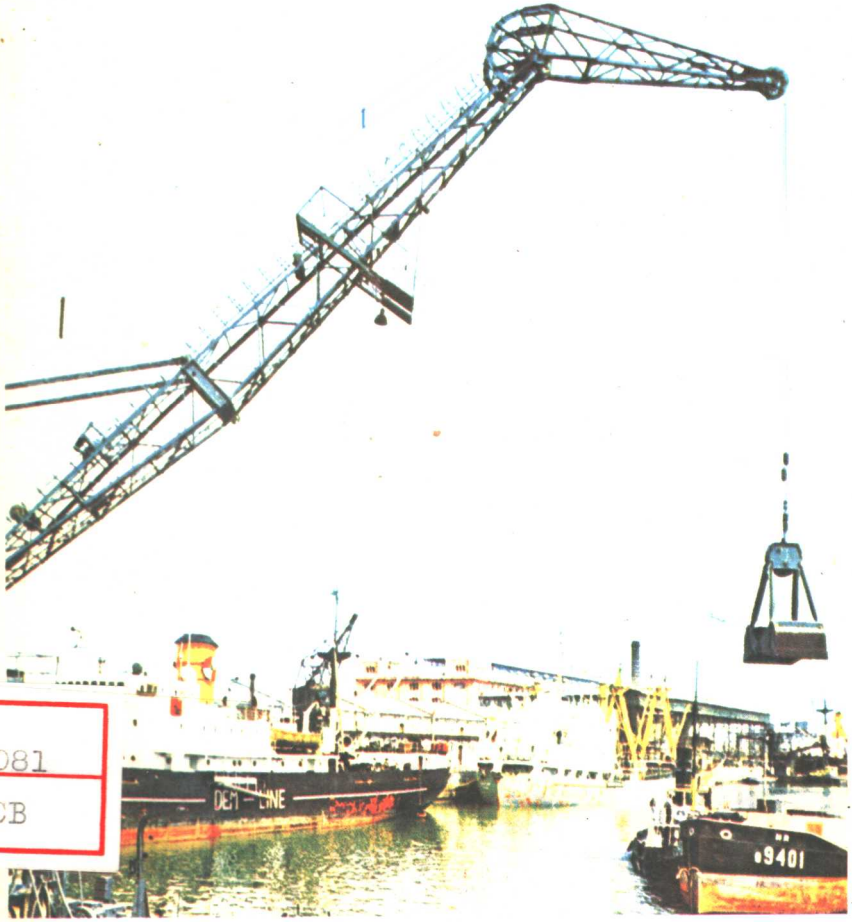
簡易英語科技叢書

力・量度



中外出版社

簡易英語科技叢書

力・量度

出版說明

《簡易英語科技叢書》是爲初學英語的中國青年學生提供一套閱讀英語科技書藉資料的參考讀物。

本叢書包括十六個科學課題，分爲十六册出版。每一課題構成一個完整的知識讀物。這十六個課題把目前國外學校教學中的基礎科學內容都包括進去了。

爲提高讀者科學知識和閱讀興趣，每一分册均附有生動的彩色插圖，英語文字力求淺顯，使一般初學英語的中國青年學生都能接受。

CONTENTS

INTRODUCTION

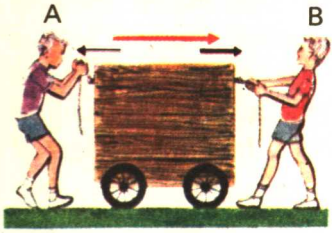
In our everyday life we see many moving things. We see cars, bicycles, buses, lorries and vans moving along the roads. We see aeroplanes flying in the sky and ships sailing in the sea. These are only a few examples of moving things.

Do you know what causes things to move? The answer is **force**. A force can be a push or a pull. If you exert a force on a cart it will start to move. If you increase the force, the cart will move faster and faster. This is called **acceleration**. If you stop pushing or pulling the cart, it will keep moving for some time before it stops. It is the same when we ride a bicycle. The bicycle will stop moving after some time if we do not keep on pedalling.

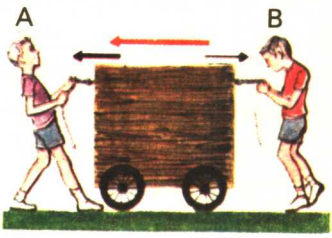
If you want to stop a moving cart, you must exert a force on it. In the same way if you want to stop your moving bicycle you apply the brake.

Force is needed to (a) move an object.
(b) stop a moving object.

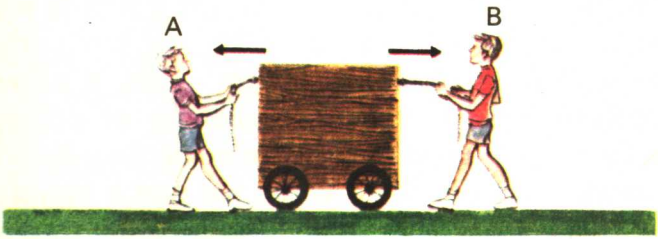
What happens when equal and opposite forces act on an object?



B pulls harder than A



A pulls harder than B



A and B pull with an equal force

If an object is not moving it does not mean that there are no forces acting on it. An object will not move if there are equal and opposite forces acting on it.

WHAT IS WEIGHT?

If you hold a book and then let it go, the book will fall to the ground. The book falls because a force pulls it down. This force is due to the Earth's gravity. The Earth's gravitational pull on an object is called its **weight**. A smaller gravitational force acts on a lighter object and a bigger force acts on a heavier object.

WEIGHING MACHINES

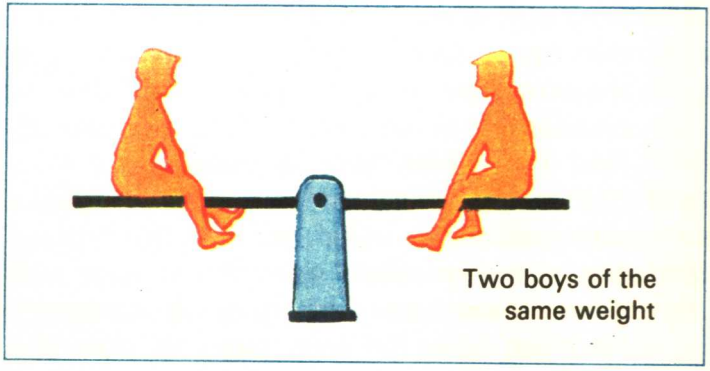
Weighing machines are used to find out the **weights** of objects or to compare the weights of different objects. There are many kinds of weighing machines. Next time you go shopping or marketing, find out the different ways in which shop-keepers weigh things.

Now let's find out more about the weighing of things and weighing machines. First, let us find out about a **see-saw**, which can be used as a simple weighing machine. Then we will find out how to make simple weighing machines and how to use them.

A SEE-SAW

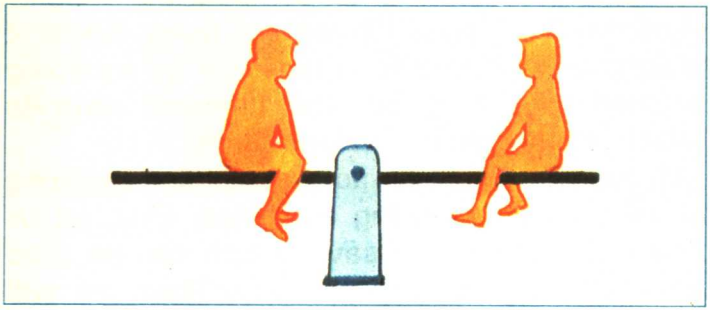
Two boys, both of the same weight, sit on opposite sides of a see-saw. How far must they be from the centre in order to keep the see-saw balanced?

To balance a see-saw



Two boys of the same weight

When two boys of different weights sit on a see-saw, which boy must sit further away from the centre of the see-saw in order to balance it?

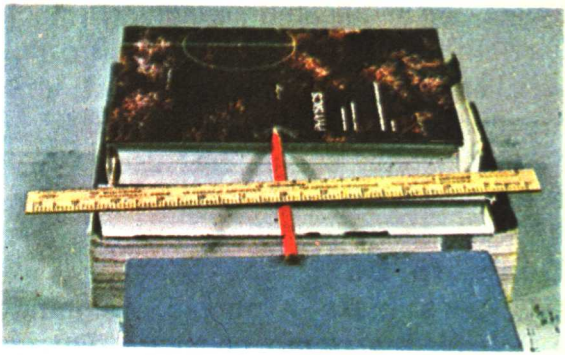


By moving to different positions, they will soon find out that they have to sit at equal distances from the centre. Now, if one of them is heavier, the heavier boy has to be nearer to the centre to make the see-saw balance.

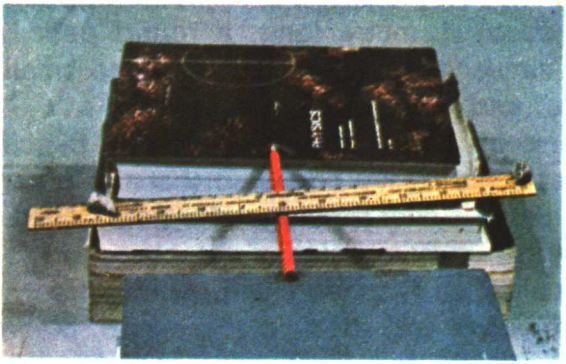
Things to Do

Take a stone in each hand. Can you find out which stone is heavier? If the two stones are about the same size, you may not be able to tell which one is heavier. But you can use a see-saw to find out which one is heavier.

Place a pencil on two piles of books and balance a ruler on it. Now place one stone on each side of the ruler and move them until the ruler is balanced. Find out how far each stone is from the



A balanced ruler



Stones balanced on a ruler

pencil. The stone nearer to the pencil is the heavier one. Now you know how a simple weighing machine works.

SIMPLE WEIGHING MACHINES

There are very simple weighing machines which we can make. One is a **clamp balance** and the other is a **balloon strip balance**. These weighing machines are not very accurate. They do not give us the exact weight of an

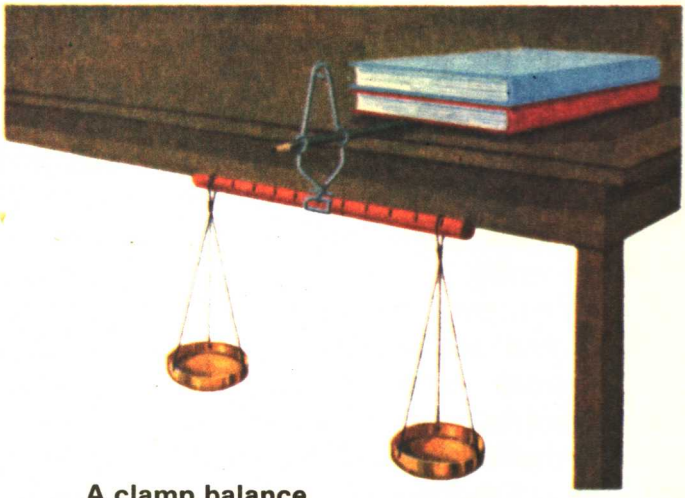
object. Complicated weighing machines are used in shops and factories. Mostly they are very accurate. Some are used for weighing meat, fish, peanuts, vegetables and other things, while some are used for weighing people.

Things to Do

(i) Let's make a simple weighing machine called a clamp balance. For your clamp balance, you will need a clamp, a wooden rod about 1 metre long, a round pencil, two similar tin lids, each with three small holes, and a piece of thin string.

First of all, put one end of the pencil under some heavy books so that the other end juts out over the edge of a desk. Next, put the two wire holes of the clamp on to the pencil so that the clamp swings freely. By opening and shutting the clamp, place the wooden rod in a position where it balances. Make pencil marks at each end of the rod at equal distances from the clamp. Using a razor blade, make a little groove at each pencil mark. The grooves are for keeping the strings in place.

Now, to make the scale pans, tie the thin string to the three holes in the tin lids. Next, hang the scale pans from the grooves, first making sure that the rod is level. The pans must be placed



A clamp balance

at equal distances from the clamp. Do the pans balance? If they do not, stick some plasticine on the lighter pan. Now your clamp balance is ready for use.

Use your weighing machine to compare the weights of some objects such as peanuts, rubber, chalk and small stones. Place these objects on the scale pans and balance them with other objects. Find out which objects are heavier and which are lighter.

(ii) To compare the weights of different objects properly, we must have standard weights. We can make our own standard weights by filling bottle-tops with plasticine. Now balance these bottle-tops

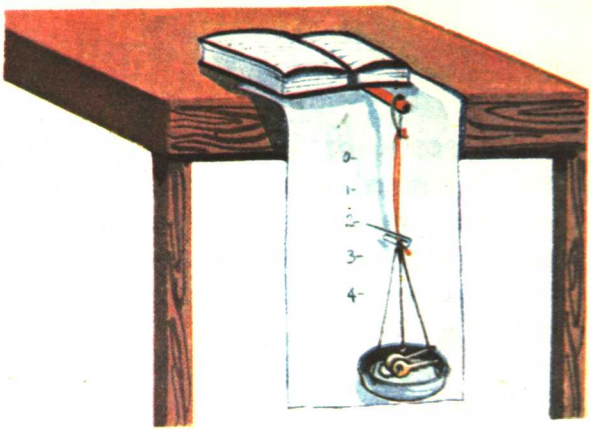
against one another. Make sure they all weigh the same by taking away or adding plasticine to them. We will call these standard weights 'sprogs'.

Place a sprog on one scale pan and some identical buttons on the other. Find out how many buttons are balanced by one sprog.

You can use your weighing machine to find the weight of a stone, a pen, a small ruler and so on. Place the object in one scale pan and put sprogs in the other until the balance is level. Record the weight of the object in sprogs. Now replace the sprogs with blocks. Record the weight of the object in blocks also.

(iii) We can make another simple weighing machine called a rubber strip balance. Cut a rubber strip 1 cm wide and 10 cm long. Tie one end of the rubber strip to a stick and the other end to a scale pan as shown in the picture. Attach a paper clip pointer at the place where the scale pan is tied to the rubber strip.

Hang your rubber strip balance over the side of a desk and put a heavy weight on the stick to hold it firmly. Now pin a piece of cardboard on the side of the desk so that a scale can be marked on it.



A rubber strip balance

You can mark the scale in this way. Mark the position on the cardboard where the pointer lies when there is no sprog on the scale pan. Write 0 (zero) against this mark. Now place one sprog on the pan. You will find that the pan moves down a little. Mark the new position of the pointer on the cardboard. Write 1 for '1 sprog' against the new mark. Add more sprogs one by one and mark the position of the pointer each time. Write 2, 3, and so on against the marks. Now remove the sprogs one by one and check that the marks are still correct. Now you have made a rubber strip balance.

(iv) We can use this machine for weighing things like stones, books, dusters and so on. We put the stone on the scale pan and read off the position of the pointer

on the scale. If the pointer lies between the '3 sprogs' and '4 sprogs' mark, we say that the stone weighs more than 3 sprogs but less than 4 sprogs. Record the weights of all the other objects in this way.

WHAT IS WORK?

When you push against a big rock and if it does not move, then in the language of Science, you are not doing any work. Can you consider yourself working when you are studying or talking?

In Science, work is only done when a force moves something that has weight through a distance.

$$\text{Work} = \text{force} \times \text{distance moved}$$

The unit of work is in **joules**, if the force is measured in **newtons** and distance in **metres**.

THE PULLEY

Sometimes we find that a piece of work cannot be done by us because the load is too heavy. We have to use something to make the work easier for us. Pulleys help to make work easier for us.

The pulley is a grooved wheel. The pulley, used together with a rope or chain, is used to lift heavy weights or to change the direction of a force.

A pulley can be used in two ways:

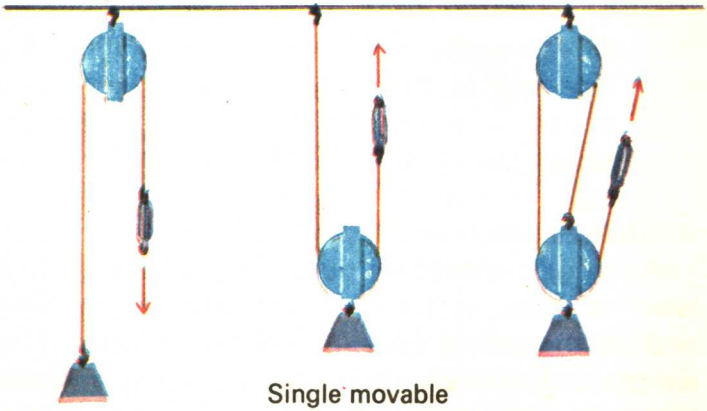
(*a*) it can be fastened by means of a hook to some support — a **fixed pulley.**

(*b*) it can be fastened to the load — a **movable pulley.**

A SINGLE FIXED PULLEY

The simplest type of pulley is the single fixed pulley. It is most commonly used on flag-poles. You must have noticed that when a person raises a flag up a flag-pole he pulls the rope downwards so that the flag goes up. A string, tied to the flag, is passed over a pulley which is fixed to the top of the flag-pole. By pulling at the free end of the string coming down from the pulley the flag will be raised.

Some common pulley systems



Single fixed pulley

Single movable pulley

Simple block and tackle

Things to Do

(i) You can lift up a large pail of water by using a pulley. Fix a pulley to a beam in your classroom. Pass a string over the pulley and tie one end of the string to the handle of the pail. Pull at the other end of the string. Is it easier to lift up the pail of water by using a pulley or to do so with your bare hands?

(ii) You can use a pulley to pull a heavy carton of sand across a table. Tie a string around the carton and move it by pulling on the string. Is it difficult to move it? Now ask someone to hold a pencil at one end of the table. Loop the free end of the string round the pencil. Move the carton away from you by pulling the string towards you. Now replace the pencil with a pulley. Thread the string around the pulley. Try to move the carton again by pulling the free end of the string towards you. Is it easier to move the carton by using the pulley or the pencil?

A SINGLE MOVABLE PULLEY

A single movable pulley is used in this way: a string is fixed to a support. The free end of the string goes round the pulley. The weight to be lifted is hung on the pulley and the effort is applied at the free end of the string. By pulling the free end of the string upwards, the