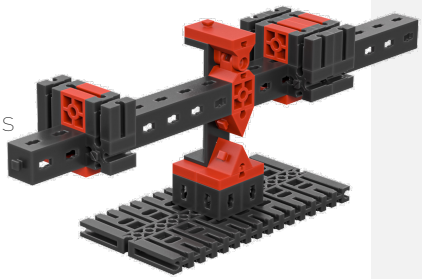
Model 13
Double-sided lever

The students receive the building instructions for constructing the two-sided lever.



Date

Name

Class

THEMATIC TASK

1. Lever in equilibrium

   By moving a weight toward the fulcrum, the lever on that side rises.

2. If the weight is doubled, the lever is in equilibrium as soon as the lever (distance S) on this side is exactly half the distance on the other side.

3. The distance of the weight must be inversely proportional to the weight: double weight – half lever arm, triple weight – 1/3 lever arm.

   The reason for this is the moment resulting from the weights. The moment is the product of the lever arm to the pivot point and the amount of force.

4.

$$M1 = F1 * s1$$

$$M2 = F2 * s2$$

If the magnitudes of F1 and F2 are equal, the distances s1 and s2 to the axis of rotation must also be equal. If we consider counterclockwise rotation to be positive, the resulting moment M1 from F1 in our system is also positive, while the force F2 acts against the positive direction of rotation and is therefore negative. The sum of the two moments is 0, and the lever is in equilibrium.

$$0 = M1 + M2 = F1 * s1 - F2 * s2$$

EXPERIMENTAL TASK

Date

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1. The spring balance acts as a counterweight: since the weight on the left has been removed, the lever arm is no longer in balance. The spring balance compensates for this and keeps the lever in balance.

2. Since the resistance of the spring increases proportionally to its deformation, it exerts exactly the counterforce on the lever that is needed to keep it in balance. Depending on the point of attachment, it generates a moment that is exactly equal to that of the counterweights, but in the opposite direction.

3. If the distance of the scale is the same as that of the weight, the scale displays exactly the amount that corresponds to the weight force of the counterweight.

If the force is measured close to the pivot point, it is higher – the spring travel is longer and can be read in more detail. However, the scale of the spring balance may then not be sufficient. If measured at the very outside, the spring travel is minimal and reading errors may occur. The most accurate measurement can therefore be obtained when the spring scale is used to its full extent and the weight of the opposite side is calculated using the lever. The disadvantage here is that it is more complicated, but more accurate.

APPENDICES

Building instructions and templates for the models:

Model 13: Construction manual for double-sided lever.