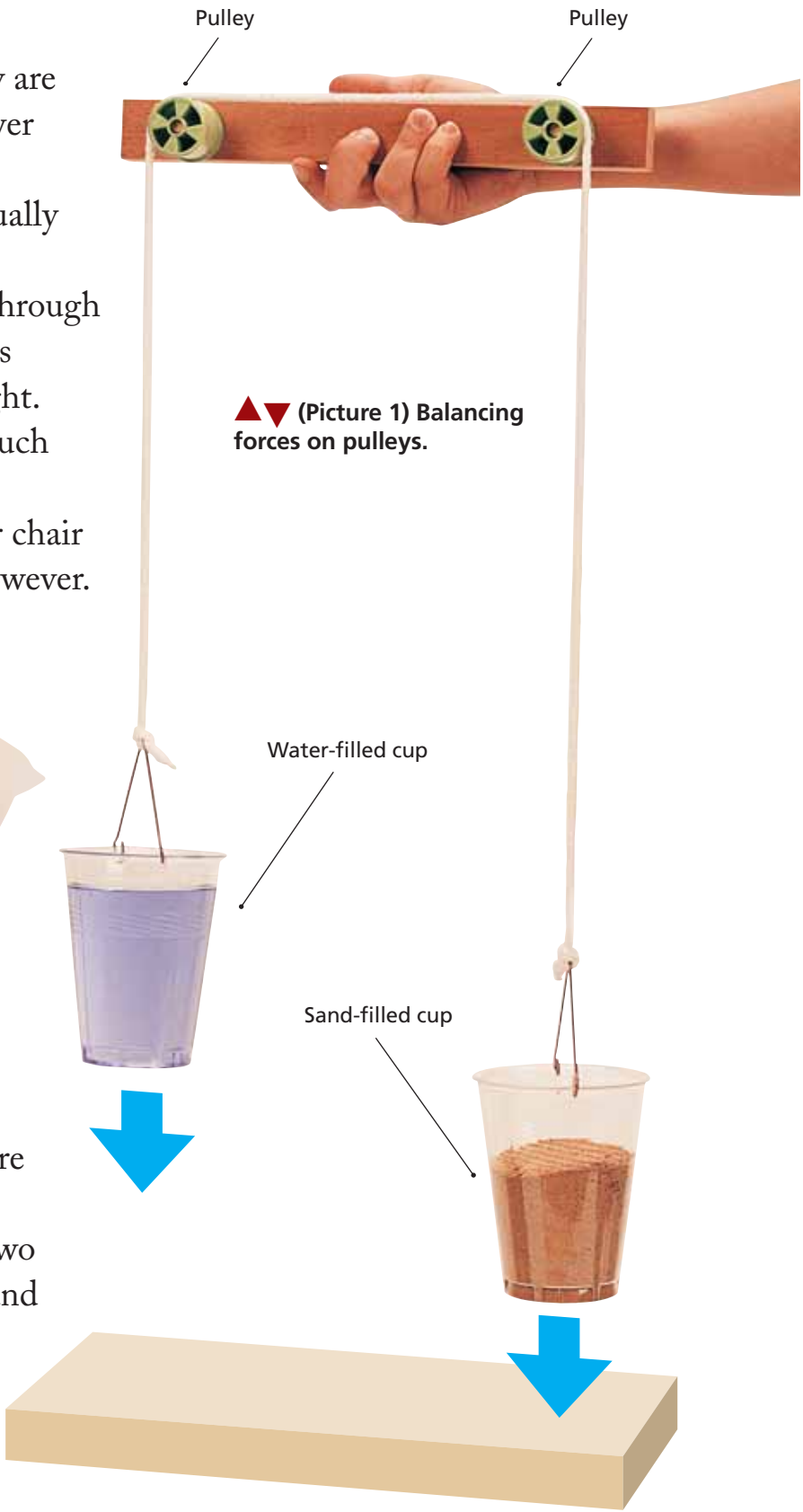
4 Forces that balance

If forces are balanced, nothing moves.

If there are forces all around, why are most things stationary? The answer is that the force trying to cause movement (such as gravity) is usually resisted by a force of equal size.

For example, you don't break through the seat of your chair, because it is strong enough to resist your weight. The chair can push back up as much as you push down. The forces are balanced. Sit an elephant on your chair and things might be different, however.



▲▼ **(Picture 1) Balancing forces on pulleys.**

Finding a balance

You know things are in balance when they do not move. In Picture 1 you can see a pair of plastic cups connected by a string over two pulleys. One cup contains sand, and water is being added to the other cup. At this moment nothing is moving. The sand-filled cup is as heavy as the water-filled

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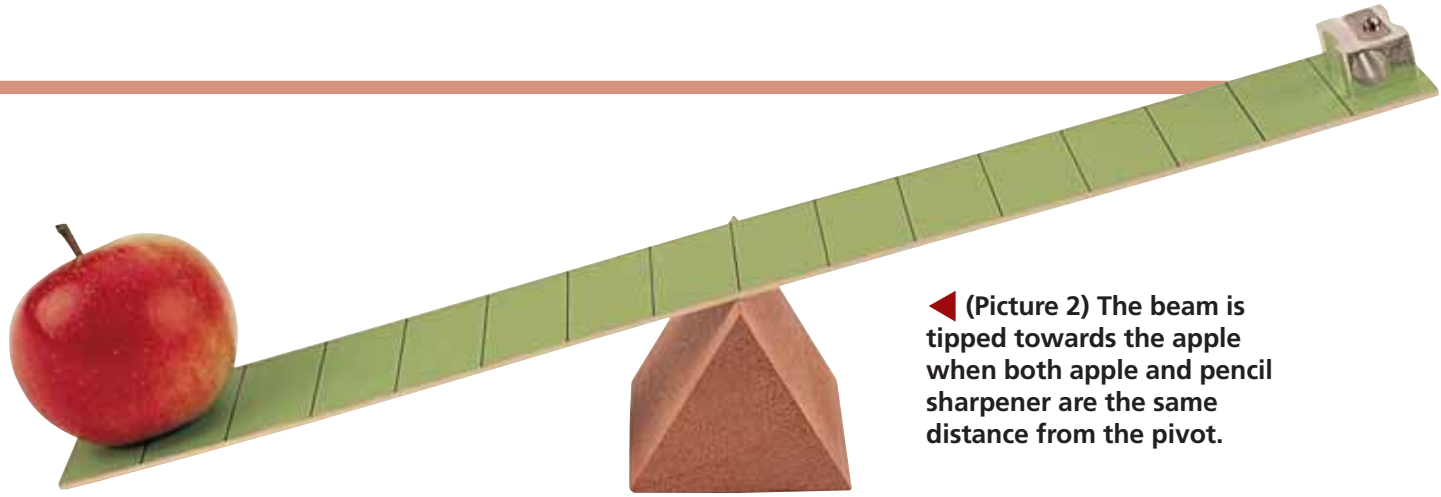
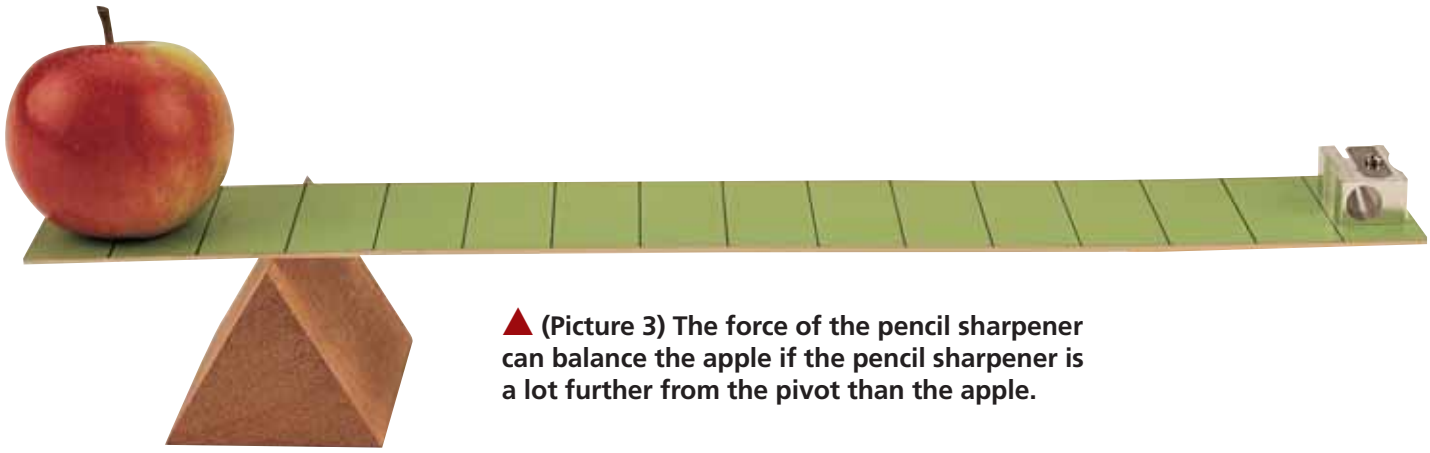


◀ (Picture 2) The beam is tipped towards the apple when both apple and pencil sharpener are the same distance from the pivot.



▲ (Picture 3) The force of the pencil sharpener can balance the apple if the pencil sharpener is a lot further from the pivot than the apple.

cup and so both are still. The water-filled cup is pulling against the sand-filled cup, but not enough to cause movement. When more water is added, the force on the water-filled cup will get bigger, and the cups will be out of balance. As a result, the sand-filled cup will rise.

Small force, large distance

In Picture 2 a cardboard 'beam' rests on a sharp-edged block of wood. The sharp edge is a **PIVOT**. It allows the beam to rock on it.

Here the apple and the pencil sharpener are the *same distance* from the pivot. The apple is heavier, so the beam tips down until the apple end is resting on the table.

In Picture 3 the pivot has been moved close to the apple. Strangely, the tiny pencil sharpener can now balance the heavy apple. To do this, the downward force of the pencil sharpener must be balancing the downward force of the apple. This is possible because the force depends not just on the weight, but also on the distance from the pivot.

This is a way of moving heavy objects with little force. You will see more of this on the next page. It is the principle of how a **LEVER** works.

Summary

- **When something is balanced, the forces are equal.**
- **A small force can balance a large force by using a pivot: the small force must be further from the pivot than the large force.**