

## novaactivity Lever Loads

You've got a massive stone to lift into place and plenty of people to help you, but all you get is a bunch of people grunting. What do you do? Turn to a lever, of course. NOVA's team of experts assumed this simple machine was available to ancient Egyptians and believed it played a part in raising the giant obelisks. Try your hand at investigating how levers make work easier.

### Materials for each pair

- two rulers, 30 cm (12 in.) plastic or lightweight wood
- pencil
- five weights (such as washers or coins)
- tape
- sheet of paper

### Part I

*Do this part individually.*

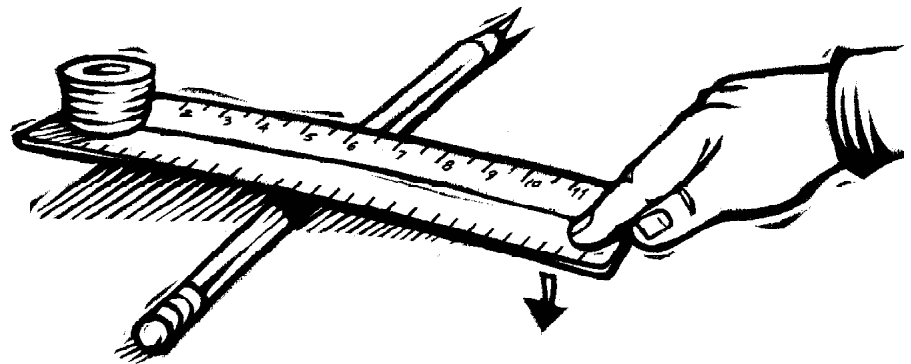
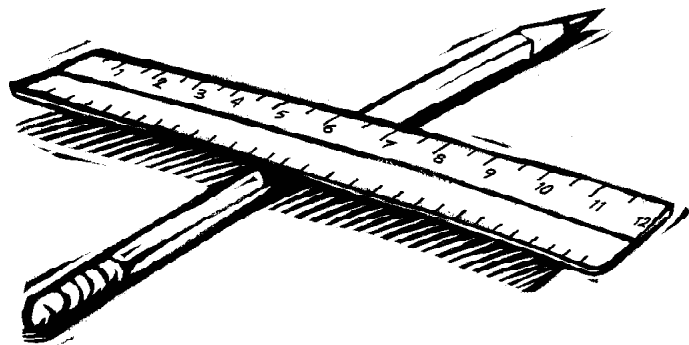
### Procedure

**1** Set up a lever by placing a ruler on top of the pencil as illustrated. The ruler acts as the two *lever arms*. The pencil that it pivots or balances on is called the *fulcrum*.

**2** Place a load of five coins or washers (taped together in a stack) at one end of the ruler on the 2.5 cm (1 in.) mark.

**3** Lift the load by pressing down at the opposite end of the ruler using one finger. Notice how hard you need to press to lift the load.

**4** Change the position of the pencil and press to lift the load. Try several different positions. Each time notice how hard you press in order to lift the load.



### Questions

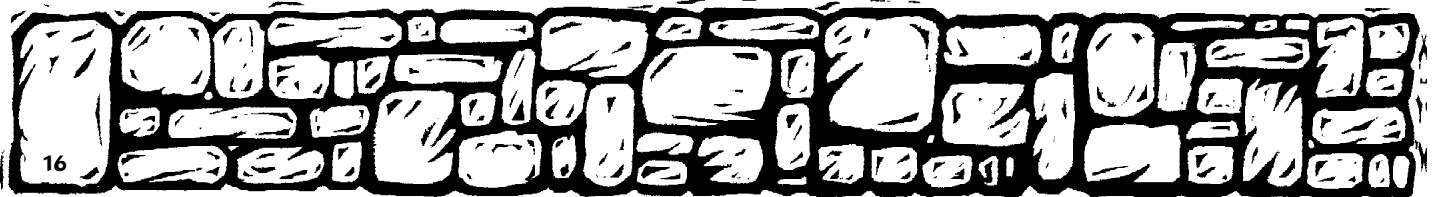
*Write your answers on a separate sheet.*

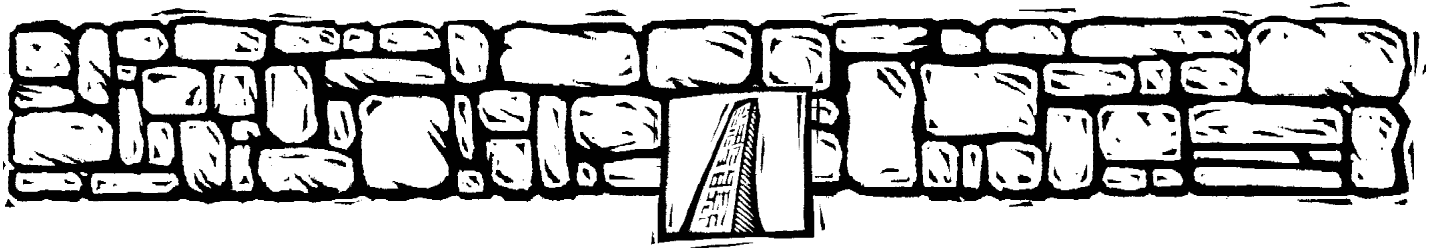
**1** Where is the pencil fulcrum when it feels easiest to lift the load?

**2** Where is the pencil fulcrum when it feels hardest to lift the load?

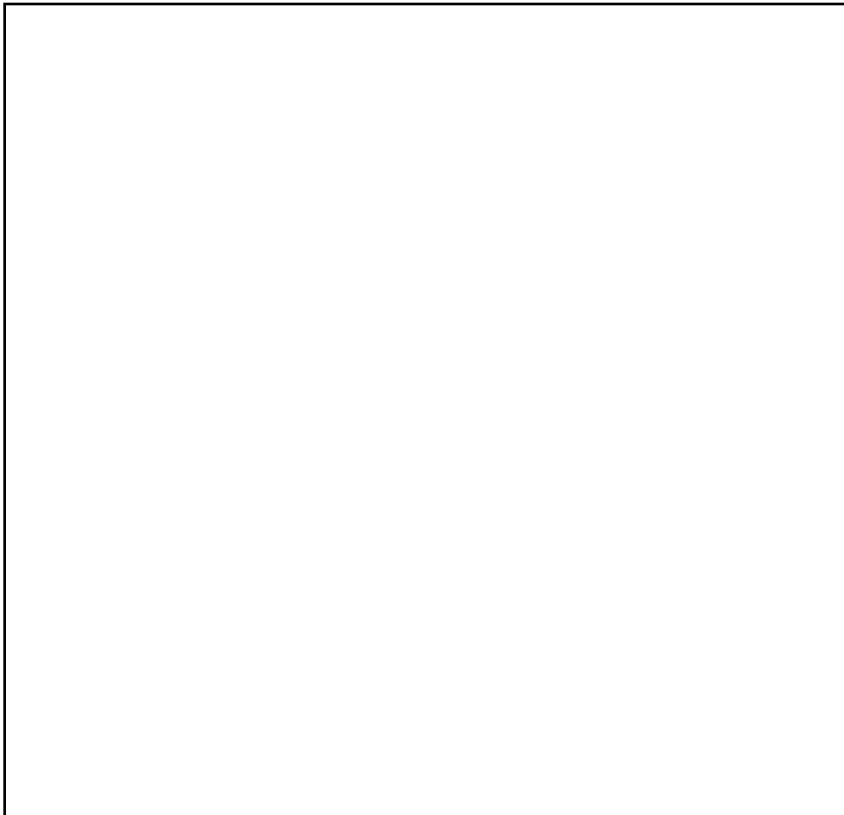
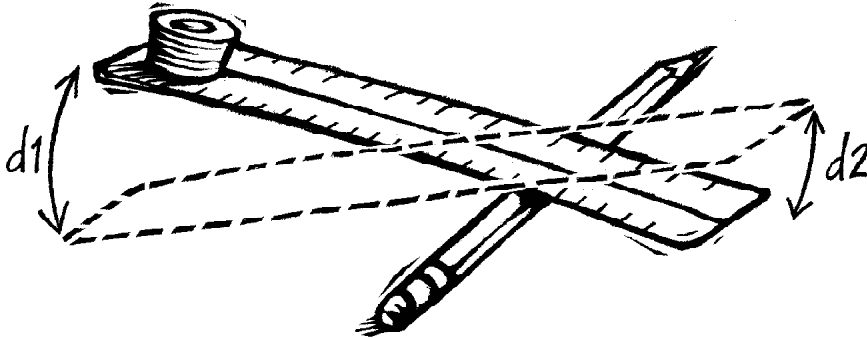
**3** Was there an instance when the load was lifted without any effort? How can you explain this?

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### Part II

*Do this part with a partner.*

#### Procedure

- 1 Place the load at the 2.5 cm (1 in.) mark. Place the pencil fulcrum under the 15 cm (6 in.) mark.
- 2 As your partner presses down on one end, measure the distance the load is lifted up ( $d_1$ ). Next, measure the distance the other end of the lever moves as your partner presses down ( $d_2$ ). Draw a picture in the box at left showing the distances and compare.
- 3 Move the fulcrum to a position where you have to push hard to lift the load. Again, measure the distance the load is lifted and measure the distance the other end of the lever moves down. Compare these distances. Draw a picture showing the distances that each end of the lever moves.
- 4 Move the fulcrum to a position where you only have to push lightly to move the load. Make the same measurements as above and draw your results.

#### Questions

*Write your answers on a separate sheet.*

- 1 Compare the distance the load was lifted when you pushed hard to when you pushed lightly. What do you notice?
- 2 What role does the fulcrum play in determining how much you have to push to raise the load?
- 3 If you needed to lift a load of ten quarters using ten pennies as the force, would you place the fulcrum closer to the pennies or the quarters? Explain.

