize and define what vibration is.
- Identify the vibrating part which is producing sound in different contexts.
- Distinguish between sounds based on their loudness and their pitch.
- Classify familiar instruments as stringed, percussion or wind instruments.
- Identify the vibrating part which is producing sound in different musical instruments.
- Recognize that sound travels through solids, water and air.
- Qualitatively compare how well sound travels through solids and air.
- Describe how we make sounds when we speak.
- Explain what noise pollution is and ways in which it can be reduced.

New Vocabulary

Vibration, audible, loudness, volume, pitch, wave, eardrum, voice box, larynx, vocal chords, percussion instruments, stringed instruments, wind instruments, noise, noise pollution.

Materials Required

For each group of students: Rubber bands, a metal plate, a stick or spoon, some paper, two paper cups, string (at least 5m long), a needle.

For the teacher: A musical instrument to demonstrate differences in pitch and volume (a stringed instrument like a guitar or a jal tarang made with glasses of water), a tuning fork, bowl of water.

Lesson Plan

Demonstration

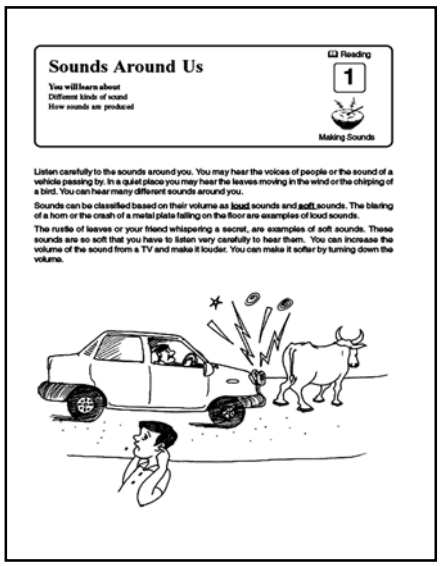
T1 Sounds Around Us

Task
Discussion to introduce sound.

Key learning
Sounds can be classified as loud and soft depending on their volume. They can be classified as high and low depending on their pitch. A vibrating object produces sound.

Materials needed
Rubber band, a musical instrument.

Teacher's role
Demonstrate sounds of different volumes and pitches.



Sounds Around Us

Reading 1

You will learn about
Different kinds of sound
How sounds are produced

Making Sounds

Listen carefully to the sounds around you. You may hear the voices of people or the sound of a vehicle passing by. In a quiet place you may hear the leaves moving in the wind or the chirping of a bird. You can hear many different sounds around you.

Sounds can be classified based on their volume as loud sounds and soft sounds. The blaring of a horn or the crash of a metal plate falling on the floor are examples of loud sounds.

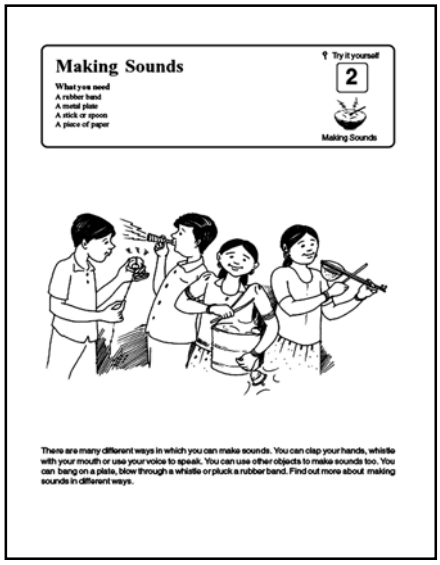
The rustle of leaves or your friend whispering a secret, are examples of soft sounds. These sounds are so soft that you have to listen very carefully to hear them. You can increase the volume of the sound from a TV and make it louder. You can make it softer by turning down the volume.

1 Sounds Around Us

Task
Reading about how sound is produced and the variety of sounds.

Key learning
Sounds can be classified as loud and soft and as high and low.
A vibrating object produces sound.

Teacher's role
Review new vocabulary.



Making Sounds

Try it yourself 2

What you need
A rubber band
A metal plate
A stick or spoon
A piece of paper

Making Sounds

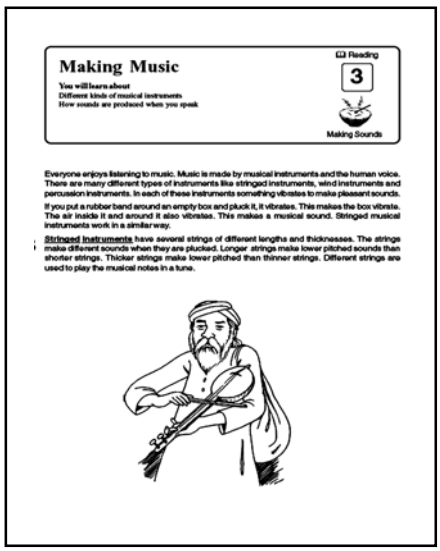
There are many different ways in which you can make sounds. You can clap your hands, whistle with your mouth or use your voice to speak. You can use other objects to make sounds too. You can bang on a plate, blow through a whistle or pluck a rubber band. Find out more about making sounds in different ways.

2 Making Sounds

Task
Experiments to observe how sound is produced.

Key learning
A vibrating object produces sound.

Materials needed
Rubber bands, a metal plate, a stick or spoon, some paper.



Making Music

Reading 3

You will learn about
Different kinds of musical instruments
How sounds are produced when you speak

Making Sounds

Everyone enjoys listening to music. Music is made by musical instruments and the human voice. There are many different types of instruments like stringed instruments, wind instruments and percussion instruments. In each of these instruments something vibrates to make pleasant sounds.

If you put a rubber band around an empty box and pluck it, it vibrates. This makes the box vibrate. The air inside it and around it also vibrates. This makes a musical sound. Stringed musical instruments work in a similar way.

Stringed Instruments have several strings of different lengths and thicknesses. The strings make different sounds when they are plucked. Longer strings make lower pitched sounds than shorter strings. Thicker strings make lower pitched than thinner strings. Different strings are used to play the musical notes in a tune.

3 Making Music

Task

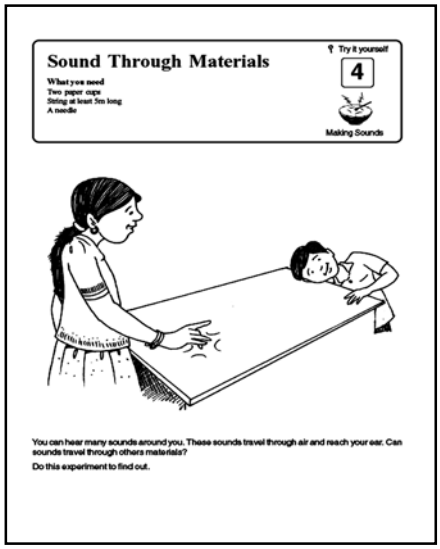
Reading about different types of musical instruments and the human voice.

Key learning

Different types of musical instrument have different vibrating parts which produce music.

Teacher's role

Provide assistance with reading if required.



Sound Through Materials

Try it yourself 4

What you need
Two paper cups
String at least 5m long
A needle

Making Sounds

You can hear many sounds around you. These sounds travel through air and reach your ear. Can sounds travel through others materials?

Do this experiment to find out.

4 Sound Through Materials

Task

Experiment to observe sound traveling through solids.

Key learning

Sounds can travel through solids as well as air.

Materials needed

Two paper cups, string at least 5m long, a needle.

Discussion

T2 Sound Through Materials

Task

Demonstration to show how sound waves travel.

Key learning

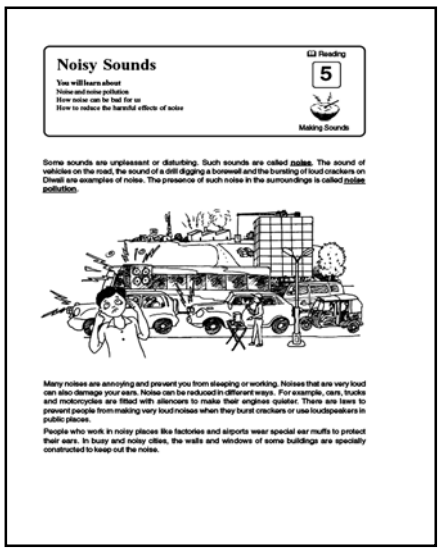
Sound needs a medium to travel. It can travel through solids, liquids and gases.

Materials needed

Bowl of water, tuning fork.

Teacher's role

Demonstrate and discuss how sounds travel through a medium.



Noisy Sounds

Reading 5

You will learn about
Noise and noise pollution
How noise can be bad for us
How to reduce the harmful effects of noise

Making Sounds

Some sounds are unpleasant or disturbing. Such sounds are called noise. The sound of vehicles on the road, the sound of a drill digging a borewell and the bursting of loud crackers on Diwali are examples of noise. The presence of such noise in the surroundings is called noise pollution.

Many noises are annoying and prevent you from sleeping or working. Noises that are very loud can also damage your ears. Noise can be reduced in different ways. For example, cars, trucks and motorcycles are fitted with silencers to make their engines quieter. There are laws to prevent people from making very loud noises when they burst crackers or use loudspeakers in public places.

People who work in noisy places like factories and airports wear special ear muffs to protect their ears. In busy and noisy cities, the walls and windows of some buildings are specially constructed to keep out the noise.

5 Noisy Sounds

Task

Reading about noise pollution and its effects.

Key learning

Unpleasant sounds are called noise. Noise pollution can damage health.

Teacher's role

Discuss students' experience of noise pollution and its prevention.

Information For The Teacher:

Sound is a form of energy. All sounds are produced by something that **vibrates** (moves rapidly back and forth). When we strike a plate the molecules in the plate start vibrating. Air molecules around the plate are set in vibration. This vibration is passed on to other molecules in the air. Vibrations thus travel through the air and reach our ear and we hear a sound.

Vibrations travel through the air in the form of **waves**. Vibrations are passed on from molecule to molecule in the air. Vibrations can also travel through solids and liquids in a similar manner. Sound needs a medium to travel through. It cannot travel in a vacuum since there are no molecules to vibrate and transmit the vibration.

A sound has three main characteristics – pitch, loudness and timbre.

The **pitch** of a sound is determined by its frequency ie the number of vibrations per second. A high pitched sound results from many vibrations per second. A low pitched sound results from fewer vibrations per second. A longer string vibrates at a lower frequency than a shorter string of the same thickness and produces a lower sound.

The **loudness** of a sound is determined by the distance the molecules are displaced. The greater the displacement, the louder the sound. A string that is plucked harder (ie the string is displaced more) will sound louder than the same string when it is plucked softly (ie the string is displaced less).

The difference in the sound or tone of two musical instruments is called timbre or quality.

Sounds are heard when the vibrations reach our ear. The structure of our ear is such that it is able to turn the vibrations reaching it into electrical signals that our brain can sense. Our ear can hear sounds of certain frequencies only. Sounds that our ear can hear are called **audible** sounds. Sounds that are unpleasant to the ear are called **noise**.

When sound reaches a surface, it may be transmitted, absorbed or reflected, depending on the nature of the surface. This influences the choice of materials for the construction of buildings. Hard surfaces reflect sound. Soft surfaces absorb sound. Hence they can be used to reduce noise.

Demonstration: Sounds Around Us

T1

The variety of sounds and the ways in which they can be classified is introduced in the this discussion.

What you need

Rubber band, a musical instrument to demonstrate differences in pitch and volume (a stringed instrument like a guitar or a jal tarang made with glasses of water).

Ideas to talk about

- *"Close your eyes for a few minutes and sit quietly. Listen carefully to all the sounds around you."*
- After a minute ask them to open their eyes and ask what sounds they heard. Give time for student responses.
- *"All these sounds are made by things around us. Which of these sounds were loud sounds?"* Give time for student responses.
- *"Which of these sounds were really soft?"* Give time for student responses.
- *"Sounds around us can be classified in different ways. We can classify them as loud sounds or soft sounds depending on their volume."* Give examples of loud sounds and soft sounds that they may have heard around them.
- *"We can make the sound coming out of a TV loud by turning up the volume. We can make it soft by turning down the volume."*
- *"Sounds can also be classified as high pitched sounds and low pitched sounds. High pitched sounds are those which are squeaky like the chirping of a cricket."* You could demonstrate a high pitched sound around you : a creaky door or dragging something across a blackboard.
- *"Low pitched sounds are like the growling of a dog or the starting of an engine."* You could demonstrate a low pitched sound around you: banging a large drum or empty bucket.
- *"We can make different sounds using this instrument."* Show the instrument you are going to use. Name it.
- Demonstrate how to make a loud and soft sound by striking the <u>same</u> glass in the jal tarang (or same string in the guitar). A loud sound is made by striking it hard, a soft sound by striking it gently. Draw students attention to that fact that you are striking the <u>same</u> glass and getting both a loud and soft sound.
- Demonstrate how to make a high pitched and low pitched sound by striking <u>different</u> glasses in the jal tarang (or different strings in the guitar). A high pitched sound is made by striking a glass that is full of water, a low pitched sound is made by striking a glass that is empty. Draw students attention to that fact that you are striking <u>different</u> glasses to get sounds of a different pitch.
- If students have experience singing you could ask them to sing a high note and a low note, and then to sing a note softly and loudly.
- You may need to spend some time clarifying this concept through repeated examples with the instrument. Students who have had little exposure to music/singing/playing an

instrument may take some time to differentiate between loudness and pitch as different characteristics of sound.

- *"All sounds are made when something vibrates. Watch what happens when I pluck this stretched rubber band."* Stretch a rubber band, pluck it and ask students to observe the vibration.
- *"Vibration means moving back and forth quickly. If you put your ear close to the rubber band you can hear the sound it makes as it vibrates."*
- *"When we strike the glass of water, it vibrates, the air and water inside it vibrates and we hear a sound. "*
- *"When we speak the vocal chords inside our throat vibrate and make a sound."*
- Ask students to feel their vocal chords vibrating by placing their fingers on their throat as they hum.

Discussion: Sound Through Materials

T2

This discussion reviews what students have observed so far. A demonstration to show what waves are and how they travel in water is used to explain how sound travels through a medium.

What you need

Bowl of water, tuning fork.

Ideas to talk about

- You could review the observations the students have made in the previous experiments by asking questions like these: *"What causes a sound?" "Can sound travel through wood? How do you know?" "Does sound travel better through air or wood? Why do you say so?" "Why can't you hear your friend speaking into the telephone when someone holds the string in the middle?"*
- *"You've observed that sound travels through wood and string and reaches your ear. Similarly sounds travel through air to reach your ear."*
- *"Sounds can also travel through liquids like water. When you go swimming, have you been able to hear sounds underwater?"* **(Yes.)**
- *"Sounds always need a material to travel through. On the moon and in outer space there is no air. You would not be able to hear any sounds on the moon, because the sound you make cannot travel when there is no material to travel through."*
- *"Lets see how sound travels. I'm going to make a sound with this tuning fork."* Strike a tuning fork and ask a student to listen to it from close.
- *"Can you hear the sound that this tuning fork is making? Watch how it vibrates."* Allow students to observe the vibrations of the tuning fork.
- Now strike it again and touch it to the surface of the water in the bowl. Ripples will be formed as the vibrations travel through the water.
- Ask the students to observe the ripples. *"These ripples are being made as the vibrations from the tuning fork are traveling through the water. If you were inside the water you would be able to hear the sound of the tuning fork."*
- *"Sound vibrations travel through materials like air and wood in waves like the ones you can see in the water. We say that sound travels in waves through materials."*

Going Further

Ideas for More Activities

Experiments and Investigations

- Testing your hearing.
- Investigating how to use different materials to reduce noise.
- Experiments with echoes.

Making and Doing

- Making simple musical instruments: manjira (cymbals), ghatam (mud pot), ektara (with a coconut shell/pot and string), jal tarang.

Notes

Human Body

Introduction

This short unit introduces students to the human body. Students learn that the body is made of organs which work together in different systems. They are also introduced to cells as the basic building blocks of the body.

This unit lays the foundation for further study of the structure and function of different systems in the human body in the units "Food and Nutrition", "Movement", "Respiration" and "Circulation and Excretion". This unit links to concepts covered in "Animals".

This unit would take approximately 1 hour of class time.

Objectives

This unit will help students to:

- Explain what a cell is.
- Name and draw some types of cells found in the human body.
- Explain what an organ is.
- Name important organs in the body (heart, brain, lungs, kidneys, stomach, liver, intestines).
- Identify where these organs are located in their own body.
- Describe what a body system is and give examples.

New Vocabulary

Cells, organs, systems.

Materials Required

For each group of students: Outline of the human body, paper cut outs of different organs (heart, brain, lungs, kidneys, stomach, liver, intestines).

For the teacher: Chart with outline of the human body, paper cut outs of different organs (heart, brain, lungs, kidneys, stomach, liver, intestines).

Lesson Plan

Discussion

T1 What Is Our Body Made Of?

Task

To introduce the human body and the location of different organs in the body.

Key learning

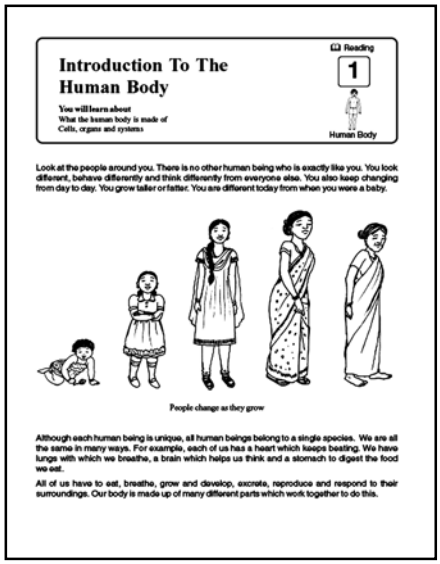
Organs in the body work together in different systems.
Organs are made up of cells.

Materials needed

Chart with outline of the human body.
Cut outs of different organs which fit into the outline.

Teacher's role

Introduce the location of the main organs in the human body.



Reading 1

Introduction To The Human Body

You will learn about
What the human body is made of
Cells, organs and systems

Human Body

Look at the people around you. There is no other human being who is exactly like you. You look different, behave differently and think differently from everyone else. You also keep changing from day to day. You grow taller or fatter. You are different today from when you were a baby.

People change as they grow

Although each human being is unique, all human beings belong to a single species. We are all the same in many ways. For example, each of us has a heart which keeps beating. We have lungs with which we breathe, a brain which helps us think and a stomach to digest the food we eat.

All of us have to eat, breathe, grow and develop, excrete, reproduce and respond to their surroundings. Our body is made up of many different parts which work together to do this.

1 Introduction To The Human Body

Task

To read about how systems, organs and cells make up the human body.

Key learning

Organs in the body work together in different systems.
Organs are made up of cells.

Discussion: What Is Our Body Made Of? T1

In this discussion introduce the systems in the body as having different functions which are necessary for keeping us alive. The concept of a system being made up of different organs which work together is introduced.

What you need

Chart with outline of the human body.
Cut outs of different organs which fit into the outline.

Ideas to talk about

About systems in the human body:

- Ask students what is inside their head. **(Brain.)**
- *"What does the brain do?"* **(It helps us think.)**
- *"The brain is an organ. A part of our body which does a specific task is called an organ. The stomach is an organ which helps us digest our food. Can you name other organs?"* Let students respond.
- *"Different organs work together in a system. For example the stomach works with our mouth, food pipe, intestines and liver, to help us eat, digest our food and send out wastes. These organs make up the digestive system. We have different systems in our body which do different tasks. For example the respiratory system helps us breathe and get oxygen. It is made of organs like the lungs."*
- *"Each organ is made up cells which are very small. You can only see cells under a microscope. There are many different cells in our body."*

Where different organs are located:

- Ask students where each of these organs are located in their body: heart, lungs, brain, stomach, kidneys, liver, small intestine, large intestine. Ask them to place their hand on the approximate location on their body. You could show the location by placing the paper cut out of each organ on the outline of the human body.
- Point out that organs may overlap each other - some being towards the front of the body, while some are towards the back. For example the kidneys are towards the back of the body while the intestines are towards the front in the abdomen.
- Students could place the cut outs of the organs on the outline of the human body to familiarize themselves with the locations of important organs.
- Tell them, *"We will be learning more about these organs and what they do as we learn about different systems in our body in the next few units."*

Food And Nutrition

Introduction

In this unit students learn about the basic concepts of nutrition and digestion. In the first part of the unit the main food groups (carbohydrates, proteins, fats, vitamins and minerals) are introduced along with the concept of a balanced diet and its importance. Students are encouraged to examine their own diets to see if they are balanced. The second part of this unit introduces the digestive system and the process of digestion.

This unit can be done after the preliminary unit on introducing the human body has been done. It links to units on "Movement", "Respiration" and "Circulation and Excretion".

This unit would take about 9 hours of class time.

Objectives

This unit will help students to:

- Explain that the body needs food to remain healthy, active and to grow.
- List the the basic nutrients we need: carbohydrates, proteins, fats, vitamins and minerals.
- Explain the function of carbohydrates: to give us energy.
- Explain the function of proteins: for growth and to repair parts of our bodies.
- Explain the function of fats: to give energy and keep us warm.
- Explain the function of vitamins and minerals: to keep us healthy and prevent disease.
- Explain that water and fibre are necessary for our body.
- Recognize and select common sources of these nutrient groups in their diets.
- Explain what a balanced diet is and it's importance.
- Evaluate their diet and see if it is balanced.
- Create a balanced diet for themselves.
- Describe the functions of the main organs in the digestive system: mouth, oesophagus, stomach, liver, small and large intestine.
- To describe the main stages in the process of digestion.

New Vocabulary

Nutrients, carbohydrates, proteins, fats, vitamins, minerals, balanced diet, digestion, food pipe, small intestine, large intestine, liver.

Materials Required

For each group of students: Food packaging with nutrient labels, a set of digestive system game cards.

For the teacher: Chart of the digestive system, a rope about 7m long, chart of food guide pyramid, some food samples from each food group (rice, dal, fruits, vegetables, oil) or pictures.

Lesson Plan

Discussion

T1 Why Do We Eat Food?

Task

Discussion to introduce why we need food and what food contains.

Key learning

We need food to survive and grow.
We eat a variety of food that contain different nutrients.

Materials needed

Samples (or pictures) of some foods from each food group.
Food pyramid chart.

Why Do We Eat?

Reading 1

You will learn about
Why you need to eat
What nutrients are

Food And Nutrition

It's almost lunchtime and you are feeling really hungry. You may be wondering what will be served for lunch today. You can hear your stomach rumbling. Your body is reminding you that you need to eat soon. But why do we need to eat?

Your body is always active. You are walking, talking, thinking or playing all day long. Even when you are asleep your body is working hard. You are breathing, your heart is pumping and you are growing. Just like a vehicle needs fuel to keep it going, your body needs food to stay alive. The food that you eat provides energy to your body so you can be active. The food you eat also helps you grow and stay healthy.

1 Why Do We Eat?

Task

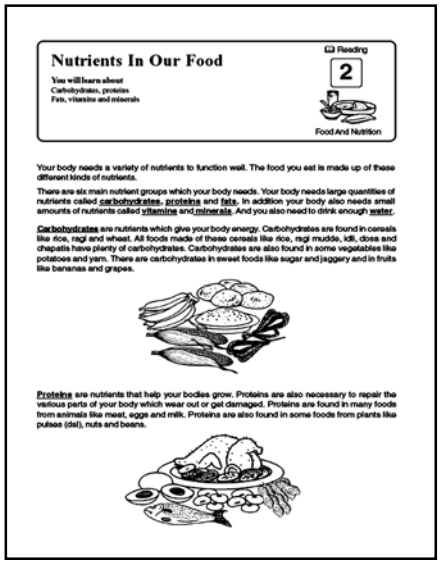
Reading about why we need food and what food contains.

Key learning

We need food to survive and grow.
We eat a variety of food that contains different nutrients.

Teacher's role

Provide assistance with reading if required and review new vocabulary.



Nutrients In Our Food

Reading 2

You will learn about
Carbohydrates, proteins
Fats, vitamins and minerals

Food And Nutrition

Your body needs a variety of nutrients to function well. The food you eat is made up of these different kinds of nutrients.

There are six main nutrient groups which your body needs. Your body needs large quantities of nutrients called carbohydrates, proteins and fats. In addition your body also needs small amounts of nutrients called vitamins and minerals. And you also need to drink enough water.

Carbohydrates are nutrients which give your body energy. Carbohydrates are found in cereals like rice, ragi and wheat. All foods made of these cereals like rice, ragi mudde, idli, dosa and chapatis have plenty of carbohydrates. Carbohydrates are also found in some vegetables like potatoes and yam. There are carbohydrates in sweet foods like sugar and jaggery and in fruits like bananas and grapes.

Proteins are nutrients that help your bodies grow. Proteins are also necessary to repair the various parts of your body which wear out or get damaged. Proteins are found in many foods from animals like meat, eggs and milk. Proteins are also found in some foods from plants like pulses (dal), nuts and beans.

2 Nutrients In Our Food

Task

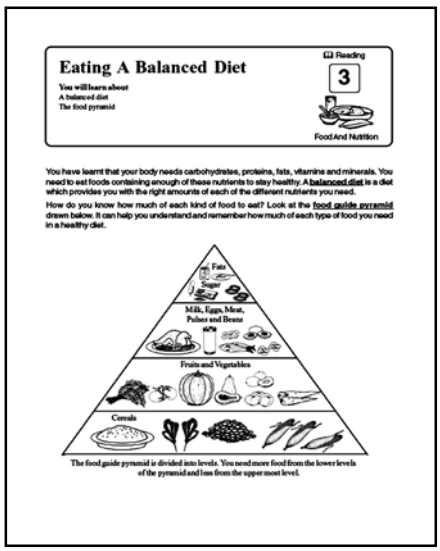
Reading about the different nutrients, their sources and functions.

Key learning

Sources and functions of carbohydrates, proteins, fats, vitamins and minerals.

Teacher's role

Discuss nutrients contained in locally available foods.
Assist students in reading nutritional tables and labels.



Eating A Balanced Diet

Reading 3

Food And Nutrition

You will learn about
A balanced diet
The food pyramid

You have learnt that your body needs carbohydrates, proteins, fats, vitamins and minerals. You need to eat foods containing enough of these nutrients to stay healthy. A balanced diet is a diet which provides you with the right amounts of each of the different nutrients you need.

How do you know how much of each kind of food to eat? Look at the food guide pyramid drawn below. It can help you understand and remember how much of each type of food you need in a healthy diet.

The food guide pyramid is divided into levels. You need more food from the lower levels of the pyramid and less from the upper most level.

3 Eating A Balanced Diet

Task

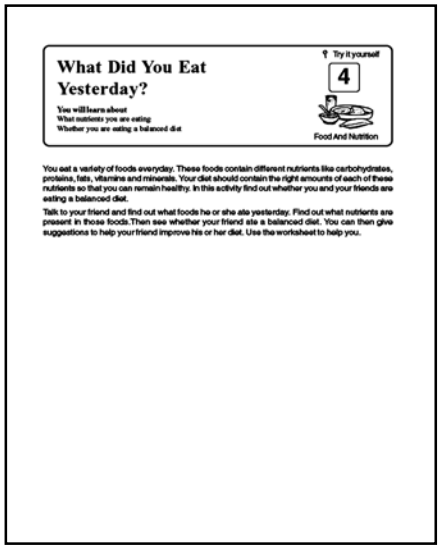
Reading about a balanced diet and its importance.

Key learning

Balanced diet, food pyramid.

Teacher's role

Give examples of local and traditional foods for each level of the food pyramid.



What Did You Eat Yesterday?

Try it yourself 4

Food And Nutrition

You will learn about
What nutrients you are eating
Whether you are eating a balanced diet

You eat a variety of foods everyday. These foods contain different nutrients like carbohydrates, proteins, fats, vitamins and minerals. Your diet should contain the right amounts of each of these nutrients so that you can remain healthy. In this activity find out whether you and your friends are eating a balanced diet.

Talk to your friend and find out what foods he or she ate yesterday. Find out what nutrients are present in those foods. Then see whether your friend ate a balanced diet. You can then give suggestions to help your friend improve his or her diet. Use the worksheet to help you.

4 What Did You Eat Yesterday?

Task

Activity to use the food pyramid/guide and evaluate your diet.

Key learning

Nutrients in different foods.
Components of a balanced diet.

Teacher's role

Provide assistance in identifying nutrients in common foods.

Discussion

T2 The Digestive System

Task

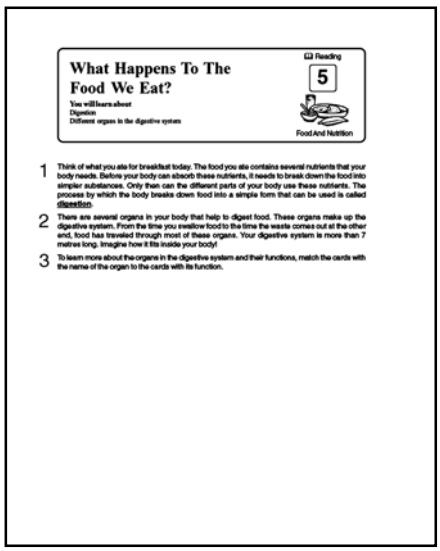
Discussion about the process of digestion.

Key learning

Process of digestion. The organs in the digestive system and their function: mouth, food pipe, stomach, small and large intestines, liver.

Materials needed

Chart of the digestive system, a rope about 7m long.



What Happens To The Food We Eat?

Reading 5

You will learn about
Digestion
Different organs in the digestive system

Food And Nutrition

1 Think of what you ate for breakfast today. The food you ate contains several nutrients that your body needs. Before your body can absorb these nutrients, it needs to break down the food into simpler substances. Only then can the different parts of your body use these nutrients. The process by which the body breaks down food into a simple form that can be used is called digestion.

2 There are several organs in your body that help to digest food. These organs make up the digestive system. From the time you swallow food to the time the waste comes out at the other end, food has traveled through most of these organs. Your digestive system is more than 7 metres long. Imagine how it fits inside your body!

3 To learn more about the organs in the digestive system and their functions, match the cards with the name of the organ to the cards with its function.

5 What Happens To The Food We Eat?

Task

Reading and matching game about the digestive system.

Key learning

Function of the organs in the digestive system: mouth, food pipe, stomach, small and large intestines, liver.

Materials needed

A set of game cards.

Teacher's role

Provide assistance with reading if required and review new vocabulary.

Information For The Teacher:

We need food for energy, to grow and repair our body and to remain healthy. Different nutrients in food help us satisfy these needs.

There are 3 nutrient groups which we need in large quantities. They are called the macronutrients. They are carbohydrates, fats and proteins. Carbohydrates give us energy, proteins help us grow and repair body parts and fats give us energy.

In addition we need small quantities of vitamins and minerals to stay healthy. Vitamins and minerals are used in all processes in our bodies. There are many different vitamins and minerals, each with their own function. A few have been discussed in this unit (Vitamin A, Calcium, Iron).

We also need adequate water and fibre in our diets. Fibre is found in many fruits and vegetables and in whole grains. Fibre helps to remove wastes from our body.

A balanced diet contains sufficient amounts of each of the nutrients we need. A food guide pyramid is a simple way to remember what we need to eat for a balanced diet. The food guide pyramid has four levels which represent the food groups we need to include in our diets. We need 6 to 11 servings of cereal foods, 6 to 9 servings of fruits and vegetables, 4 to 6 servings of proteins and only small quantities of oily and sugary foods.

Students should be encouraged to identify locally available foods which fit into each of these food groups and to observe and think about their own eating habits using the food guide as a reference. It is also useful to highlight that some foods from a food group are more nutritious than others. For example, ragi is a more nutritious cereal than raw milled white rice since ragi contains more vitamins,minerals and fibre.

Food that we eat needs to be digested before it can be used by our body. Digestion is a process by which food is physically broken down into smaller particles and chemically changed into simpler substances. Digestion happens in several stages.

In the mouth, teeth grind up the food and saliva breaks down some of the starches in food. Food passes down the food pipe due to the movement of muscles in the food pipe. In the stomach, food is churned up with gastric juices which begin digesting the proteins and also killing off any germs in the food.

In the small intestine, fats, proteins and starches are broken down further by the action of digestive juices from the liver and pancreas which are glands in our abdomen. Digested food is absorbed by blood vessels in tiny finger like projections called villi in the small intestine. Water and undigested food (including fibre) move into the large intestine. Water is absorbed into the bloodstream here. Semi solid waste matter then moves to the lower part of the large intestine from where it leaves the body.

Discussion: Why Do We Eat Food? T1

Discuss why food is necessary for the body. Introduce the basic nutrients we need and their functions: carbohydrates, proteins, fats, vitamins and minerals. Introduce the common sources of these nutrients in the local diet. Explain the importance of a balanced diet.

What you need

Samples (or pictures) of some foods from each food group: rice, ragi etc for carbohydrates, meat, dal, egg etc for proteins, oil for fats, different coloured vegetables and fruits (papaya, green veg, tomatoes, lemon etc) for vitamins and minerals.
Food pyramid chart.

Ideas to talk about

Why we need to eat:

- Say *"Did you all eat breakfast today?"* **(Yes.)**
- *"Why do we need to eat?"*
- Through questions elicit the fact that we need to eat to remain active. We feel tired, light headed, grumpy etc when we skip a few meals.
- Through questions elicit the fact that we need to eat to grow and to stay healthy.
- *"Food is very important to us. It is the fuel that keeps our body going. It helps us grow and repair worn out body parts. It keeps us healthy."*

Nutrients in our food:

- *"What did you eat for breakfast today?"* **(Eg Porridge.)**
- *"The food you ate (Eg: Porridge) is made of several ingredients . Can you name the ingredients? (Eg wheat, milk, jaggery). Each of these ingredients has several different nutrients in them which our body needs."*
- *"Nutrients are substances in food that our body uses. There are 5 basic types of nutrients that our body needs."*
- *"Cereals like these give us energy. They contain a lot of carbohydrates."* Show rice, wheat.
- *"Carbohydrates are nutrients which give us energy. We need them to stay active. There are plenty of carbohydrates in most cereals and vegetables like potatoes, yam etc."*
- *"We also need proteins. Proteins are nutrients that help us grow. Proteins are found in many animal foods like meat, fish, eggs, milk. Pulses like dal (show dal), beans like rajma also have plenty of proteins. We need to eat enough of these kinds of food everyday."* Show illustrations or samples of these foods.
- *"The third major nutrient we need are fats. We get fats from oil, butter, ghee etc. Fats are sources of energy which our body can store. We need small amounts of fats."*
- *"Vitamins and minerals are very important nutrients which help us to prevent diseases and stay healthy. Vitamins and minerals are found in small quantities in most foods. Fruits and vegetables are especially good sources of vitamins and minerals."*

- *"There are many different vitamins and minerals which help us in different ways. For example calcium is a mineral which helps us have strong teeth and bones. We get calcium from milk, ragi and green vegetables."*

A balanced diet:

- *"It's important to eat the right amount of different kinds of food to stay healthy and active. We can use this chart, called the food guide pyramid to help us remember how much of each kind of food we need."*
- Show the chart.
- *"The chart is divided into 4 levels. Each level represents a different food group. The bigger the level, the more of that kind of food you need. Which is the biggest level?"* **(The bottom most one.)**
- *"Look at the bottom most level. What kinds of foods does it show?"* **(Rice, wheat, ragi.)**
- *"All these grains are cereals. How do we know a grain is a cereal?"* **(We can't split the grain into two halves.)**
- *"What kind of nutrients are cereals a good source of?"* **(Carbohydrates.)** *"Cereals also have some proteins, vitamins and minerals. Whole grain cereals like ragi are more nutritious that polished cereals like white rice."*
- *"We need to eat the most amount of cereals. We can remember that because the base of the triangle is the biggest level."* Point to the chart and explain.
- *"What foods can you see in the next level?"* **(Fruits and vegetables.)**
- *"What nutrients do you think these foods provide?"* **(Vitamins and minerals.)** *"Many fruits and vegetables also provide carbohydrates and fibre."*
- *"We need vitamins and minerals to stay healthy. Different fruits and vegetables provide us with different vitamins and minerals. Its important to eat a variety of vegetables and fruits. Green leafy vegetables are especially nutritious. Can you name some leafy vegetables you eat?"* Let students name locally produced green vegetables.
- *"What foods can you see in the next level?"* **(Milk, eggs, meat, pulses, groundnuts.)**
- *"Can you name some pulses and beans that you eat?"* Let students name locally available dals and bean varieties.
- *"What nutrients do you think these foods provide?"* **(Proteins.)** *"Foods from this level help us grow."*
- *"If we sprout dals and beans before eating them they become even more nutritious."*
- *"Look at the topmost level. It is the smallest of all the levels. We need to less of these foods than the others. This level represents oily and sugary foods. Can you name some?"* **(Murukku, biscuits, chocolates etc.)** *"Too much of these foods causes diseases."*
- *"When we eat enough foods from each level of the food guide pyramid we are eating a balanced diet which helps us to stay active, healthy and to grow."*

Discussion: The Digestive System

T2

Explain the functioning of the digestive system in this discussion.

What you need

Chart of the digestive system,
A rope about 7m long.

Ideas to talk about

Review the concepts covered so far:

- Ask questions like these to review what students have learnt. What are nutrients? What are the main nutrients we need? What are their common local sources?
- What is a balanced diet? Which are the main food groups?

Introducing digestion:

- *"We have studied about how our body needs food to stay healthy and active. But our body cannot use food in the form in which we eat it. It needs to convert it into a form that it can use."*
- *"The process by which different organs in our body convert the food we eat into a usable form is called digestion. Food goes through various organs which help to digest it. Together they make up the digestive system."* Show the chart of the digestive system.
- *"Let's see what happens to the food we eat."*
- *"We first put food into our mouth. What do you think happens there?"* Let students answer - chew it, taste it, mixes with saliva etc.
- *"We use our teeth to bite off the food and then chew it. Saliva in our mouth wets the food. As we chew, the food gets ground into a paste. Chemicals in the saliva also begin chemically breaking down the food. Finally we swallow the food."*
- *"Our food goes down a narrow pipe called the food pipe or esophagus."* Show it on the chart. *"The muscles in this pipe squeeze the food down to the stomach. In fact, even if you stood on your head, you would be able to swallow food and it would reach your stomach!"*
- *"The food pipe is about this long."* Show about 25 cms on the rope. You could tie a knot at that point of the rope. You could also label it with a tag "STOMACH".
- *"The stomach is like a flexible pouch made of muscles."* Point out the stomach on the chart. *"It mashes the food further. More chemicals are secreted by the stomach walls and mixed with the food. These chemicals further break up the food into simpler substances."*
- *"Then the liquidy food goes into another long thin tube called the small intestine."* Point out the small intestine on the chart. *"The small intestine is REALLY long. It is about 6 m long."* Unravel another 6m of the rope and show the students. *"Imagine how such a long tube fits into your abdomen. It fits because it is all coiled up."*
- *"In the small intestine food is digested further. A large gland called the liver secretes chemicals into the small intestine which help to do this."* Point out the liver on the chart.

- *“As this digested food moves further along the small intestine it is absorbed by our body. There are tiny blood vessels in the walls of the small intestine which absorb the nutrients from the food and take them to other parts of the body.”*
- *“Now undigested food and water move into another tube which is thicker called the large intestine. The large intestine is about 1 metre long.”* Unwind another 1m from the rope.
- *“In the large intestine water is absorbed by our body. Then undigested food is ready to be thrown out of the body.”*

Going Further

Ideas for More Activities

Experiments and Investigations

- Testing for proteins, fats and starch.
- Looking at food labels on packaged food (biscuits etc).
- Experiment to observe how the taste of rice changes in the mouth.
- Why is rice milled? What is the difference in nutritive value between milled and whole grain rice? Which is better? Why? Investigate these questions.
- To know what happens when we eat contaminated food and how to treat diarrhoea.

Making and Doing

- Making a model of the digestive system.
- Making a food guide pyramid chart using local foods.

Going Outdoors

- Interviewing elders in the village to find out the different varieties of cereals, pulses and vegetables that were eaten traditionally.
- Interviewing elders in the village to find out about dishes that were made traditionally but are not common now. What were those dishes made of? Were they nutritious?
- To plan/cook a balanced midday meal in school. Interview the cook etc.

Notes

Movement

Introduction

In this unit students learn about movement in the human body by observing the variety of movements that their bodies can make. They learn about bones and joints and the functions of the skeletal system. They are introduced to how muscles function and the different kinds of muscles in the body.

This unit follows the introductory work on the "Human Body". It has links with other units on the human body: "Food And Nutrition", "Respiration" and "Circulation And Excretion".

The unit would take about 9 hours of class time.

Objectives

This unit will help students to:

- Recognize different body movements: large and small movements, voluntary and involuntary movements.
- Identify some bones in the body: skull, vertebrae, ribs, bones in the arm and leg.
- Explain how our bones are joined together at the joints.
- Identify different joints in the body: elbow, wrist, ankle, hip, shoulder etc.
- Recognize different types of joints in the body: hinge joints, pivot joint, ball and socket joints, fixed joints.
- Compare how different kinds of joints move.
- Explain how the skeletal system supports the body, helps in movement and protects internal organs.
- Explain how muscles work with bones to enable movement.
- Recognize different kinds of muscles: skeletal or voluntary muscles, involuntary muscles and heart muscles.
- Explain how skeletal muscles expand and contract as they enable movement.

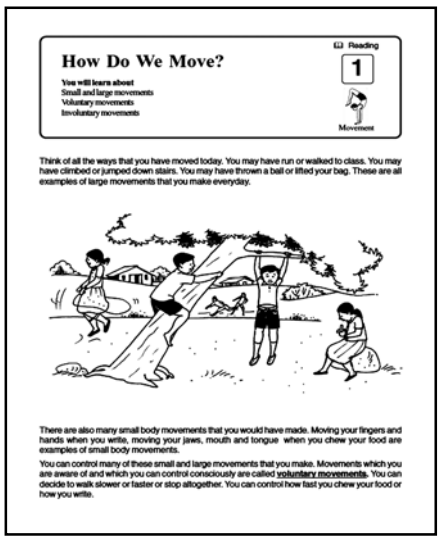
New Vocabulary

Voluntary movements, involuntary movements, bones, muscles, joints, hinge joints, pivot joint, ball and socket joints, fixed joints, skeletal system, skeletal muscles, cardiac muscle, smooth muscle, involuntary muscles, heart muscles.

Materials Required

For each group of students: Stick, rope.

For the teacher: Models of different types of joints, x ray, model of arm with elbow joint and biceps and triceps.



Reading 1

How Do We Move?

You will learn about
Small and large movements
Voluntary movements
Involuntary movements

Movement

Think of all the ways that you have moved today. You may have run or walked to class. You may have climbed or jumped down stairs. You may have thrown a ball or lifted your bag. These are all examples of large movements that you make everyday.

There are also many small body movements that you would have made. Moving your fingers and hands when you write, moving your jaws, mouth and tongue when you chew your food are examples of small body movements.

You can control many of these small and large movements that you make. Movements which you are aware of and which you can control consciously are called **voluntary movements**. You can decide to walk slower or faster or stop altogether. You can control how fast you chew your food or how you write.

1 How Do We Move?

Task

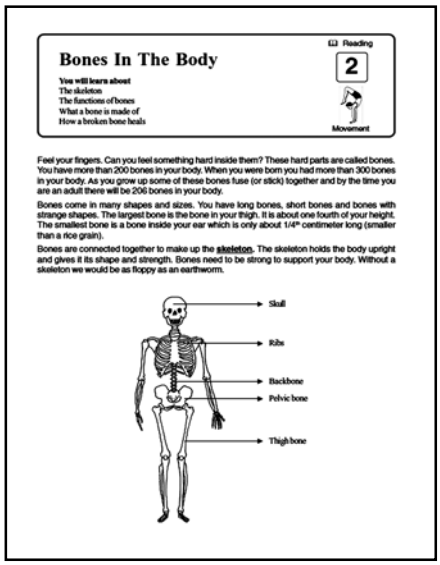
Reading about movements in the body.

Key learning

Large and small movements, voluntary and involuntary movements. Bones and muscles help us move.

Teacher's role

Discuss examples of different kinds of movements.



Reading 2

Bones In The Body

You will learn about
The skeleton
The functions of bones
What a bone is made of
How a broken bone heals

Movement

Feel your fingers. Can you feel something hard inside them? These hard parts are called bones. You have more than 200 bones in your body. When you were born you had more than 300 bones in your body. As you grow up some of these bones fuse (or stick) together and by the time you are an adult there will be 206 bones in your body.

Bones come in many shapes and sizes. You have long bones, short bones and bones with strange shapes. The largest bone is the bone in your thigh. It is about one fourth of your height. The smallest bone is a bone inside your ear which is only about 1/4th centimeter long (smaller than a rice grain).

Bones are connected together to make up the **skeleton**. The skeleton holds the body upright and gives it its shape and strength. Bones need to be strong to support your body. Without a skeleton we would be as floppy as an earthworm.

Skull
Ribs
Backbone
Pelvic bone
Thigh bone

2 Bones In The Body

Task

Reading about bones, the skeletal system and their functions.

Key learning

Bones are hard, strong and light. They support the body, protect internal organs and help us move. Bones are joined together and make up the skeleton.

Teacher's role

Provide assistance with reading if required.

Try it yourself 3

Different Ways Of Moving

What you need
A long (about ½ m) stick or scale
Some rope or string

Movement

Have you ever done yoga or gymnastics? You would have noticed that your body is very flexible. It can move in several ways. You can squat on the floor, jump from a rock, shake your head and touch your toes.

Do this activity and observe the different ways your body can move.

3 Different Ways Of Moving

Task

Activity to observe the movements of different joints.

Key learning

Different joints enable different movements.

Materials needed

Stick, rope.

Lesson Plan

Discussion

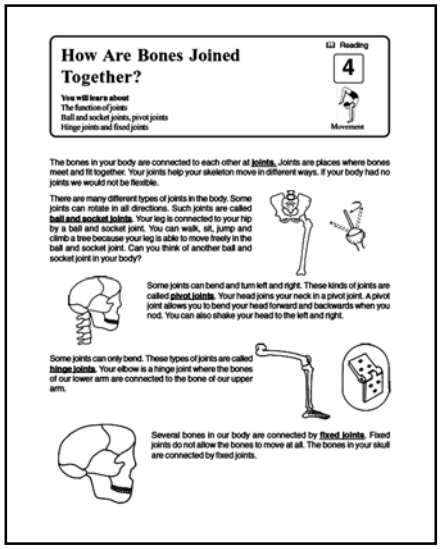
T1 How Are Bones Joined Together?

Task
Discussion about joints.

Key learning
Bones fit into each other at joints.
Similarities and differences in movements of different joints.

Materials needed
Model of different types of joints.
X ray of some part of the skeletal system.

Teacher's role
Demonstrate how different joints move.



How Are Bones Joined Together?

Reading 4

You will learn about
The function of joints
Ball and socket joints, pivot joints
Hinge joints and fixed joints

Movement

The bones in your body are connected to each other at **joints**. Joints are places where bones meet and fit together. Your joints help your skeleton move in different ways. If your body had no joints we would not be flexible.

There are many different types of joints in the body. Some joints can rotate in all directions. Such joints are called **ball and socket joints**. Your leg is connected to your hip by a ball and socket joint. You can walk, sit, jump and climb a tree because your leg is able to move freely in the ball and socket joint. Can you think of another ball and socket joint in your body?

Some joints can bend and turn left and right. These kinds of joints are called **pivot joints**. Your head joins your neck in a pivot joint. A pivot joint allows you to bend your head forward and backwards when you nod. You can also shake your head to the left and right.

Some joints can only bend. These types of joints are called **hinge joints**. Your elbow is a hinge joint where the bones of our lower arm are connected to the bone of our upper arm.

Several bones in our body are connected by **fixed joints**. Fixed joints do not allow the bones to move at all. The bones in your skull are connected by fixed joints.

4 How Are Bones Joined Together?

Task
Reading about different types of joints.

Key learning
Different joints enable different movements.

Teacher's role
Provide assistance with reading if required.

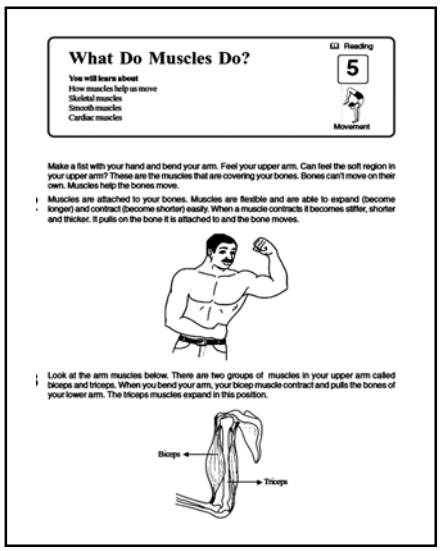
Discussion

T2 What Do Muscles Do?

Task
Discussion about muscles and how they function.

Key learning
Muscles help us move. Skeletal muscles, involuntary muscles and heart muscles.

Materials needed
Model of the elbow joint with biceps and triceps.



What Do Muscles Do?

Reading 5

You will learn about
How muscles help us move
Skeletal muscles
Smooth muscles
Cardiac muscles

Movement

Make a fist with your hand and bend your arm. Feel your upper arm. Can feel the soft region in your upper arm? These are the muscles that are covering your bones. Bones can't move on their own. Muscles help the bones move.

Muscles are attached to your bones. Muscles are flexible and are able to expand (become longer) and contract (become shorter) easily. When a muscle contracts it becomes stiffer, shorter and thicker. It pulls on the bone it is attached to and the bone moves.

Look at the arm muscles below. There are two groups of muscles in your upper arm called biceps and triceps. When you bend your arm, your bicep muscle contract and pulls the bones of your lower arm. The triceps muscles expand in this position.

Biceps

Triceps

5 What Do Muscles Do?

Task

Reading about muscles and how they function.

Key learning

Muscles help us move. Skeletal muscles, involuntary muscles and heart muscles.

Teacher's role

Provide assistance with reading if required.

Discussion: How Are Bones Joined Together? T1

Begin this discussion by reviewing the functions of bones and the skeletal system that students have already learnt about. Explain what joints are and why they are required for movement. Introduce different types of joints in the human body and the ways in which they move.

What you need

Model of different types of joints,
X ray of some part of the skeletal system (optional).

Ideas to talk about

- Ask students questions about the functions of bones and the skeletal system.
- Use an X ray (of the chest or limbs) to show different bones and how they are joined to each other. You could ask students to locate the bones they can see in the xray in their own bodies.
- Point to the joints in the X ray. *"Bones are attached to each other at these places called joints. Bones can move relative to each other at the joint."*
- Ask students where they have joints in their bodies.
- Demonstrate the different ways in which each of these joints move: the elbow, the neck and the shoulder. For each of these joints ask students to try and see whether the joint allows rotation and bending.
- Introduce the names of each type of joint and the movements that it allows. *"The elbow is an example of a hinge joint. It behaves like the hinge of a door. It can bend in one direction but not in the other. It cannot rotate."*
- Show a door hinge and point out the similarity between its movement and that of the elbow joint.
- *"The shoulder joint allows rotation in many directions. It is an example of a ball and socket joint. It behaves like a ball inside a cup."*
- Show how a ball moves inside a hemispherical bowl. *" This is how a ball and socket joint can move."*
- Explain that the neck is an example of a pivot joint which allows bending and rotation from side to side.
- Ask students to find other joints in their bodies and find out how they move.

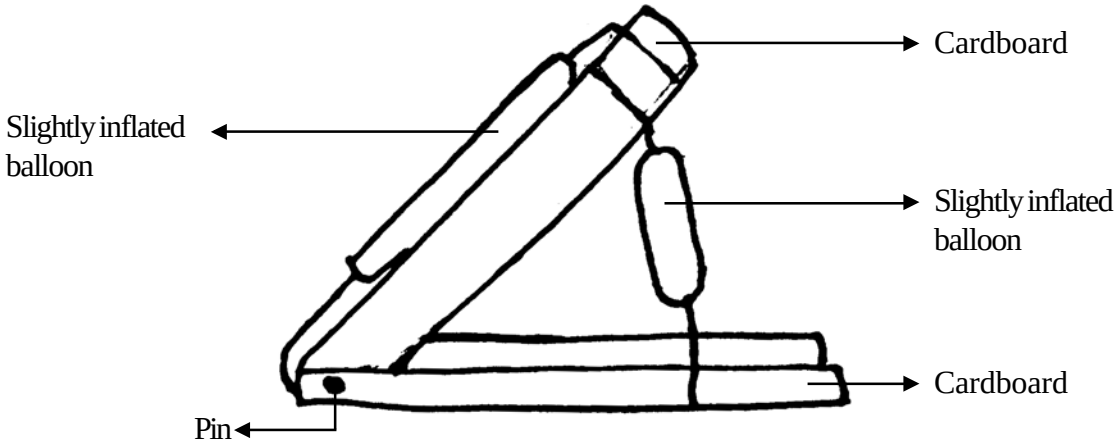
Discussion: What Do Muscles Do?

T2

Explain how muscles help in movement using a model in this discussion.

What you need

Model of arm with elbow joint and biceps and triceps.



Ideas to talk about

- Ask students to flex their arms and feel their biceps. *"What can you feel on your upper arm?"* **(Muscles.)**
- *"Bend your arm and feel your upper arm muscles. How do they feel?"* Let students answer.
- *"Stretch your arm and feel your upper arm muscles. How do they feel?"* Let students answer.
- *"The muscles in your upper arm are called biceps and triceps. They are attached to the bones of your lower arm at the elbow joints."*
- *"When you flex your arm, the muscles on top pull the bones of the lower arm and make it move. When you extend your arm the muscle on the underside of your arm pull on the bones of the upper arm and make it extend."*
- You can show how this happens using a model of the elbow joint. You could also illustrate it on the blackboard.
- *"Muscles attached to bones make them move. These muscles are called skeletal muscles. Bones cannot move on their own."*
- *"There are other kinds of muscles in your body which are not attached to bones. Read about these types of muscles in the textbook".*

Going Further

Ideas for More Activities

Experiments and Investigations

- Comparing the bones of different animals (fish, hen, goat etc).

Making and Doing

- Making a model of different joints.
- Making a model of how muscles and bones work together : Eg: bending the arm.

Notes

Respiration

Introduction

In this unit students learn about the human respiratory system. They observe their own breathing and learn about how and why breathing occurs. They learn about the different organs in the respiratory system and their functions. Students also learn about the some diseases of the respiratory system and ways to prevent them.

This unit follows the introductory work on the "Human body". It has links with other units on the human body: "Food And Nutrition", "Movement" and "Circulation And Excretion".

The unit would take about 9 hours of class time.

Objectives

This unit will help students to:

- Explain the mechanism of breathing.
- Differentiate between inhalation and exhalation.
- Explain why the rate of breathing changes when we exercise.
- Draw a diagram of the human respiratory system and label the parts: nose, pharynx, epiglottis, bronchi, bronchioles, alveoli, lungs.
- List some ways that the respiratory system can be damaged: air pollution, diseases like tuberculosis, smoking tobacco etc.
- Explain ways in which we can protect and take care of our respiratory system.

New Vocabulary

Pharynx, trachea, epiglottis, bronchi, bronchioles, alveoli, lungs, diaphragm, inhalation, exhalation, respiration.

Materials Required

For each group of students: Measuring tape, clock.

For the teacher: Model to demonstrate the mechanism of breathing.

Try it yourself

How Fast Do You Breathe? 1

Respiration

What you need
A clock or watch
A measuring tape

You breathe all the time, when you are awake and asleep. How fast do you breathe? Does everyone breathe at the same rate? How does your breathing change when you do different activities? Do this activity and find out.

1 How Fast Do You Breathe?

Task

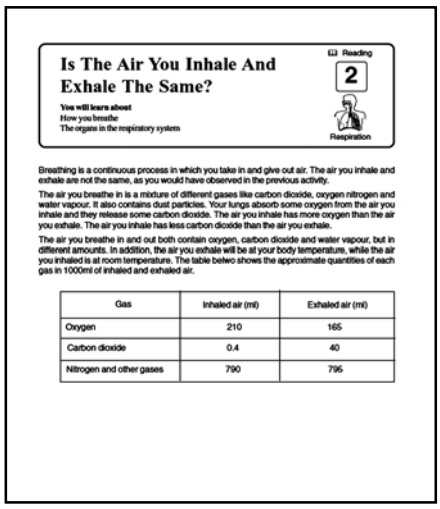
Activity to observe breathing.

Key learning

Inhalation, exhalation.
Rate of breathing changes with exercise.
Inhaled and exhaled air is different.

Materials needed

Measuring tape, a watch.



Reading

Is The Air You Inhale And Exhale The Same? 2

Respiration

You will learn about
How you breathe
The organs in the respiratory system

Breathing is a continuous process in which you take in and give out air. The air you inhale and exhale are not the same, as you would have observed in the previous activity.

The air you breathe in is a mixture of different gases like carbon dioxide, oxygen nitrogen and water vapour. It also contains dust particles. Your lungs absorb some oxygen from the air you inhale and they release some carbon dioxide. The air you inhale has more oxygen than the air you exhale. The air you inhale has less carbon dioxide than the air you exhale.

The air you breathe in and out both contain oxygen, carbon dioxide and water vapour, but in different amounts. In addition, the air you exhale will be at your body temperature, while the air you inhaled is at room temperature. The table belwo shows the approximate quantities of each gas in 1000ml of inhaled and exhaled air.

Gas	Inhaled air (ml)	Exhaled air (ml)
Oxygen	210	165
Carbon dioxide	0.4	40
Nitrogen and other gases	790	796

2 Is The Air You Inhale And Exhale The Same?

Task

Reading about air that is inhaled and exhaled.

Key learning

Exhaled air contains more carbon dioxide and less oxygen than inhaled air.

Teacher's role

Provide assistance with reading if required.

Discussion

T1 How We Breathe

Task

Demonstration to explain the mechanism of breathing: inhalation and exhalation.
Explain the structure and function of the respiratory system.

Key learning

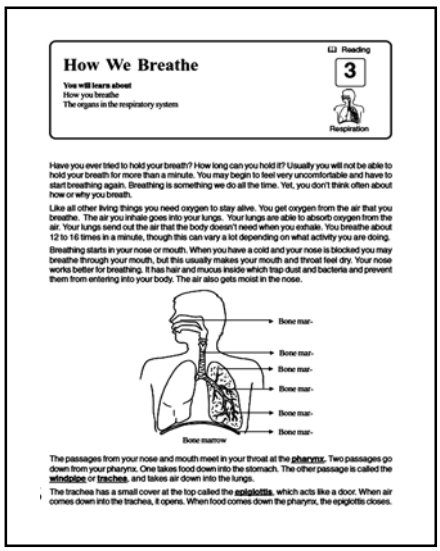
Mechanism of inhalation and exhalation.
Structure and parts of the respiratory system.
Functions of pharynx, trachea, epiglottis, bronchi, bronchioles, alveoli, lungs and diaphragm.

Materials needed

Model to demonstrate the mechanism of breathing.

Teacher's role

Demonstrate the mechanism of breathing and introduce the structure of the respiratory system.



Reading 3

How We Breathe

You will learn about
How you breathe
The organs in the respiratory system

Respiration

Have you ever tried to hold your breath? How long can you hold it? Usually you will not be able to hold your breath for more than a minute. You may begin to feel very uncomfortable and have to start breathing again. Breathing is something we do all the time. Yet, you don't think often about how or why you breath.

Like all other living things you need oxygen to stay alive. You get oxygen from the air that you breathe. The air you inhale goes into your lungs. Your lungs are able to absorb oxygen from the air. Your lungs send out the air that the body doesn't need when you exhale. You breathe about 12 to 16 times in a minute, though this can vary a lot depending on what activity you are doing.

Breathing starts in your nose or mouth. When you have a cold and your nose is blocked you may breathe through your mouth, but this usually makes your mouth and throat feel dry. Your nose works better for breathing. It has hair and mucus inside which trap dust and bacteria and prevent them from entering into your body. The air also gets moist in the nose.

Bone marrow

The passages from your nose and mouth meet in your throat at the **pharynx**. Two passages go down from your pharynx. One takes food down into the stomach. The other passage is called the **windpipe** or **trachea**, and takes air down into the lungs.

The trachea has a small cover at the top called the **epiglottis**, which acts like a door. When air comes down into the trachea, it opens. When food comes down the pharynx, the epiglottis closes.

3 How We Breathe

Task

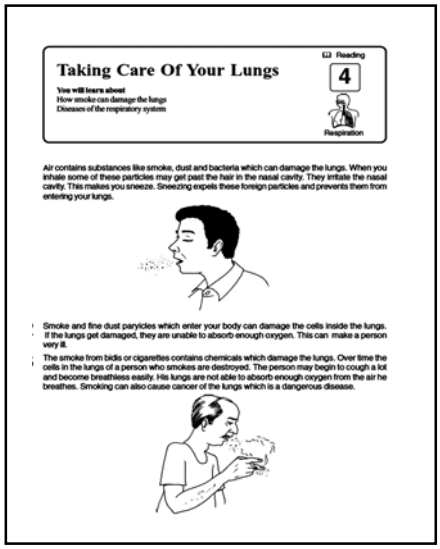
Reading about the structure and function of the respiratory system.

Key learning

Mechanism of inhalation, exhalation.
Structure and parts of the respiratory system.
Functions of pharynx, trachea, epiglottis, bronchi, bronchioles, alveoli, lungs and diaphragm.

Teacher's role

Provide assistance with reading if required.



Reading 4

Taking Care Of Your Lungs

You will learn about
How smoke can damage the lungs
Diseases of the respiratory system

Respiration

Air contains substances like smoke, dust and bacteria which can damage the lungs. When you inhale some of these particles may get past the hair in the nasal cavity. They irritate the nasal cavity. This makes you sneeze. Sneezing expels these foreign particles and prevents them from entering your lungs.

Smoke and fine dust parycles which enter your body can damage the cells inside the lungs. If the lungs get damaged, they are unable to absorb enough oxygen. This can make a person very ill.

The smoke from bidis or cigarettes contains chemicals which damage the lungs. Over time the cells in the lungs of a person who smokes are destroyed. The person may begin to cough a lot and become breathless easily. His lungs are not able to absorb enough oxygen from the air he breathes. Smoking can also cause cancer of the lungs which is a dangerous disease.

4 Taking Care Of Your Lungs

Task

Reading about some ways the lungs are damaged.

Key learning

Smoking tobacco, air pollution, tuberculosis.

Teacher's role

Provide assistance with reading if required.

Discussion: How We Breathe

T1

Explain the mechanism of inhalation and exhalation using a simple model of the lungs and diaphragm. Introduce the structure of the respiratory system and the functions of the different parts.

What you need

Model of human lungs made with empty plastic bottle, straws and balloons.

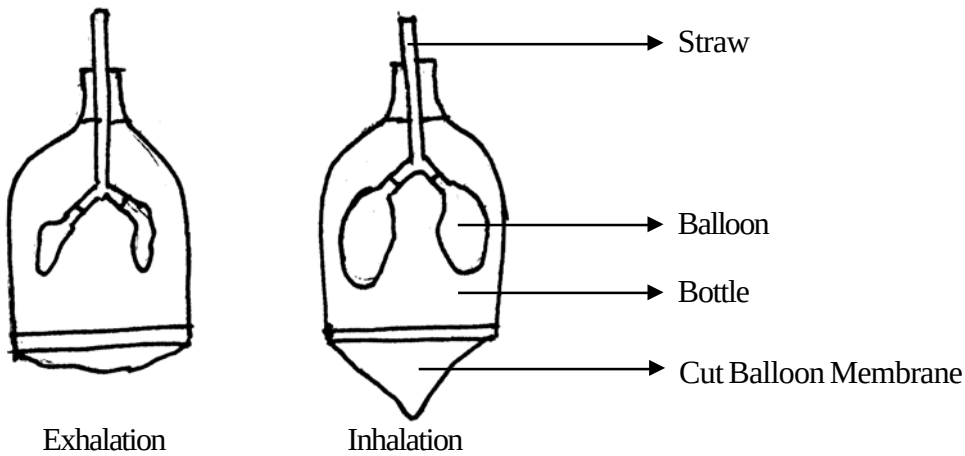
Ideas to talk about

Breathing:

- *"All living things need oxygen to stay alive. Where do we get oxygen from?"* **(Air.)**
- *"We get oxygen from the air around us. We breathe air into our lungs. Our lungs are able to absorb the oxygen that we need from the air."*
- *"Have you ever observed how you breathe? We take in air into our lungs by breathing in. This is called inhalation."*
- *"Put your hand on your chest and observe what happens when you breathe in. Where do your ribs move? How does your abdomen move?"* Allow students to share their observations.
- *"Breathing out is called exhalation. Now breathe out and observe how your ribs and abdomen move when you exhale."* Allow students to share their observations.
- *"Lets learn about what happens in our bodies when we inhale and exhale. Your lungs are located inside your chest cavity. This cavity is surrounded by ribs on the sides. A large muscle called the diaphragm forms the floor of the chest cavity."* Draw (or show) an illustration of the ribs, lungs and diaphragm.

Demonstrating the mechanism of breathing:

- Demonstrate how inhalation and exhalation take place using the model. When the membrane (representing the diaphragm) is pulled down the balloons (representing the lungs) fill up with air. This represents inhalation.
- When the membrane (representing the diaphragm) is released upwards, the balloons (representing the lungs) get deflated. This represents exhalation.



- *"During inhalation, the diaphragm moves down, the ribs move outwards. Your chest cavity expands. This makes the lungs expand and fill with air."* Show this on the illustration.
- *"During exhalation the diaphragm moves up the ribs move inwards. Your chest cavity contracts. This makes the lungs contract and send out the air."* Show this on the illustration.
- *"This is a model of the chest cavity. The balloons represent the lungs. The sheet at the bottom represents the diaphragm."* Show the model of the lungs.
- *"Observe what happens to the balloons (lungs) when the rubber sheet (diaphragm) moves down. This is what happens when we inhale."* Move balloon (diaphragm) down. The small balloons that represent the lungs will fill up with air.
- *"Observe what happens to the balloons (lungs) when the rubber sheet (diaphragm) moves up. This is what happens when we exhale."* Move the balloon (diaphragm) up. The small balloons that represent the lungs will empty.
- Repeat a few times and ask students to describe what happens during inhalation and exhalation.
- *"This process of inhalation and exhalation is called breathing."*

Respiratory system:

- On the blackboard, draw a diagram of the respiratory system showing the nose, pharynx, trachea, epiglottis, bronchi, bronchioles, alveoli, lungs and diaphragm. (or you could use a chart).
- Explain how air enters and leaves the body and the function of each part of the respiratory system.

Going Further

Ideas for More Activities

Experiments and Investigations

- Measuring lung capacity.

Making and Doing

- Make a model of the respiratory system.
- Make a poster about the dangers of smoking.
- Making a spirometer to measure lung capacity.

Notes

Circulation And Excretion

Introduction

In this unit students learn about how the human circulatory and excretory systems transport substances inside the body and remove wastes from the body. They learn about the different organs in the circulatory system and their functions. They observe their own heartbeat and pulse and learn how the heart works. Students also learn about the composition and function of blood. Students are introduced to the process of excretion, the different organs in the excretory system and their functions.

This unit follows the brief introduction to the "Human body" and the units on "Food And Nutrition", "Movement" and "Respiration".

The unit would take about 9 hours of class time.

Objectives

This unit will help students to:

- Explain why substances like oxygen, glucose and wastes have to be transported around the body.
- Explain the functions of the circulatory system.
- Describe the main parts of the circulatory system and their functions: arteries, veins, capillaries, heart.
- Explain how the heart works.
- Draw a diagram of the heart and identify the four chambers.
- Explain the functions of each of the four chambers of the heart.
- Observe and record their pulse rate and heartbeat and explain why it changes when they exercise.
- Explain the function of blood to transport essential substances around the body.
- Describe the components of blood and their functions: red blood cells, white blood cells, platelets, plasma.
- Explain the importance of excretion.
- Explain how wastes are removed from the body by the kidneys.
- Draw a diagram of the excretory system and identify the parts (kidneys, ureter, bladder).
- Describe the functions of each part of the excretory system.

New Vocabulary

Circulatory system, arteries, veins, ventricles, atrium, pulse rate, heartbeat, blood vessels, capillaries, red blood cells, white blood cells, platelets, plasma, excretory system, kidneys, ureter.

Materials Required

For each group of students: Clock.

For the teacher: Stethoscope (optional).

Discussion

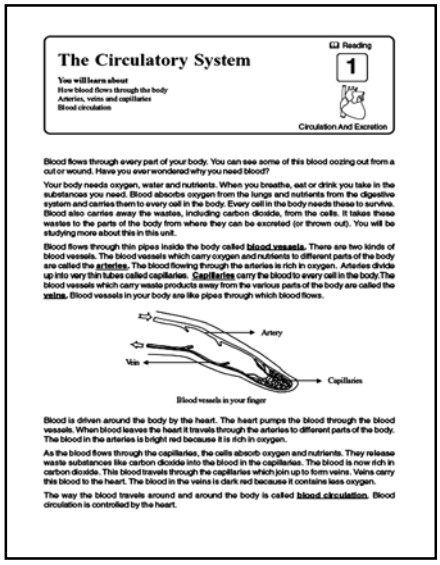
T1 Transport In The Body

Task
Discussion about the structure and function of the circulatory system.

Key learning
The circulatory system transports nutrients and wastes through the body.

Materials needed
Stethoscope.

Teacher's role
Explain the need for transporting substances around the body and the function of the circulatory system.



Reading 1

The Circulatory System

You will learn about
How blood flows through the body
Arteries, veins and capillaries
Blood circulation

Circulation And Excretion

Blood flows through every part of your body. You can see some of this blood oozing out from a cut or wound. Have you ever wondered why you need blood?

Your body needs oxygen, water and nutrients. When you breathe, eat or drink you take in the substances you need. Blood absorbs oxygen from the lungs and nutrients from the digestive system and carries them to every cell in the body. Every cell in the body needs these to survive. Blood also carries away the wastes, including carbon dioxide, from the cells. It takes these wastes to the parts of the body from where they can be excreted (or thrown out). You will be studying more about this in this unit.

Blood flows through thin pipes inside the body called blood vessels. There are two kinds of blood vessels. The blood vessels which carry oxygen and nutrients to different parts of the body are called the arteries. The blood flowing through the arteries is rich in oxygen. Arteries divide up into very thin tubes called capillaries. Capillaries carry the blood to every cell in the body. The blood vessels which carry waste products away from the various parts of the body are called the veins. Blood vessels in your body are like pipes through which blood flows.

Artery
Vein
Capillaries

Blood vessels in your finger

Blood is driven around the body by the heart. The heart pumps the blood through the blood vessels. When blood leaves the heart it travels through the arteries to different parts of the body. The blood in the arteries is bright red because it is rich in oxygen.

As the blood flows through the capillaries, the cells absorb oxygen and nutrients. They release waste substances like carbon dioxide into the blood in the capillaries. The blood is now rich in carbon dioxide. This blood travels through the capillaries which join up to form veins. Veins carry this blood to the heart. The blood in the veins is dark red because it contains less oxygen.

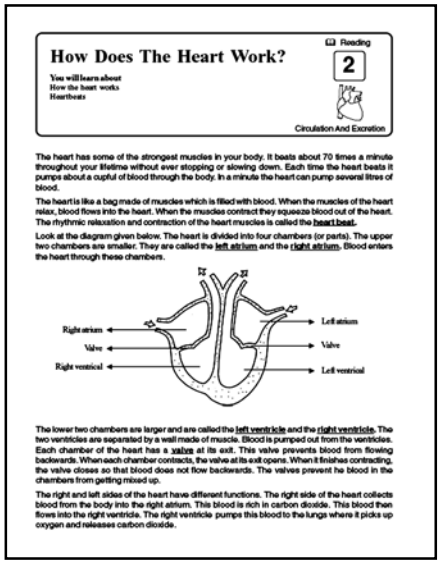
The way the blood travels around and around the body is called blood circulation. Blood circulation is controlled by the heart.

1 The Circulatory System

Task
Reading about blood circulation and the circulatory system.

Key learning
Blood flows through blood vessels and transports substances around the body.
Arteries, veins and capillaries.

Teacher's role
Provide assistance with reading if required and review new vocabulary.



Reading 2

How Does The Heart Work?

You will learn about
How the heart works
Heartbeats

Circulation And Excretion

The heart has some of the strongest muscles in your body. It beats about 70 times a minute throughout your lifetime without ever stopping or slowing down. Each time the heart beats it pumps about a cupful of blood through the body. In a minute the heart can pump several litres of blood.

The heart is like a bag made of muscles which is filled with blood. When the muscles of the heart relax, blood flows into the heart. When the muscles contract they squeeze blood out of the heart. The rhythmic relaxation and contraction of the heart muscles is called the heart beat.

Look at the diagram given below. The heart is divided into four chambers (or parts). The upper two chambers are smaller. They are called the left atrium and the right atrium. Blood enters the heart through these chambers.

Right atrium
Valve
Right ventrical
Left atrium
Valve
Left ventrical

The lower two chambers are larger and are called the left ventricle and the right ventricle. The two ventricles are separated by a wall made of muscle. Blood is pumped out from the ventricles. Each chamber of the heart has a valve at its exit. This valve prevents blood from flowing backwards. When each chamber contracts, the valve at its exit opens. When it finishes contracting, the valve closes so that blood does not flow backwards. The valves prevent he blood in the chambers from getting mixed up.

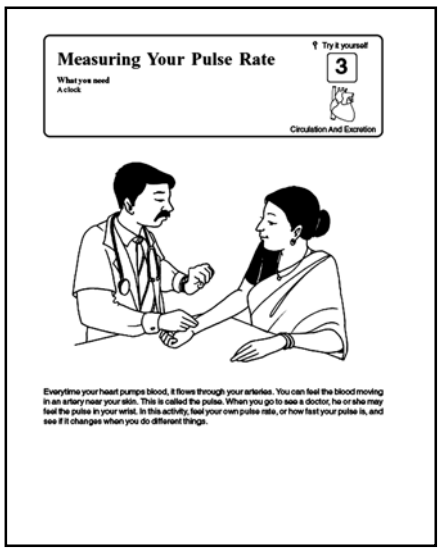
The right and left sides of the heart have different functions. The right side of the heart collects blood from the body into the right atrium. This blood is rich in carbon dioxide. This blood then flows into the right ventricle. The right ventricle pumps this blood to the lungs where it picks up oxygen and releases carbon dioxide.

2 How Does The Heart Work?

Task
Reading about the structure and function of the heart.

Key learning
The chambers of the heart and their functions.

Teacher's role
Provide assistance with reading if required and review new vocabulary.



Measuring Your Pulse Rate

Try it yourself 3

What you need
A clock

Circulation And Excretion

Everytime your heart pumps blood, it flows through your arteries. You can feel the blood moving in an artery near your skin. This is called the pulse. When you go to see a doctor, he or she may feel the pulse in your wrist. In this activity, feel your own pulse rate, or how fast your pulse is, and see if it changes when you do different things.

3 Measuring Your Pulse Rate

Task

Activity to measure pulse rate and and its variation.

Key learning

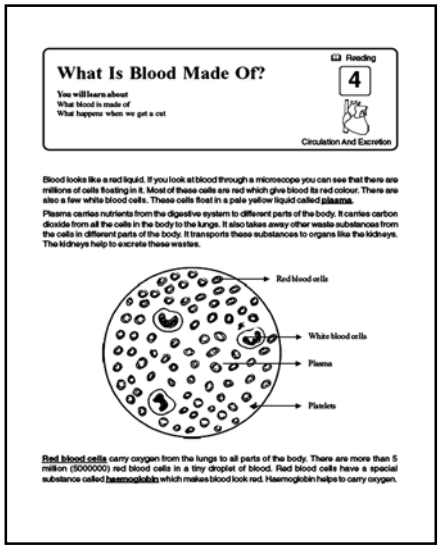
The pulse indicates how fast the blood is being pumped through the body. It increases during exercise.

Materials needed

Clock.

Teacher's role

Help students locate their pulse.



What Is Blood Made Of?

Reading 4

You will learn about
What blood is made of
What happens when we get a cut

Circulation And Excretion

Blood looks like a red liquid. If you look at blood through a microscope you can see that there are millions of cells floating in it. Most of these cells are red which give blood its red colour. There are also a few white blood cells. These cells float in a pale yellow liquid called plasma.

Plasma carries nutrients from the digestive system to different parts of the body. It carries carbon dioxide from all the cells in the body to the lungs. It also takes away other waste substances from the cells in different parts of the body. It transports these substances to organs like the kidneys. The kidneys help to excrete these wastes.

Red blood cells
White blood cells
Plasma
Platelets

Red blood cells carry oxygen from the lungs to all parts of the body. There are more than 5 million (5000000) red blood cells in a tiny droplet of blood. Red blood cells have a special substance called haemoglobin which makes blood look red. Haemoglobin helps to carry oxygen.

4 What Is Blood Made Of?

Task

Reading about the composition and functions of blood.

Key learning

Blood contains plasma, red blood cells, white blood cells, platelets. Each has a unique function.

Teacher's role

Provide assistance with reading if required and review new vocabulary.

Discussion

T2 Removing Wastes From The Body

Task

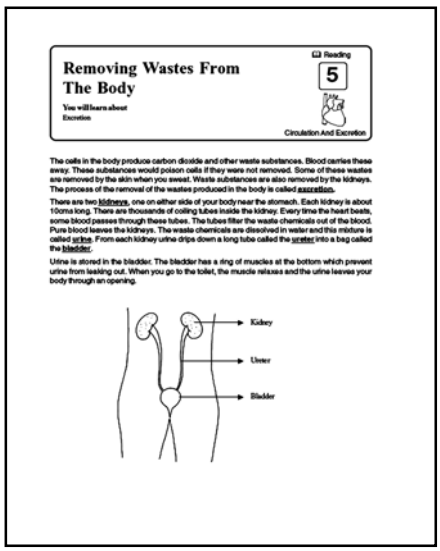
Discussion about the excretory system.

Key learning

Wastes need to be removed from the body. The excretory system does this.

Teacher's role

Discuss the need for excretion and introduce the excretory system.



Reading

5

Removing Wastes From The Body

You will learn about
Excretion

Circulation And Excretion

The cells in the body produce carbon dioxide and other waste substances. Blood carries these away. These substances would poison cells if they were not removed. Some of these wastes are removed by the skin when you sweat. Waste substances are also removed by the kidneys. The process of the removal of the wastes produced in the body is called excretion.

There are two kidneys, one on either side of your body near the stomach. Each kidney is about 10cms long. There are thousands of coiling tubes inside the kidney. Every time the heart beats, some blood passes through these tubes. The tubes filter the waste chemicals out of the blood. Pure blood leaves the kidneys. The waste chemicals are dissolved in water and this mixture is called urine. From each kidney urine drips down a long tube called the ureter into a bag called the bladder.

Urine is stored in the bladder. The bladder has a ring of muscles at the bottom which prevent urine from leaking out. When you go to the toilet, the muscle relaxes and the urine leaves your body through an opening.

5 Removing Wastes From The Body

Task

Reading about the excretory system.

Key learning

The structure and function of the excretory system.

Teacher's role

Provide assistance with reading if required.

Discussion:Transport In The Body

T1

Explain the need for transporting substances around the body in this discussion. Introduce the circulatory system and its parts – blood vessels and the heart. Let students listen to their heartbeats using a stethoscope.

What you need

Stethoscope.

Ideas to talk about

- Ask students, *"When you eat and digest food, what happens to the nutrients?"* **(They are used by the body.)**
- *"How do they reach all parts of the body?"* **(Blood carries nutrients to all parts of the body.)**
- *"Nutrients are transported to all the cells in the body by blood which flows through your body."*
- *"What are the other substances that we take in that are needed by all the parts of our body?"* **(Oxygen, water.)**
- *"These substances are also transported around the body by blood."*
- *"What substances do cells give out which need to be taken away?"* **(Carbon dioxide, other wastes etc.)**
- *"Blood carries these substances away from the cells in different parts of the body to the organs which can send them out of the body."*
- *"Can you name the organ that sends out carbon dioxide that is generated by the cells?"* **(The lungs.)**
- *"Just like plants transport nutrients, gases, water and other essential substances through the sap that flows through them, the human body transports substances using blood."*
- *"Blood flows through pipes in the body called blood vessels. There are different kinds of blood vessels which take blood to and away from the cells. You will learn about these in this unit."*
- *"You can see some blood vessels which are just under your skin."* Show students the veins that are visible in their arms.
- *"The heart pumps the blood through the blood vessels. "Every time the heart pumps blood out you hear a heart beat."*
- Ask students to feel their heartbeat by placing their hands over their heart.
- If possible, ask students to listen to their heartbeat using a stethoscope.

Discussion: Removing Wastes From The Body T2

Discuss why wastes need to be removed from the body and the different substances that need to be excreted. Introduce the parts and functions of the excretory system.

Ideas to talk about

- *"You've learn about how blood transports different substances around the body. Some of these substances are wastes that are given out by cells. What would happen if these wastes were not removed from the body?"* **(We would fall sick.)**
- *"If wastes accumulate in the body they can poison us and make us very sick. Wastes that are generated by the cells in the body need to be removed from the body."*
- *"Do you remember how carbon dioxide is removed from the body?"* **(It is sent out when we exhale.)**
- *"The process by which wastes are removed from the body is called excretion. There are several organs in the body which excrete wastes. The skin is the largest and most visible of these organs."*
- *"When you sweat, the body is sending out some waste substances through the skin."*
- *"The kidneys are another important organ which helps to filter wastes out of the blood and send them out through the bladder as urine,"*
- Draw a diagram of the excretory system on the blackboard showing the kidneys, ureter, bladder and explain how the excretory system works. Explain the function of each organ in the system.

Going Further

Ideas for More Activities

Experiments and Investigations

- Find out about blood groups.
- Investigate how much liquid passes through you each day.

Making and Doing

- Make a model of the circulatory system.
- Make a model of the excretory system.
- Making a stethoscope.

Notes

Heat

Introduction

In this unit students recognize the difference between heat and temperature. They learn about some effects of heat on substances. Temperature rise and expansion and contraction of liquids are the two kinds of changes that are explored in this unit. Change of state from gases to liquid and liquids to solids and vice versa have been covered in the unit "Solids, Liquids And Gases". Students learn how to use a laboratory thermometer and learn about a clinical thermometer.

Concepts developed in this unit are extended in the units on "Water" and "Air".

This unit would take approximately 8 hours of class time.

Objectives

This unit will help students to:

- Identify common sources of heat.
- Explain some ways in which heat changes materials: temperature change, change of state, expansion or contraction of liquids, chemical changes.
- Recognize that heat is transferred from a substance at higher temperature to a substance at lower temperature.
- Recognize that different substances (like sand and water) show different rise in temperature when they are left in the sun.
- Recognize that liquids expand when heated and contract when cooled.
- Recognize that temperature is a measure of the hotness or coldness of a substance.
- Recognize the need for a temperature scale.
- Explain how a mercury thermometer works.
- Measure and record the temperature of substances with a laboratory thermometer.
- Explain how a clinical thermometer works.
- Recognize the Fahrenheit and Celsius scales of temperature.

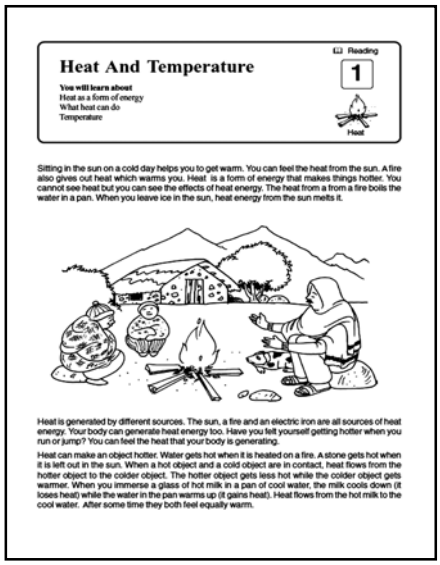
New Vocabulary

Temperature, Celsius, Fahrenheit.

Materials Required

For each group of students: Laboratory thermometer, small containers, sand, water.

For the teacher: Laboratory thermometer, clinical thermometer, digital thermometer, glass bottle with tube and stopper, containers, hot water.



Heat And Temperature

Reading 1

You will learn about
Heat as a form of energy
What heat can do
Temperature

Heat

Sitting in the sun on a cold day helps you to get warm. You can feel the heat from the sun. A fire also gives out heat which warms you. Heat is a form of energy that makes things hotter. You cannot see heat but you can see the effects of heat energy. The heat from a from a fire boils the water in a pan. When you leave ice in the sun, heat energy from the sun melts it.

Heat is generated by different sources. The sun, a fire and an electric iron are all sources of heat energy. Your body can generate heat energy too. Have you felt yourself getting hotter when you run or jump? You can feel the heat that your body is generating.

Heat can make an object hotter. Water gets hot when it is heated on a fire. A stone gets hot when it is left out in the sun. When a hot object and a cold object are in contact, heat flows from the hotter object to the colder object. The hotter object gets less hot while the colder object gets warmer. When you immerse a glass of hot milk in a pan of cool water, the milk cools down (it loses heat) while the water in the pan warms up (it gains heat). Heat flows from the hot milk to the cool water. After some time they both feel equally warm.

1 Heat And Temperature

Task

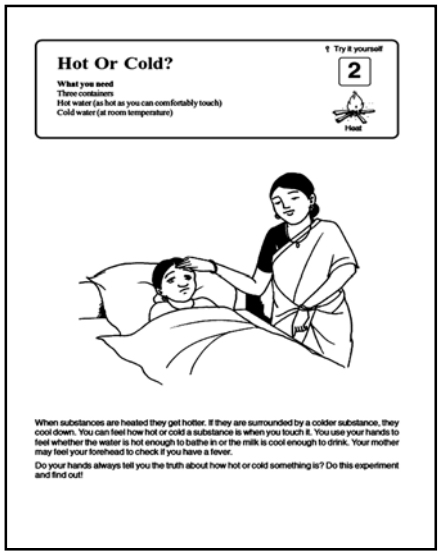
Reading about heat and its effects and temperature.

Key learning

Heat is a form of energy. Sources of heat.
Temperature is the degree of hotness or coldness of an object.

Teacher's role

Discuss the text if required.



Hot Or Cold?

Try it yourself 2

What you need
Three containers
Hot water (as hot as you can comfortably touch)
Cold water (at room temperature)

Heat

When substances are heated they get hotter. If they are surrounded by a colder substance, they cool down. You can feel how hot or cold a substance is when you touch it. You use your hands to feel whether the water is hot enough to bathe in or the milk is cool enough to drink. Your mother may feel your forehead to check if you have a fever.

Do your hands always tell you the truth about how hot or cold something is? Do this experiment and find out!

2 Hot Or Cold?

Task

Experiment to observe how reliable touch is to sense temperature.

Key learning

Touch as a poor judge of the hotness/coldness of substances.

Materials needed

Containers, hot water, cold water.

Teacher's role

Discuss students experiences and point out how the sense of touch is an unreliable indicator of temperature.

Discussion

T1 Using A Thermometer

Task

Demonstration of liquids expanding on heating and how a thermometer works.
Demonstration of how to use a laboratory and clinical thermometer to measure temperature.

Key learning

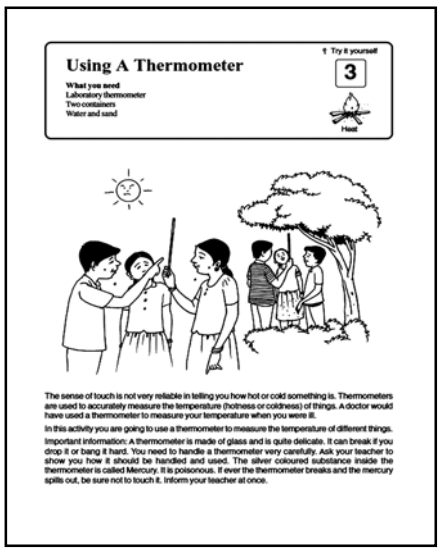
Liquids expand on heating. Thermometer works on this principle.
Centigrade or Celsius are units for measuring temperature.

Materials needed

Laboratory thermometer, glass bottle with tube and stopper, containers, hot water.

Teacher's role

Explain the use and working of a laboratory thermometer.



Using A Thermometer

Try it yourself 3

What you need
Laboratory thermometer
Two containers
Water and sand

Heat

The sense of touch is not very reliable in telling you how hot or cold something is. Thermometers are used to accurately measure the temperature (hotness or coldness) of things. A doctor would have used a thermometer to measure your temperature when you were ill.

In this activity you are going to use a thermometer to measure the temperature of different things.

Important information: A thermometer is made of glass and is quite delicate. It can break if you drop it or bang it hard. You need to handle a thermometer very carefully. Ask your teacher to show you how it should be handled and used. The silver coloured substance inside the thermometer is called Mercury. It is poisonous. If ever the thermometer breaks and the mercury spills out, be sure not to touch it. Inform your teacher at once.

3 Using A Thermometer

Task

Using a laboratory thermometer.

Key learning

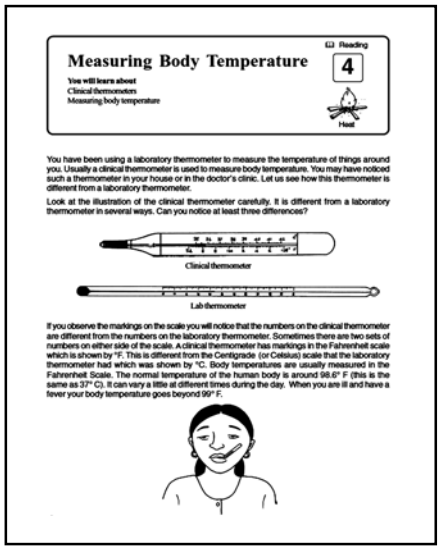
Measuring temperature.
Centigrade/Celsius as units of measuring temperature.
Concept of range, least count of thermometer.

Materials needed

Laboratory thermometer, containers, water, sand.

Teacher's role

Provide assistance with using a thermometer correctly.



Measuring Body Temperature

Reading 4

You will learn about
Clinical thermometers
Measuring body temperature

Heat

You have been using a laboratory thermometer to measure the temperature of things around you. Usually a clinical thermometer is used to measure body temperature. You may have noticed such a thermometer in your house or in the doctor's clinic. Let us see how this thermometer is different from a laboratory thermometer.

Look at the illustration of the clinical thermometer carefully. It is different from a laboratory thermometer in several ways. Can you notice at least three differences?

Clinical thermometer

Lab thermometer

If you observe the markings on the scale you will notice that the numbers on the clinical thermometer are different from the numbers on the laboratory thermometer. Sometimes there are two sets of numbers on either side of the scale. A clinical thermometer has markings in the Fahrenheit scale which is shown by °F. This is different from the Centigrade (or Celsius) scale that the laboratory thermometer had which was shown by °C. Body temperatures are usually measured in the Fahrenheit Scale. The normal temperature of the human body is around 98.6° F (this is the same as 37° C). It can vary a little at different times during the day. When you are ill and have a fever your body temperature goes beyond 99° F.

4 Measuring Body Temperature

Task

Reading about a clinical thermometer and using it to measure body temperature.

Key learning

Difference between a laboratory and clinical thermometer.
Human body temperature.
Introducing the Fahrenheit scale.

Materials needed

Clinical thermometer, digital thermometer.

Teacher's role

Show different kinds of thermometers.

Discussion: Using A Thermometer

T1

Demonstrate how a liquid like water expands when it is heated and explain the working of a laboratory thermometer based on this principle. Explain how to use a laboratory thermometer to measure the temperatures of air, liquids and solids.

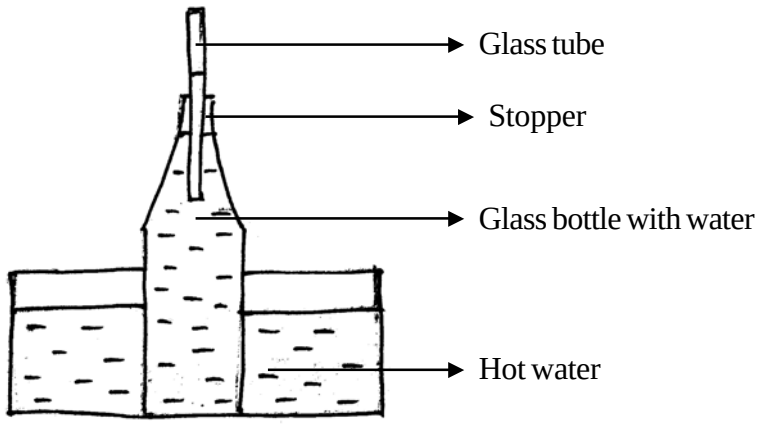
What you need

Bottle made of thin glass,
A cork or stopper with a central glass tube (a straw inside plasticine can also be used).
Hot water (to immerse the bottle in),
Large container (for the hot water),
A laboratory thermometer.

Ideas to talk about

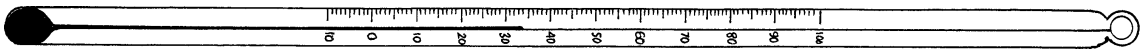
Demonstrating the expansion of water:

- Ask students what happens to a liquid when you heat it. (**Its temperature increases, it may change into a vapour.)**
- Explain to the students that you will be observing another effect that heat has on a liquid.
- Completely fill the glass bottle with tap water. Add a drop of ink so that the water is visible to the students.
- Close the bottle with the stopper and insert the glass tube into the bottle. A little water should be visible at the bottom of the glass tube.
- Ask students to observe the water level in the tube.
- Put hot water in the large container. Immerse the bottle in hot water. (The mouth of the bottle should be above the water level.) Keep the bottle in the hot water for a while.
- Ask students to observe the level of the coloured water in the tube.
- The coloured water level will go up slightly.
- Explain that liquids expand when they are heated. The hot water in the container heats up the coloured water in the glass bottle. The coloured water expands. It needs more space and so its level rises.
- Explain that liquids expand when they are heated. A thermometer uses this principle.



Demonstrating the use of a lab thermometer:

- Refer to the previous experiment (Hot or cold?) that the children have done. Ask them whether they found their sense of touch a reliable way of knowing the temperature of a substance.
- Explain that when we need some way of accurately and reliably measuring temperature we use a thermometer.
- A thermometer is used to measure the temperature (or the hotness/coldness) of substances. There are many different kinds of thermometers.
- Show a laboratory thermometer and tell students what it is called.
- Point out the various parts of the thermometer shown in the figure below. (Bulb, thin tube in the centre, mercury in the bulb, column of mercury in the tube, markings on the tube.)
- Explain that the mercury in the bulb and tube is a liquid. You can explain that when we put the bulb in something hot, the mercury inside expands and needs more space. So it moves up the thin tube in the centre, where we can see it as a thin silver coloured line.



- *"When we put the bulb in something cold, the mercury contracts or takes up less space, and we see the mercury in the tube moving down."*
- Show the children how to hold and rotate the thermometer from side to side to identify the thread of mercury in the thin tube.
- Explain briefly how the rising and falling mercury column in the thermometer is a measure of the temperature that the bulb experiences.
- Point to the highest marking on the thermometer and the lowest marking. Ask the children what the maximum temperature (hotness) and minimum temperature (coldness) that the thermometer can measure would be. Tell them that the laboratory thermometer can measure temperatures hotter than boiling water and also temperatures colder than that of ice.
- Talk about the units we use to measure temperature with this thermometer. *"This thermometer is calibrated in degrees Centigrade (or Celsius)."*
- You could show them the difference between two consecutive long markings on the thermometer and say *"This gap on the scale measures 10 degrees C"*.
- Also draw the students attention to the smallest difference in temperature that the thermometer can measure. (This is also called the least count of the thermometer. Students do not need to know this terminology.)
- Ask them how many divisions there are between two long markings. Help them figure out how much one small division represents. Use the blackboard to illustrate this.
- Now show the students how to measure the temperature of water in a bowl.
- Draw attention to the fact that the thermometer should not touch the sides or bottom of the vessel and that the bulb should be surrounded by the liquid on all sides. It should be kept vertical.
- Demonstrate how to read the temperature on the thermometer by seeing where the line of mercury ends. Point out that we should be looking at the reading directly in front of our eye and not at an angle.
- Demonstrate how we write the temperature along with the units e.g: 27° C.
- You can ask students to take turns to come and read the temperature using the thermometer.

Going Further

Ideas for More Activities

Experiments and Investigations

- Investigating whether the colour of an object affects how hot it gets in the sun.
- Observing how temperature changes in different substances as they are heated (ice, water, etc).

Making and Doing

- Making a thermometer using water.

Notes

Air And Wind

Introduction

In this unit students learn about air. They learn about the composition of air. Students will learn about air pressure and how it depends on the volume of air and the speed of air. They will apply these concepts to some phenomena they observe around them. Students will observe how air expands, becomes lighter and rises when it is heated. They will learn about how winds are caused.

Concepts developed in this unit are related to concepts in the units on “Heat”, “Water” and “Solids, Liquids And Gases”.

This unit would take approximately 8 hours of class time.

Objectives

This unit will help students to:

- Explain that air is present all around us.
- Explain what the atmosphere is.
- Describe the composition of air.
- Explain how plants and animals depend on air and how they help to maintain the oxygen and carbon dioxide balance.
- Recognize that air exerts a pressure.
- Recognize that compressed air exerts a greater pressure.
- Explain various everyday phenomena related to air pressure (filling a cycle tire, bursting of a balloon etc).
- Explain how the speed of moving air and air pressure are related.
- Recognize that air expands when it is heated and contracts when it is cooled.
- Recognize that hot air is lighter than cold air and that hot air rises.
- Explain what wind is.
- Explain how winds are formed when hot air rises and cool air flows to take its place.
- Explain how land and sea breezes are formed.
- Explain how the monsoon winds bring rain.

New Vocabulary

Wind, atmosphere, sea breeze, land breeze, monsoon winds.

Materials Required

For each group of students: Syringe, empty bottle, strip of paper.

For the teacher: Empty glass bottle, large transparent container with water, glass, empty glass bottle with a narrow mouth, balloon, large container, hot water, two equal sized paper cups, stick, string, candle and matchbox, chart showing land and sea breeze.

Lesson Plan

Demonstration

T1 Air Around Us

Task

Demonstration to show that air is all around.
Discussion about the composition of air.

Key learning

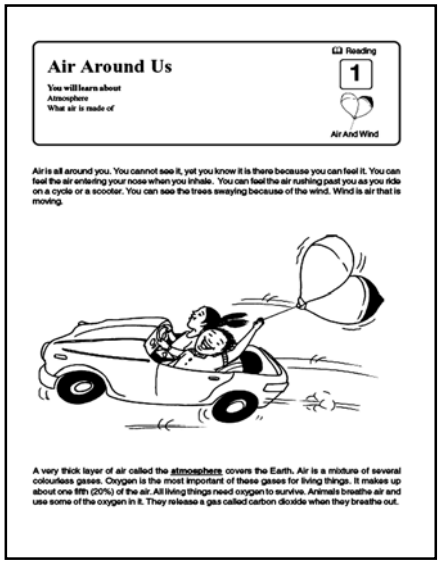
Air is all around. The atmosphere is a layer of air that covers the Earth. The composition of air.

Materials needed

Empty glass bottle, large transparent container with water, glass.

Teacher's role

Discuss the presence of air all around and its composition.



Air Around Us

Reading 1

You will learn about
Atmosphere
What air is made of

Air And Wind

Air is all around you. You cannot see it, yet you know it is there because you can feel it. You can feel the air entering your nose when you inhale. You can feel the air rushing past you as you ride on a cycle or a scooter. You can see the trees swaying because of the wind. Wind is air that is moving.

A very thick layer of air called the atmosphere covers the Earth. Air is a mixture of several colourless gases. Oxygen is the most important of these gases for living things. It makes up about one fifth (20%) of the air. All living things need oxygen to survive. Animals breathe air and use some of the oxygen in it. They release a gas called carbon dioxide when they breathe out.

1 Air Around Us

Task

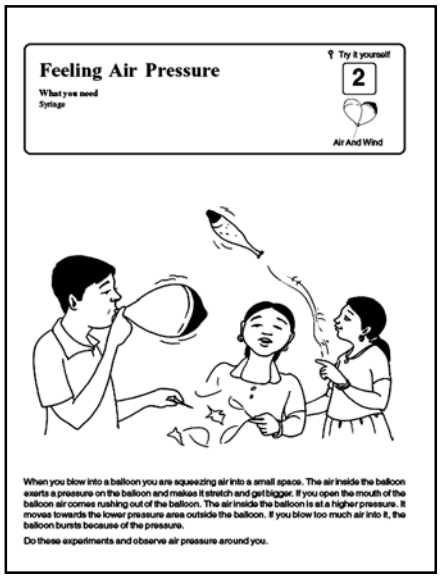
Reading about air, its composition and the atmosphere.

Key learning

Air is all around us. The atmosphere is a layer of air that covers the Earth.
The composition of air.
Plants and animals maintain the oxygen, carbon dioxide balance in the air.

Teacher's role

Explain how the balance of oxygen and carbon dioxide is maintained.



Feeling Air Pressure

Try it yourself 2

What you need
Syringe

Air And Wind

When you blow into a balloon you are squeezing air into a small space. The air inside the balloon exerts a pressure on the balloon and makes it stretch and get bigger. If you open the mouth of the balloon air comes rushing out of the balloon. The air inside the balloon is at a higher pressure. It moves towards the lower pressure area outside the balloon. If you blow too much air into it, the balloon bursts because of the pressure.

Do these experiments and observe air pressure around you.

2 Feeling Air Pressure

Task

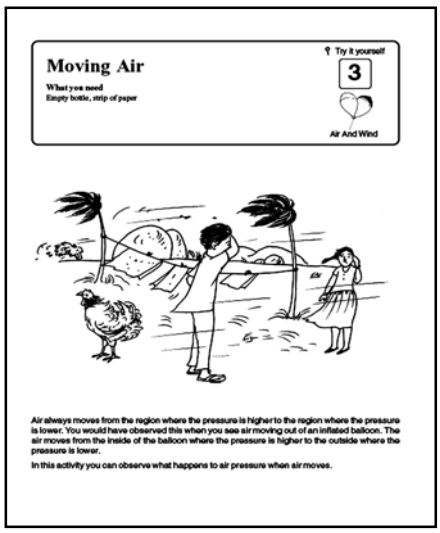
Experiment to study air pressure when it is compressed.

Key learning

Air pressure increases when air is compressed. It reduces when air expands.

Materials needed

Syringe.



Moving Air

Try it yourself 3

What you need
Empty bottle, strip of paper

Air And Wind

Air always moves from the region where the pressure is higher to the region where the pressure is lower. You would have observed this when you see air moving out of an inflated balloon. The air moves from the inside of the balloon where the pressure is higher to the outside where the pressure is lower.

In this activity you can observe what happens to air pressure when air moves.

3 Moving Air

Task

Experiment to study air pressure when air is moving.

Key learning

Air pressure decreases when air is moving faster.

Materials needed

Empty bottle, strip of paper.

Teacher's role

Help students explain their observations.

Demonstration

T2 Expansion Of Air

Task

Demonstration to show that air expands when it is heated and that hot air rises. Discussion about winds.

Key learning

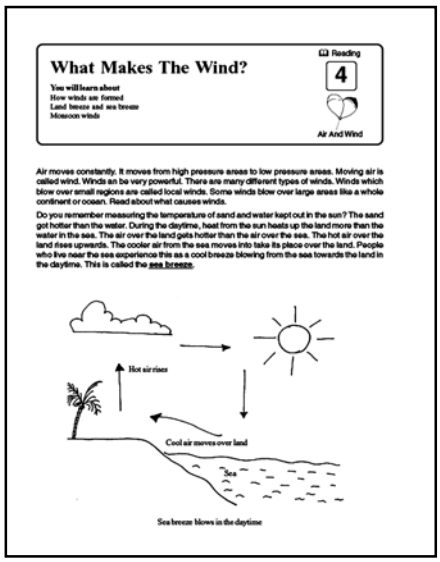
Air expands on heating and contracts on cooling.
Hot air rises upwards.
Formation of winds based on the above principles.

Materials needed

Glass bottle, balloon, large container, hot water.
Two equal sized paper cups, stick, string, candle and matchbox.
Chart showing land and sea breeze.

Teacher's role

Demonstrate how hot air rises and explain how winds are created.



What Makes The Wind?

Reading 4

You will learn about
How winds are formed
Land breeze and sea breeze
Monsoon winds

Air And Wind

Air moves constantly. It moves from high pressure areas to low pressure areas. Moving air is called wind. Winds an be very powerful. There are many different types of winds. Winds which blow over small regions are called local winds. Some winds blow over large areas like a whole continent or ocean. Read about what causes winds.

Do you remember measuring the temperature of sand and water kept out in the sun? The sand got hotter than the water. During the daytime, heat from the sun heats up the land more than the water in the sea. The air over the land gets hotter than the air over the sea. The hot air over the land rises upwards. The cooler air from the sea moves into take its place over the land. People who live near the sea experience this as a cool breeze blowing from the sea towards the land in the daytime. This is called the sea breeze.

Hot air rises

Cool air moves over land

Sea

Sea breeze blows in the daytime

4 What Makes The Wind?

Task

Reading about what causes winds.

Key learning

Winds arise because of uneven heating of air.
Sea and land breezes.
Monsoon winds, major wind systems on earth.

Teacher's role

Provide assistance with reading tasks and review new vocabulary if required.

Demonstration: Air Around Us

T1

This demonstration shows how there is air everywhere around us, even in apparently 'empty' containers. The discussion that follows explains the composition of air and how the balance of oxygen and carbon dioxide is maintained by living things.

What you need

Empty glass bottle, large transparent container with water, glass.

Ideas to talk about

Demonstration to show that air exists everywhere:

- Show an empty glass bottle and ask what is inside it. If students say "Nothing" tell them you will show them that there is something inside. (If students recognize that there is air inside the bottle you can tell them that you will be showing that there is air inside.)
- Fill the large container with water. Invert the bottle and dip the bottle with its mouth facing down into the water.
- Ask students, *"Is water entering the bottle?"* **(No.)**
- Now tilt the bottle slightly so that water starts entering it. Ask, *"Is water entering the bottle?"* **(Yes.)**
- Ask, *"What can you see coming out of the bottle?"* **(Bubbles.)** *"What's in the bubbles?"* **(Air.)**
- *"Where did the air come from?"* **(From inside the bottle.)**
- *"Although the bottle looks empty, it is actually full of air. When I pushed the bottle in straight there was no place for the air to escape. So the water could not enter the bottle. When I tilted the bottle, the air in the bottle could escape. The bottle started filling the space that the air had vacated."*
- *"Air occupies space. It is present all around us though we cannot see it. We live at the bottom of a very thick layer of air that covers the Earth called the **atmosphere**."*
- *"Can you give some other ways we can tell that there is air around us?"* **(We can feel moving air, we can feel air that we breathe in.)**

Composition of air:

- *"Air around us is a mixture of different gases, water vapour and tiny dust particles. Can you name some of the gases present in air?"* **(Oxygen, carbon dioxide, water vapour.)**
- *"Oxygen is the most important of these gases for living things. It makes up about one fifth (20%) of the air. All living things need oxygen to survive. Do you know why living things need oxygen?"* Let students answer using their prior knowledge about respiration.
- *"Carbon dioxide is a gas that plants use to make food during photosynthesis. Carbon dioxide is also created when substances like paper, wood and petrol burn."*
- *"Air also contains nitrogen gas. Almost four fifths (80%) of the air is made up of nitrogen. Air also has water vapour, dust particles and small amounts of other gases."*
- You could also explain how animals and plants maintain the balance of oxygen and carbon dioxide in the air.

Demonstration: Expansion Of Air

T2

Do these experiments to demonstrate that hot air is lighter than cold air and that it expands and rises. Use this phenomena to explain how winds are formed.

What you need

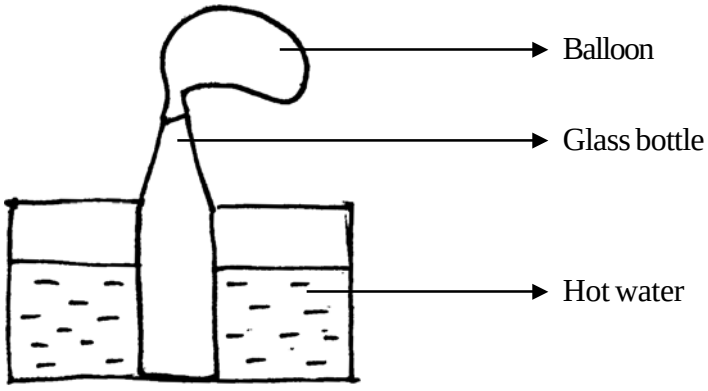
Empty glass bottle with a narrow mouth
Balloon, large container, hot water
Two equal sized paper bags or paper cups
Stick, string
Candle and matchbox
Chart showing land and sea breeze.

Ideas to talk about

- Review concepts about air pressure by asking questions.
- *"What happens to air pressure when you compress air?" "What happens to air pressure when air moves faster?"*
- You could also ask students to explain the observations they made in the previous two experiments on air pressure.

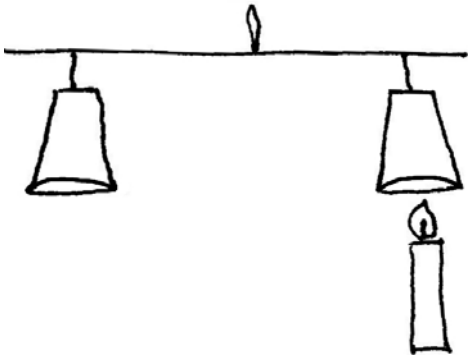
Air expands when it is heated:

- *"Lets look at some other properties of air. We are going to observe what happens to air when we heat it."*
- Show the empty bottle and ask, *"What is in the bottle?"* **(Air.)**
- Fit the deflated balloon over the mouth of the empty bottle. Ask, *"What is inside this balloon?"* **(Its empty.)**
- Pour hot water in the container. Put the bottle in the hot water and wait for a few minutes. The balloon will get inflated. Ask, *"What is in the balloon now?"* **(Air.)**
- *"Where did the air come from?"* **(From the bottle.)**
- *"What do you think happened?"* Encourage students to respond. You could lead them to the explanation that the hot water heated the air in the bottle. The air in the bottle expanded as it got hotter. It filled the balloon.
- Remove the bottle from the hot water and wait a few minutes. The balloon will get deflated.
- Ask students to explain what happened.
- You could lead them to the explanation that the air in the bottle cooled down. The air in the bottle contracted as it got cooler.
- Explain that the volume of air expands when it is heated and contracts when it is cooled.



Hot air is lighter than cold air:

- Explain that as air gets hotter it expands and takes up more space. When it does this it gets lighter. A lighter substance rises up compared to a heavier substance. So hot air rises up.
- You can demonstrate this by showing the smoke from an agarbatti rising.
- You can also demonstrate this by taking two empty paper bags (or paper cups) of the same size and tying them to a stick so that they are balanced. Hold a lighted candle under one paper bag so that the air inside gets heated. The paper bag that is heated will rise up as the air inside it gets lighter. Ask students to explain why this happens.
- You can also ask students if they have felt the hot air and smoke rising when they hold their hands over a fire.



How winds are formed:

- *"We've observed how air expands and rises when it is heated. As the hot air rises, cold air moves in to take its place. This movement of the air is called wind."*
- *"Moving air or wind is very powerful. Can you think of some ways in which we use wind?"* **(Winnowing, windmills, etc.)**
- *"All winds on Earth are created by the movement of air because of its uneven heating."*
- *"Lets look at what happens near the sea. Do you remember the experiment you did in the unit on heat? When you put sand and water out in the sun for the same time, which one got hotter?"* **(The sand.)**
- *"During the daytime, heat from the sun heats up the land more than the water in the sea. The air over the land gets hotter than the air over the sea. The hot air over the land rises upwards. The cooler air from the sea moves into take its place over the land. People who live near the sea experience this as a cool breeze blowing from the sea towards the land in the daytime. This is called the sea breeze."*
- Explain this with a diagram or a chart.
- *"During the night, the land cools faster than the sea. The air over the sea is warmer than the air over the land. The warmer air rises and the cool air from the land moves over the sea to take its place. This movement of cool air from the land to the sea is called the land breeze."*
- Explain this with a diagram or a chart.
- You could also explain how the monsoon winds are formed.

Going Further

Ideas for More Activities

Experiments and Investigations

- Measuring air pressure using a barometer.
- Measuring wind direction and wind speed.

Making and Doing

- Making a windmill.

Notes

Assessment

Assessment

I Choose the correct statement from the choices given below:

1. Which of the following ***always*** happens in a chemical change?
   a) Heat is given out
   b) A new substance is formed
   c) The colour of the substance changes
   d) There is a smell

2. You see bubbles when you add cooking soda to vinegar because
   a) A gas is formed
   b) The substances are boiling
   c) Cooking soda is trying to escape
   d) Vinegar often bubbles

3. A word equation tells us
   a) What substances react and are produced in a chemical change
   b) Whether the change was fast or slow
   c) How hot the substances were
   d) How much of each substance reacted

4. Burning of wood is
   a) a chemical reaction taking place between fire and wood
   b) a physical change in which wood turns into burnt wood
   c) a chemical reaction between wood and oxygen in the air
   d) a very slow reaction in which wood reacts with fire

5. Rusting of iron happens in
   a) cold weather
   b) the presence of oxygen and water
   c) in the presence of only oxygen
   d) the presence of carbon dioxide and water

II State whether the following statements are true or false:

1. A new substance is always formed in a chemical change.
2. Paper gets a new shape when it is torn. This is an example of a chemical change.
3. Chemical changes can take place in our bodies.
4. When ice melts, water is formed. This is an example of a physical change.
5. When we put a piece of plastic in copper sulphate solution a chemical reaction takes place.

III Answer these questions briefly:

1. How can we prevent rusting? Describe at least two ways.

2. Why does a fire go out when you pour water on it?

3. What is a physical change?

Acids And Bases

Assessment

I Choose the correct statement from the choices given below:

1. Phenolphthalein is an example of a

   a) acid b) base c) salt d) indicator

2. Which of the following is not an acidic substance :

   a) lemon juice b) tamarind water c) amla d) sugar

3. Which of the following is an example of a basic substance:

   a) lemon juice b) cooking salt c) antacid medicine d) turmeric

4. Toothpaste prevents tooth decay by

   a) killing bacteria in our mouth b) neutralizing acid in our mouth

   c) removing food particles from our mouth d) making foam

5. What would you apply to reduce the burning sensation of an ant bite?

   a) wet cooking soda b) sugar solution c) lemon juice d) salt water

II State whether the following statements are true or false:

1. Vinegar turns turmeric paper red.
2. Soap solution turns red litmus paper blue.
3. All substances are either acidic or basic.
4. Acids and bases change the colour of all indicators.
5. Copper sulphate is used as an indicator.

III Fill in the blanks:

1. A chemical reaction between an acid and a base is called a _____ reaction.
2. Such a reaction results in the formation of a _____ and water.
3. The quality of basic soil can be improved by adding _____.
4. Acidic substances generally taste _____.
5. Sodium chloride is an example of a _____.

IV Answer these questions in one or two sentences:

1. What is an indicator?

2. What is a salt?

3. How does brushing your teeth with toothpaste prevent tooth decay?

4. How can acidic soils be improved?

5. How can basic soils be improved?

Assessment

I Choose one correct alternative for each of the following:

1. Which of the following appliances uses the heating effect of electricity:
   a) An electric motor b) An electric switch c) A magnetic compass d) An electric iron

2. Which of the following appliances has an electromagnet inside it:
   a) A electric switch b) An electric motor c) A magnetic compass d) A fuse

3. A safety device that is used inside buildings is called a :
   a) A battery b) A switch c) A fuse d) A bell

4. The filament in a bulb is made of:
   a) Copper b) Plastic c) Tungsten d) Iron

5. Which of the following appliances uses the magnetic effect of electricity:
   a) An electric motor b) An electric switch c) A fuse d) An electric iron

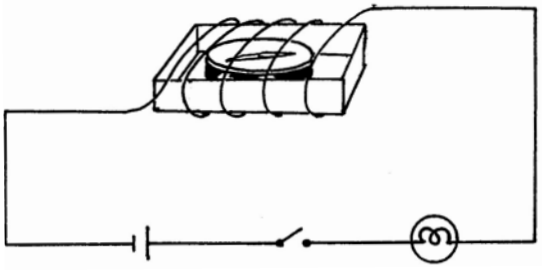
II State whether the following statements are true or false:

1. An electric wire always behaves like a magnet.
2. An electromagnet does not attract iron.
3. The filament in a bulb melts easily.
4. Heat is always produced in a wire through which electricity flows.
5. A thicker wire gets hotter than a thinner wire when electricity passes through it.

III Answer these questions briefly:

1. What is the heating effect of electricity?

2. Look at the circuit given below. What happens to the compass needle when the switch is turned on? Why?



3. Describe how you can make an electromagnet.

Assessment

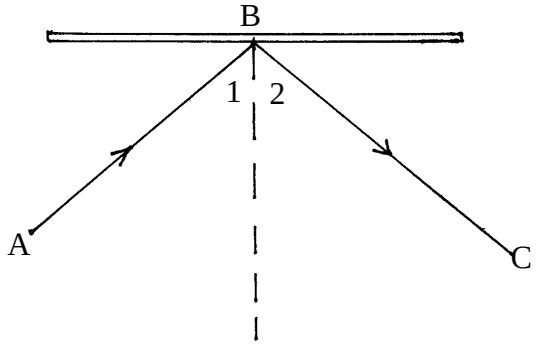
Reflection In Mirrors

I Choose the correct answer in each of the following:

1. The inside surface of a shiny steel spoon is an example of
   a) a concave mirror b) a convex mirror
   c) a poor reflector d) a plane mirror
2. A convex mirror always gives
   a) a larger image than the object b) an inverted image
   c) a smaller image than the object d) an image that is the same size as the object
3. When two plane mirrors are placed at 90º to each other how many images will you see?
   a) four b) six
   c) nine d) three
4. If you stand 2 metres in front of a plane mirror your image would appear
   a) upside down b) 4 metres from where you are standing
   c) 2 metres from where you are d) 1 metres from where you are standing
5. Which of the following mirrors is used inside a torch
   a) a convex mirror b) a concave mirror
   c) a plane mirror d) all of them

II Fill in the blanks using information from the figure given below:

1. AB is the _____ray.
2. BC is the _____ray.
3. Angle 1 is called the _____angle.
4. Angle 2 is called the _____angle.
5. If Angle 1 is equal to 30º,
   then Angle 2 is equal to _____



III A few letters are given below. What will their image look like in a plane mirror?

1. **A**
2. **N**
3. **p**
4. **d**

IV Answer these questions in a few sentences each:

1. What is the difference between a real image and a virtual image?

2. Which type of mirrors are used in vehicles to see vehicles coming from behind? Why are these kinds of mirrors used?

Assessment

I Fill in the blanks:

1. The _____ is the hole in our eyeballs through which light enters our eyes.
2. A _____lens is used as a magnifying glass.
3. A water drop acts like a _____lens.
4. The screen inside our eye where an image is formed is called the _____.
5. A _____lens is thinner in the middle than on the edges.

II Answer the these questions briefly:

1. You cannot see objects in a dark room. Explain why.

2. What is the pupil? What is its function?

3. Name three instruments that use lenses.

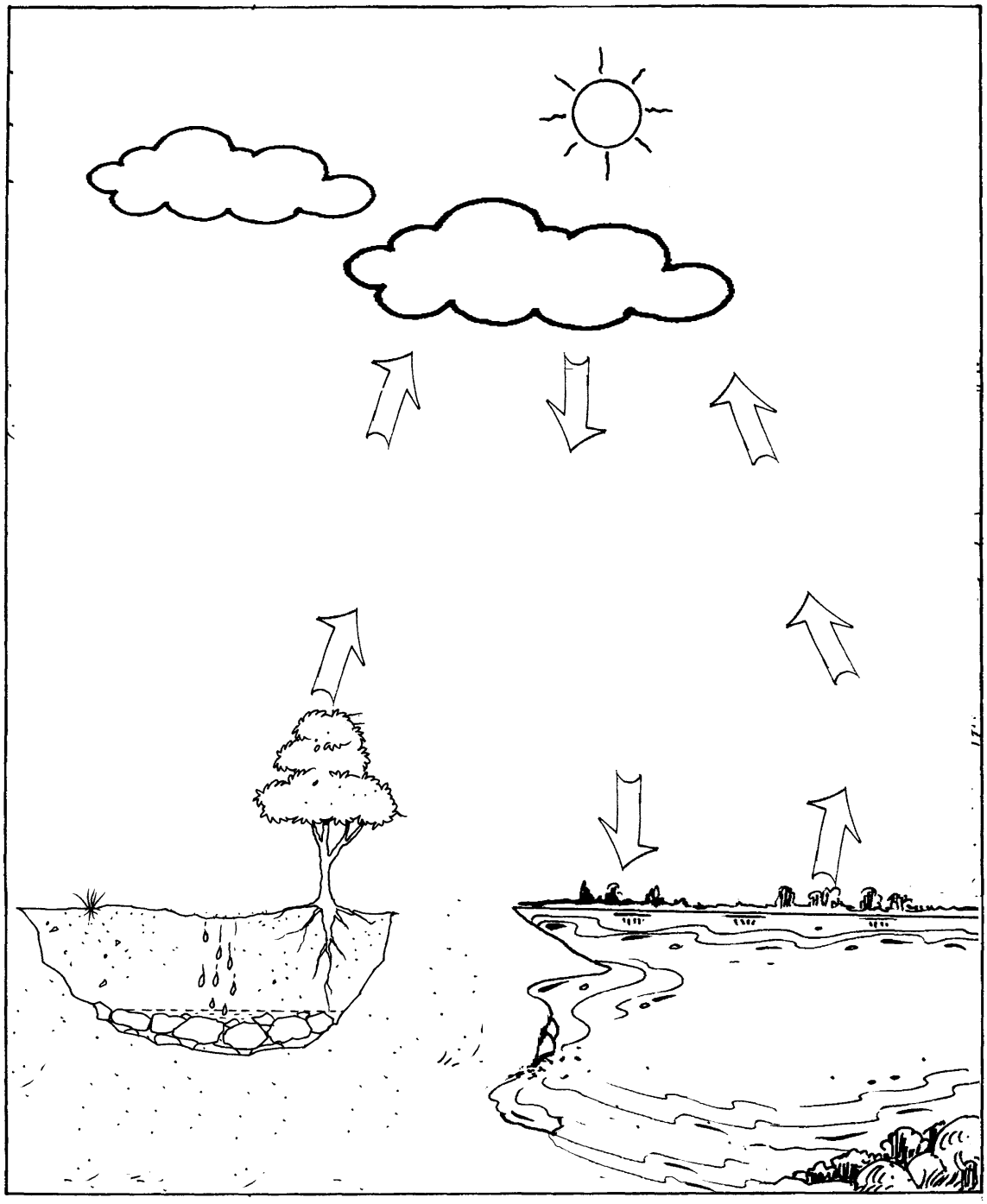
4. You are given three pieces of glass. How will you determine whether they are convex, concave or flat?

III Draw and label the diagram of the eye.

Assessment

I Label the following stages of the water cycle in this diagram:

transpiration, evaporation, precipitation, percolation, groundwater, clouds



II Give one example where you have observed each of the following properties of water:

1. Capillary action of water.
2. Water changes from a gas to a liquid
3. Water moves from a lower level to a higher level
4. Water moves from a higher level to a lower level
5. Water carries dissolved substances

III Fill in the blanks:

1. Clouds are made up of _____
2. _____ is the process by which liquid water evaporates from plants.
3. Fish are able to breathe _____ which is _____ in water.
4. The movement of water between land, the oceans and the atmosphere is called _____
5. A blackboard dries up after you wipe it with a wet cloth. This is an example of _____

IV Answer the following questions in one or two sentences each

1. What is evaporation?

2. What is condensation?

Using Water

Assessment

I Fill in the blanks with the correct words:

1. Water which lathers well with soap is called _____.
2. Catching and saving rain where it falls is called _____.
3. Rivers, lakes and groundwater are examples of _____ water sources.
4. Evaporating water, cooling the vapour and collecting the purified water is called _____.
5. Boiling water is a good way to purify water that has _____ in it.

II Answer these questions briefly:

1. Describe three ways in which farmers can help to conserve water.

2. How does water become hard?

3. How do check dams help to conserve rain water?

4. What is an aquifer?

5. How does the excessive use of pesticides contaminate the groundwater?

Making Sounds

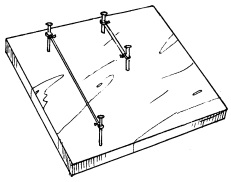
Assessment

I Fill in the blanks using some of the words given below:

1. A flute is an example of a _____ instrument.
2. When you speak _____ in your throat vibrate.
3. A drum is an example of a _____ instrument.
4. The back and forth movement of an object is called _____ .
5. A grown mans voice is _____ than a small boys.

II State whether the following statements are true or false:

1. Sounds are made when things vibrate.
2. Sounds travel better in air than in wood.
3. The shorter string would make a lower pitched sound that the longer string.



4. Sounds cannot travel through water.
5. When we strike a drum, the air inside it also vibrates.

III Answer the following questions in a few sentences each:

1. A cycle bell does not ring properly when you hold it with your palm. Explain why.

2. Explain why sounds cannot be heard on the moon.

3. Why is noise pollution bad for you?

Food And Nutrition

Assessment

I Choose one correct alternative for each of the following:

1. Which of these is a good source of Vitamin A?
   a) Rice b) Mango c) Ragi d) Butter
2. If I want to add protein to my diet which of these could I choose?
   a) Papaya b) Chapati c) Dal d) Potato
3. Digested food is absorbed in the
   a) Mouth b) Large intestine c) Small intestine d) Stomach
4. Calcium is useful for
   a) Building strong bones b) Giving us energy
   c) Carrying oxygen in the blood d) Repair our body
5. Vegetables and fruits are rich sources of
   a) Fats b) Proteins c) Vitamins d) Calcium

II Match the following:

Proteins	( )	A. Give us energy
Fats	( )	B. Found in green leafy vegetables and meat
Carbohydrates	( )	C. Keeps our eyes healthy
Vitamin A	( )	D. Help us grow
Iron	( )	E. Are found mainly in cereals like rice and ragi

III Draw the digestive system and label the organs.

IV Plan a balanced meal. List the foods you would choose to eat for dinner. Write the main nutrients you would get from each of the foods you eat.

Movement

Assessment

I State whether the following statements are true or false:

a) Our elbow is an example of a ball and socket joint.

b) A hinge joint allows only bending.

c) Smooth muscles are found in the heart.

d) The ribs protect the stomach and intestines.

e) Skeletal muscles can push and pull.

II Answer these questions briefly:

1. What are the functions of the skeletal system?

2. What are skeletal muscles?

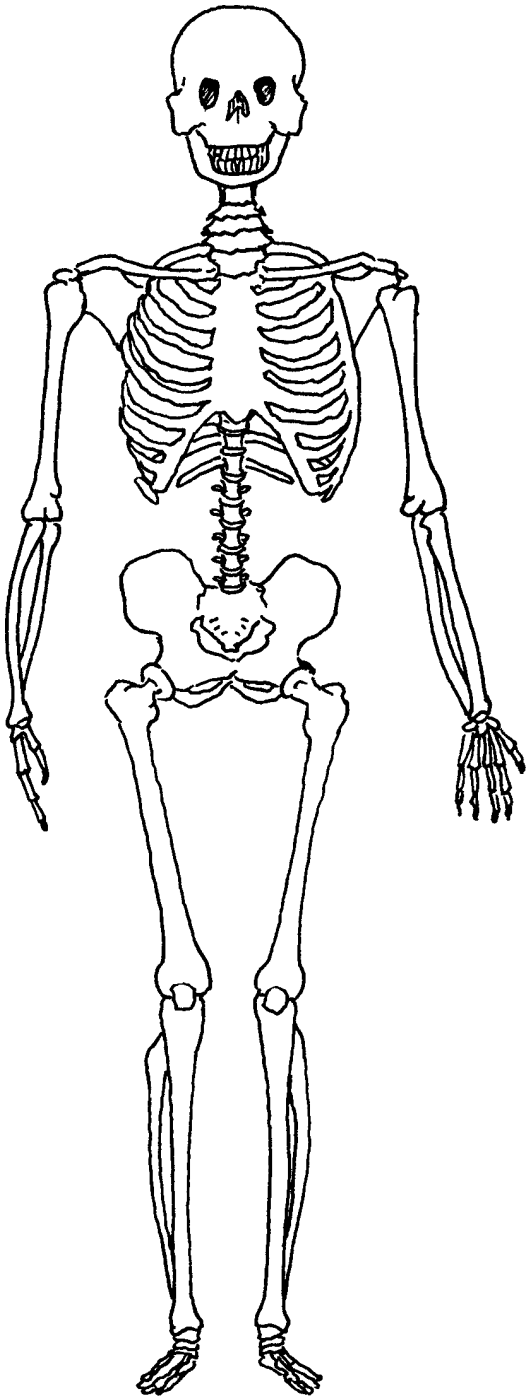
3. What is a joint?

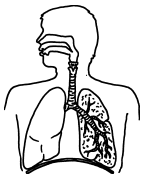
4. What are involuntary movements? Give examples of 2 involuntary movements.

5. Why are the long bones in our arms and legs hollow?

III Here is a diagram of the human skeleton. Label the following bones and joints.

1. Skull
2. Ribcage
3. Thigh bone
4. Backbone
5. A joint which can move in all directions
6. A hinge joint
7. Elbow
8. Spine
9. Pelvic bone
10. A ball and socket joint





Respiration

Assessment

I Write true or false next to each statement:

a) During inhalation the chest contracts.

b) Breathing and respiration mean the same.

c) Blood carries carbon dioxide from the lungs to different parts of the body.

d) The pipe through which air goes from the pharynx to the lungs is called epiglottis.

e) Your body needs nitrogen.

II Answer these questions briefly:

1. Why is smoking bad for health?

2. Why do you breathe faster when you are running than when you are sitting?

3. What is the function of alveoli?

III Give one word for each of the following:

1. The process by which we take air into our lungs:

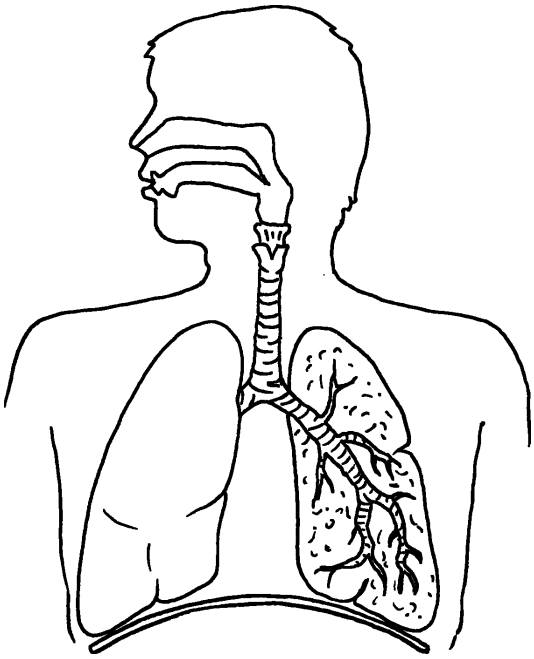
2. The big muscle at the base of the chest cavity which helps in breathing

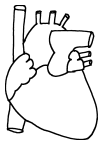
3. The small cover at the top of the trachea which prevents food from going down the windpipe

4. The gas which is absorbed by blood in the lungs.

5. The pipe through which air goes from the pharynx to the lungs.

IV Label the diagram of the human respiratory system.





Assessment

Circulation And Excretion

I Match the following:

Part of the body	Function
Arteries ( )	A. Pumps blood to all parts of the body
Veins ( )	B. Carry blood rich in oxygen to different parts of the body
Capillaries ( )	C. Carry blood rich in carbon dioxide to the heart
Heart ( )	D. Filter blood and remove waste substances
Kidneys ( )	E. Tiny tubes which transport blood to the cells

II Fill in the blanks:

1. The pale yellow liquid in blood is called _____
2. The substance in red blood cells which helps to carry oxygen is called _____
3. _____ stop blood from flowing back into the atrium from the ventricles.
4. The lower chambers of the heart are called the _____
5. You can usually feel your pulse in your _____ and _____
6. Urine is stored in the _____ before it leaves the body.
7. The _____ help your body fight against germs which cause diseases.
8. Blood from the lungs enters the _____ chamber of the heart.
9. Carbon dioxide is removed from the blood in the _____
10. The rhythmic expansion and contraction of the heart is called_____

III Answer these questions in a few sentences:

1) Why does the heart beat faster when you run?

2) What are the functions of the circulatory system?

3) What is excretion? Why is it necessary?

4) Explain how a scab is formed when you get a cut.

IV Draw and label the excretory system.

Heat

Assessment

I Choose the correct statement from the choices given below:

1. The shiny substance inside a thermometer is

   a) silver b) mercury c) aluminium d) steel

2. If we mix a cup of water at 70°C with a cup of water at 25°C, we will get

   a) two cups of water at 70°C b) two cups of water at 25°C

   c) two cups of water between 25°C and 70°C d) two cups of water below 25°C

3. The shiny substance in a thermometer rises when the bulb is immersed in a hot substance. This is an example of

   a) Melting of a solid b) Expansion of a liquid

   c) Expansion of a solid d) Solidifying of a liquid

4. A clinical thermometer can measure a temperature of

   a) 100°F b) 100°C c) 37°F d) 0°F

5. Normal human body temperature is around

   a) 98.6°F b) 98.6°C c) 102.3° F d) 102.3°C

II State whether the following statements are true or false:

a) A clinical thermometer is shorter than a laboratory thermometer.

b) A laboratory thermometer has a bend in the glass tube near the bulb.

c) Mercury is a liquid at room temperature.

d) A laboratory thermometer has mercury in the bulb.

e) Body temperature remains the same at all times of the day.

III Answer these questions briefly:

1. What is heat? Name one natural and one man made source of heat.

2. What are the main differences between a laboratory thermometer and a clinical thermometer?

3. Why does the mercury column rise when you immerse the bulb of a thermometer in a warm substance?

IV Draw a diagram of a laboratory thermometer and label its parts.

Assessment

I State whether these statements are true or false:

1. Plants always give out oxygen.
2. Air pressure increases when air expands.
3. Air has 80% oxygen in it.
4. In the night winds blow from the sea towards the land near the seashore.
5. Air pressure decreases when air moves faster.

II Answer these questions briefly:

1. What is meant by atmosphere? What are the different gases found in the atmosphere?

2. What are monsoon winds? Why do they bring rain in the months of July to September?

3. What happens to the paper when the girl blows over it?

4. Why does this happen?