WORK MADE EASY - MACHINES

19

Imagine what life would be like in a world where tools and machines did not exist. No trains, no ox-carts, no ploughs, not even shovels. No clothes on our bodies, nor shoes for our feet. For even clothes and shoes are made with the help of machines.

In such a world what else do you think we would have to live without? And how would our lives be?

However, this is not just imagination. As you might have read in history books, many many years ago, our ancestors actually lived like this - without any machines or tools. They were not able to cultivate crops as we do, nor could they kill other animals for food or to save themselves. By and by, prehistoric people built tools for their needs. With the help of tools, many of their tasks became much easier. Thanks to tools, certain jobs which were impossible to perform earlier, became possible.

Let us have a look at some such tools.

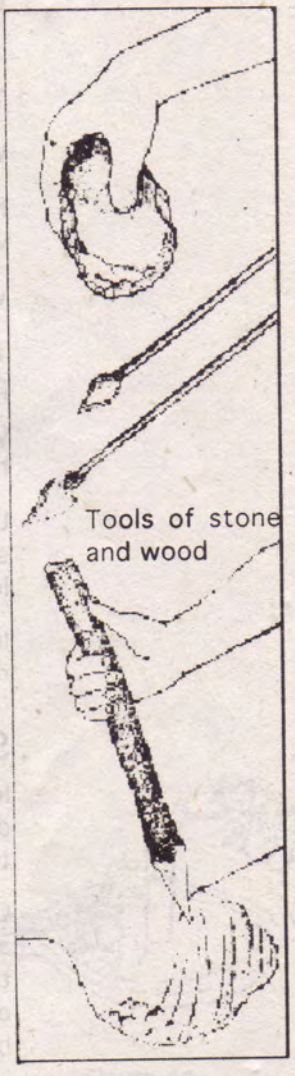


Figure-1

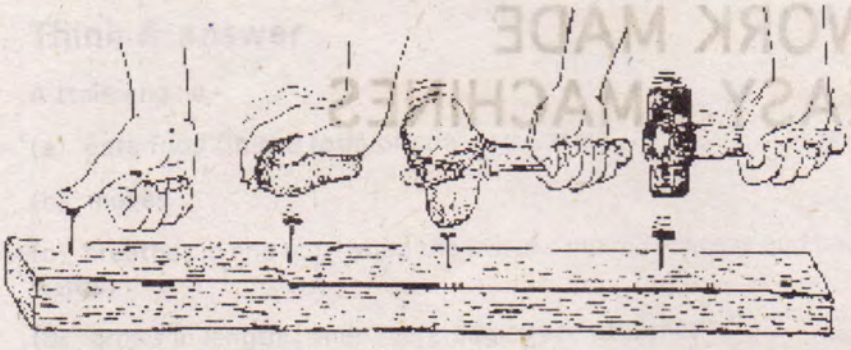


Figure-2

Using a hammer

Take a nail and try to insert it into a piece of wood using your thumb.

Were you successful in doing this? (1)

Now try doing the same with the help of a stone. First try this out with a small stone and then with a larger stone.

With which stone was this job easier? (2)

Take a small stone and tie it tightly to the end of a stick. Use it to pound the nail into the piece of wood.

Was it even more easy to insert the nail using this stone hammer? (3)

Using this stone hammer repeatedly or banging it may cause the stone in it to break. Can you suggest a way to overcome this problem?

Instead of stone, could we use some other material which would make the hammer stronger and more durable?

Story of metals

In the beginning, tools were made of stone, wood or bones. With the discovery of metals, there was great improvement in the making of tools.

Compared to stone or wood, tools made of copper or iron were much stronger. Another special thing about metals was that if heated up, they could be cast into various shapes. Once metals were discovered, all sorts of new tools began to be made. In this way, metal hammers also came into existence.

With the help of metal tools, some jobs became further easy. In order to dig up soil, shovel was invented and knives were made for

skinning animals. Agriculture, hunting and many other activities became easier than ever before.

Sewing without needles

Can you sew two pieces of cloth together using just your fingers and some thread? In place of your fingers, what if you try using a *babul* (acacia) thorn?

What problems would you face in sewing the cloths together in this manner? (4)

What improvement could you make in the babul thorn in order to make it easier to sew the cloths? (5)

How has this problem been solved in sewing needles? (6)

What sort of arrangement does the awl have for this purpose? Awl is the tool cobblers use for sewing shoes. (7)

Weight lifting, the easy way - Levers

A heavy rock, a fallen tree or some other heavy object must be lying around your school. Try to lift or shift it with your hands. Now take a big pole. Push one end of the pole under the heavy object. As shown in Figure 3, prop a rock or brick under the stick.

Figure-3

Now, try lifting or shifting the heavy object by pushing down on the other end of the pole.

Was it easier to lift the weight this time? (8)

Now repeat this a few times keeping the prop (or fulcrum) underneath the pole at various distances from the heavy object.

What difference does change in distance make? (9)

While pushing down, how far down does your hand go in comparison with upward movement of the object? (10)

What could you do to make lifting the weight in this experiment even easier? (11)

Figure-4a

Figure-4b

Lifting rocks with a pole, rowing a boat with an oar, check point **barriers** and hand pumps are all examples of **levers**.

Let us make a pulley

Now we shall make a few pulleys. Yes, just like the pulleys in wells used to draw water or the ones used in modern **cranes** which lift heavy materials. One method of making pulleys is given here. Besides this, there are many other ways of making pulleys.

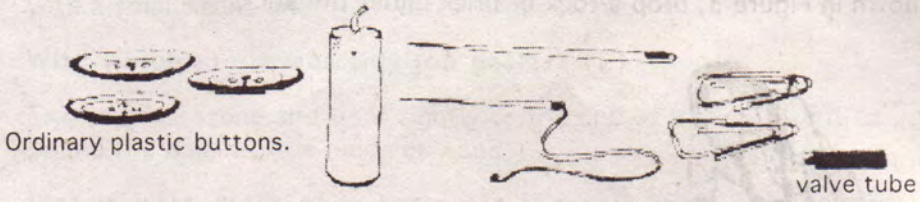


Figure-5a

Get two ordinary plastic buttons. Holding the two buttons back to back, take a needle and thread and sew them together. Do not **cross stitch**, otherwise centre of the buttons would get covered.

Heat the tip of a long needle. With the heated tip, make a hole straight through the centre of both buttons. There you are with your button pulley.

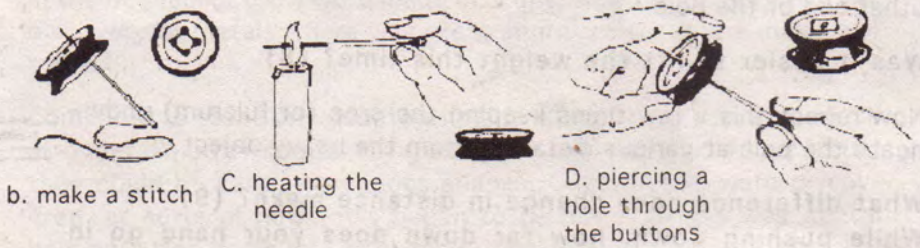


Figure-5b

In order to hang the pulley, make a hook with a paper clip. For this, open the clip, so that it becomes S shaped. Now turn one of the loops of the S downward and fix the buttons on this **axle**.

e: making a hook with paper clip

To keep the buttons from falling off, we can now attach a valve tube piece on the end of the axle. In this way, we have an inexpensive, lightweight and fast turning pulley. Make three such pulleys.

A suggestion : Use plastic buttons which can be pierced by a heated needle.

Look at Figure 6. Hang a pulley on a nail. Put a thread around the pulley. Open up a paper clip to make a hook. If you do not have a paper clip, you can make a similar hook from a piece of wire. Tie one end of the thread to the hook. Put a rubber band around a filled match box. Now insert the hook through the rubber band so that the box hangs down. Pull the other end of the string downwards and see which way the match box goes.

When you loosen your grip on the thread a bit, which way does the match box go? (12)

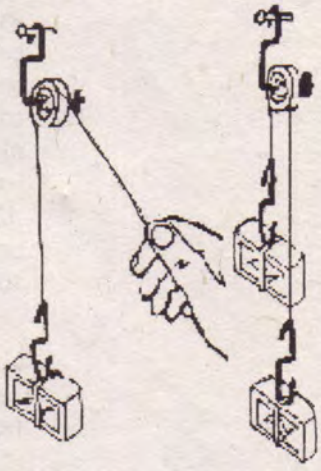


Figure-6

Now hang one more match box through another hook on that end of the thread which you had pulled with your hand.

What happened this time? (13)

Pull one of the match boxes down and see how far up the other match box goes. (14)

More work with less effort

This time, hang two pulleys as shown in Figure 7. Hang a filled match box each from both the hooks.

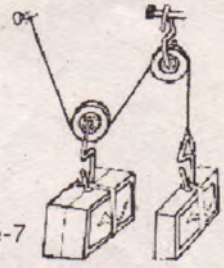


Figure-7

Do both match boxes remain stable? (15)

If not, which match box goes downward? (16)

Now, on the left side, hang another match box as in Figure 7.

With your finger, move the single match box slightly upwards and note whether the two joined boxes move the same distance downward. (17)

In this experiment, which weight moves more - the lighter one or the heavier one? (18)

Compare one-pulley experiment with two-pulley experiment, and answer the following questions -

(a) In which situation does an object lift a weight heavier than itself?

(b) If the light weight is pulled 1 centimetre downwards,

Figure-8

how much will the heavier weight go up - the same distance, less, or more? (19)

There can be another arrangement for hanging two pulleys (Figure 8). In this experiment, in place of match boxes, hang a pebble on one side and a pan of a balance on the other. Now, slowly pour sand in the balance pan until the pan and the pebble are at the same height.

According to you, which weighs more, the pebble or the pan filled with sand? (20)

Using this set-up, is it possible to lift more weight with less force? (21)

Do at home

Given below are two ways to lift weights using a three-pulley set-up.

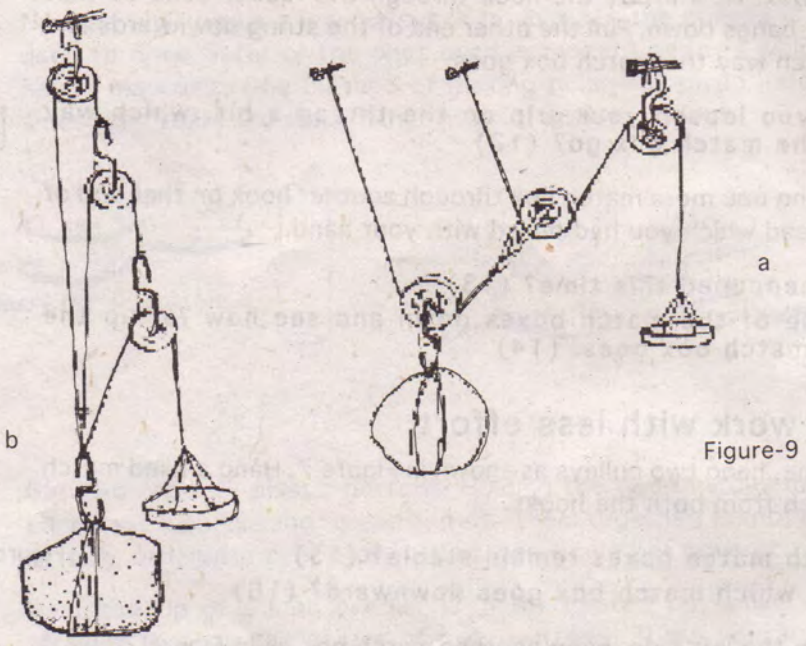


Figure-9

Was it possible to lift more weight using the three-pulley system than the two-pulley set-up?

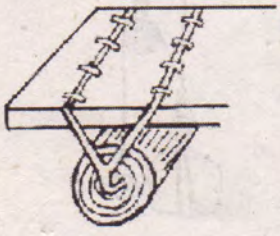


Figure-10

Machines related to transport

Till now, you have learned about the machines which help in lifting weights. Let us now learn about machines which are used in transport. Make a stack of books on the floor or a table. Try pushing it forward. Get four round pencils and put them parallel to each other on the floor or on a table. Put the stack on top of these pencils and try rolling it forward. If you do not get round pencils, reeds can be used for this activity.

Was it easier to push the stack forward this time? (22)

If you wished to push the stack a long distance using only 4-5 pencils, how would you do this? (23)

Long ago, very heavy weights (like boulders) were transported from one place to another in this way. Tree trunks were spread out on the ground. Heavy objects were placed upon them and pushed. Stones for constructing buildings were brought from the mountains using this method. While doing the last activity, you might have noticed that when pushing the weight a long distance, it becomes necessary to pick up the pencil left behind and bring it to the front. For this reason, the speed with which the load can be pushed cannot be very fast. To solve this problem, people devised the wheel. It is hard to say exactly how the idea of the first wheel came about. It is possible that before the invention of the wheel, someone tried using tree-trunks in such a way that the trunks moved along with the load. Thus, continuous shifting of the last trunk to the front remained no longer necessary. After this, the idea of a wheel was probably not long in coming.

If the wheel had not been invented, what effect would this have had on the life in your village and the country? Discuss this with your friends and write a summary of the discussion in your note book. (24)

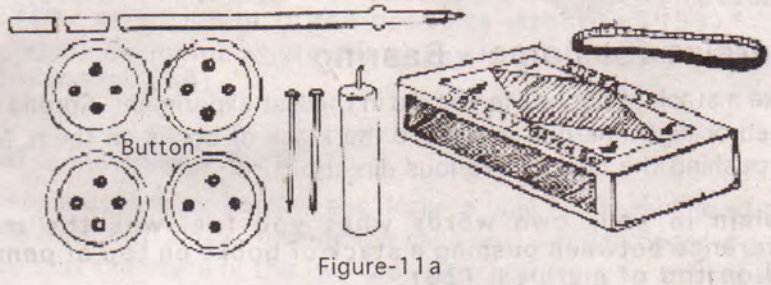


Figure-11a

Heat the pointed end of a pin and pierce it in the centre of a plastic button. Now heat the head of the pin. Place the pin with the heated head on the ground and press the button down on it, holding the button by its edges. The hot head of the pin will get fixed into the middle of the button. The button and pin joined in this way will look like a drawing pin.

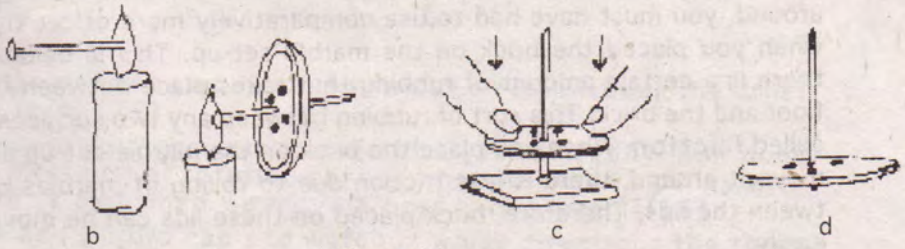
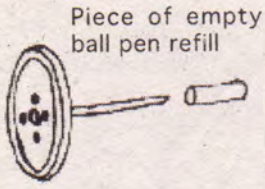


Figure-11



e

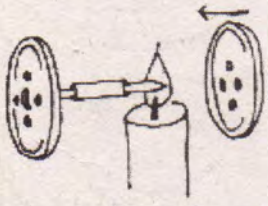
Take a 1.5 cm piece of empty ball pen refill and slide it onto this drawing pin.

Heat up the tip of your drawing pin and stick it into the middle of another button.

Both these buttons will serve as wheels.

The pin between the buttons will be the axle.

The piece of refill will become a **bearing**.

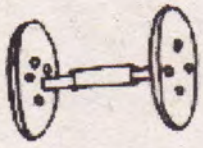


f

In this manner, build two pairs of wheels.

Place a match box on top of the refills of the wheels. Wind a rubber band over it.

That's our match box cart.



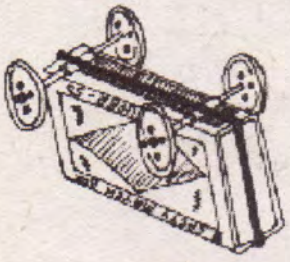
g

Get another match box. Put it on a table such that one of its striking surfaces touches the table. Try pushing it along the table. Note how much effort is needed.

Now roll the match box cart.

Which one takes more effort? Why? (25)

Join together several such box carts to make a train.

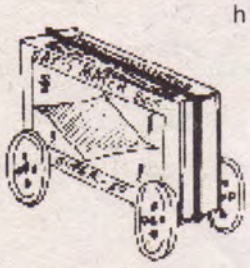


h

Exercise for home - Bearing

Make a stack of books like you did in the last experiment. Spread out seven or eight marbles and place the stack of books on them. Now try pushing the books in various directions.

Explain in your own words what you feel was the main difference between pushing a stack of books on top of pencils and on top of marbles. (26)



i

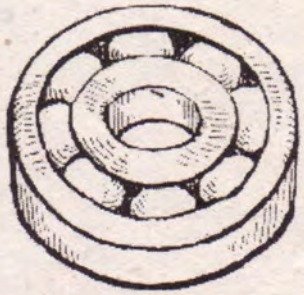
Find two Dalda-type tin can lids. Place one lid on the ground and put marbles along its periphery. Now turn the other lid upside down and place it on the marbles. Place a brick over it and roll the brick around. Next, place the brick directly on ground and try rolling it.

Did you find any difference? (27)

When you placed the brick directly on the floor and tried moving it around, you must have had to use comparatively more effort than when you placed the brick on the marble set-up. This is because there is a certain amount of rubbing that takes place between the floor and the brick. This sort of rubbing between any two surfaces is called **friction**. When you place the brick on the marble set-up and move it around, there is less friction due to rolling of marbles between the lids. Therefore, brick placed on these lids can be moved easily.

Get an old ball-bearing from any bicycle repair shop.

Looking at it can you tell why tiny balls (*chharra*) are placed between the axle and the wheels? (28)



A pulley moves another

Blades of a wind mill or water mill are moved by air or water. How can we use this motion to make other machines work? Let us do some simple experiments to get an idea.

In a match box, set up two pulleys made from large buttons with the help of two pins as shown in Figure 13a. Wind a rubber band around them. Make sure the rubber band is not so large that it remains loose. The rubber band functions like a belt. Now rotate one of the pulleys.

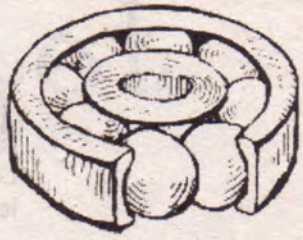
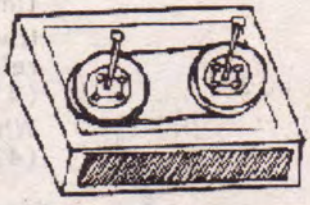


Figure-12

What happens? (29)
Do both pulleys rotate in the same direction? (30)
Do both pulleys rotate at the same speed? (31)

In Figure 13b, one of the pulleys has been replaced by a piece of pen refill. This piece is also a small pulley.



Now watch how many turns the small pulley makes for every one turn of the big pulley. (32)
When one pulley is rotated, does the other pulley rotate in the same direction or in the opposite direction? (33)
Give some examples where one pulley is used to make another pulley move. (34)

Learn to make gears

Get some cold drink bottle caps. Make a hole in the middle of the bottle caps with a nail. Arrange the caps on a wooden board in such a way that the teeth of the two caps interlock. Now, fix the caps on the board with small nails such that the caps can turn easily.

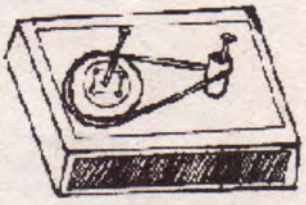
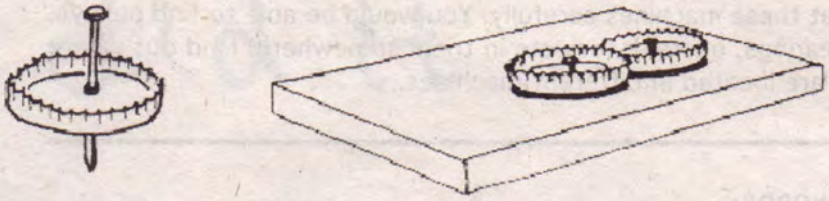
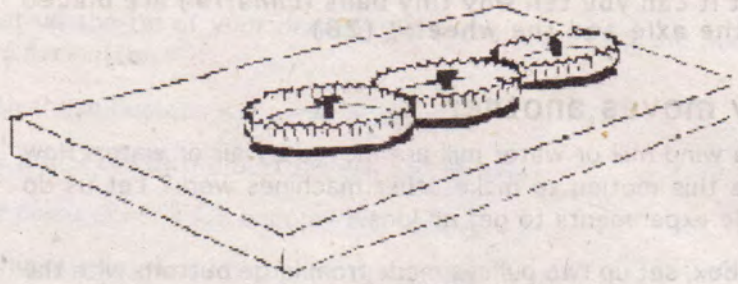


Figure-13



Rotate one cap and observe in which direction does the other cap turn. (35)
Compare your answers to questions (33) and (35). How does the direction of rotation change when we move a pulley with a pulley and when we move a gear with a gear? (36)
Now add a third cap and watch in which directions the three

caps rotate. (37)



A few questions on bicycles

Look at a bicycle carefully. Find out where its levers, bearings, pulleys, and gears are located.

Make a list of these. (38)

Which parts of the bicycle are oiled and why? (39)

Give one turn to the bicycle's pedal and count how many times the rear wheel turns round. (40)

If we push a bicycle with brakes applied and then with brakes released, in which situation would more effort be needed? (41)

Why is it hard to pedal a bicycle if the tyres have less air? (42)

Machines of all sorts

Divide all the machines you have seen around you into following four groups :

(a) machines powered by hands or feet,

(b) machines driven by animals,

(c) machines which run on electricity or petrol, and

(d) machines driven by air or water (43)

Look at these machines carefully. You would be able to find pulleys, ball-bearings, gears, levers etc in them somewhere. Find out where these are located in different machines.

NEW WORDS:

lever	bearing	barrier
pulley	friction	crane
axle	gear	cross stitch