

Levers and Muscle Forces

KS3 Biology · Follows the national curriculum

Name _____ Class _____ Date _____

1. Worked example

Identify the pivot, effort and load when you lift a bag with your forearm.

Step 1 · Pivot

The point the lever turns about — the elbow joint.

Step 2 · Effort

The force that makes the lever move — the biceps pulling up, through its tendon on the forearm.

Step 3 · Load

The force being moved — the weight of the bag in your hand.

Answer: Pivot = elbow; effort = biceps; load = bag

Check: Bones act; joints act; muscles supply the effort.

2. Now try one with the steps

A 2 kg bag is held in the hand. What is its weight? (Use 10 N per kg.)

Step 1 · Formula

Step 2 · Calculate

Answer:

3. Practice

Show your working. The marks tell you how much is expected.

1. In the arm lever, what acts pivot? [1]

2. In the arm lever, what provides the effort? [1]

3. What unit is force measured in? [1]

4. What is the weight of a 3 kg mass, in newtons? (Use 10 N/kg.) [1]

5. Write the formula for the moment of a force. [1]
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6. A 10 N load is 30 cm from the elbow. Calculate its moment in N cm. [1]
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7. A 50 N load is 25 cm from the elbow. Calculate its moment in N cm. [1]
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8. The load's moment is 600 N cm and the biceps is 5 cm from the elbow. What force must the biceps exert, in N? [2]
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9. Explain why it is harder to hold a heavy bag with your arm straight out than with your elbow tucked in. [2]
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10. In the leg, what is the pivot when you stand on tiptoe? [1]
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11. A 30 N load is held 35 cm from the elbow. The biceps is 3 cm from the elbow. What force does the biceps exert, in N? [3]
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12. The biceps exerts a much larger force than the load. Suggest one advantage of the muscle being attached so close to the elbow. [2]
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13. Explain how a weightlifter's coach could use the lever idea to reduce strain on the back when lifting a box. [2]
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4. Before you hand it in

Using mass in kg force.

Convert: weight (N) = mass (kg) $\times$ 10.

Measuring the distance from the hand instead of the pivot.

Measure every distance from the joint that turns.

"The biceps only needs the same force load."

Smaller distance means a much bigger force to give the same moment: $\text{force} = \text{moment} \div \text{distance}$.