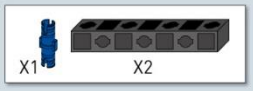
1 Stacking two beams



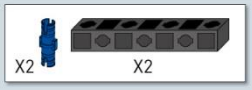


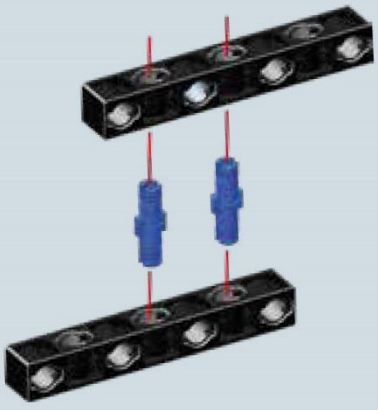


Assembled beams

2 Stacking beams with two pegs

Two pegs make the construction very robust!

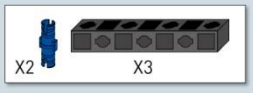


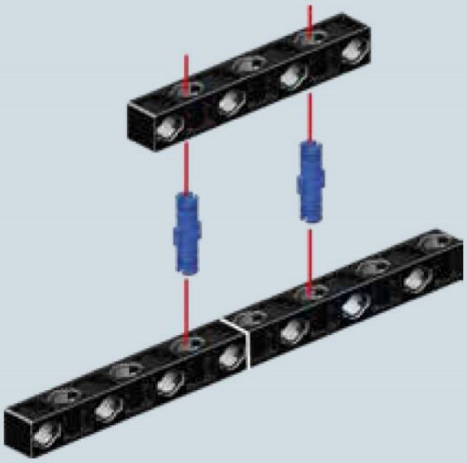




Assembled beams

3 Joining beams



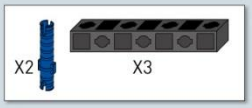




Assembled beams

4 Stacking three beams

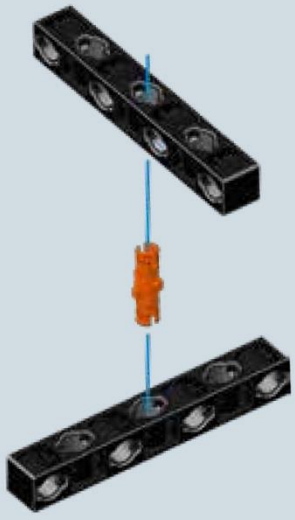


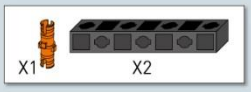




Assembled beams

5 Stacking beams perpendicularly

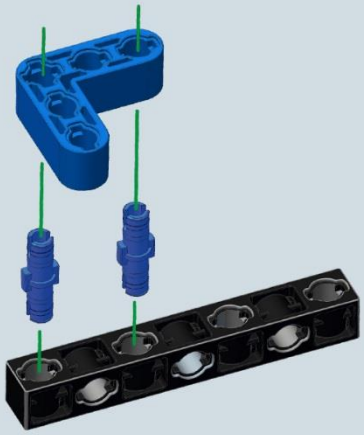


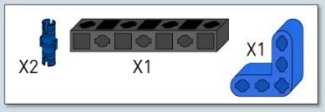




Assembled beams

6 Stacking with an L-shaped beam

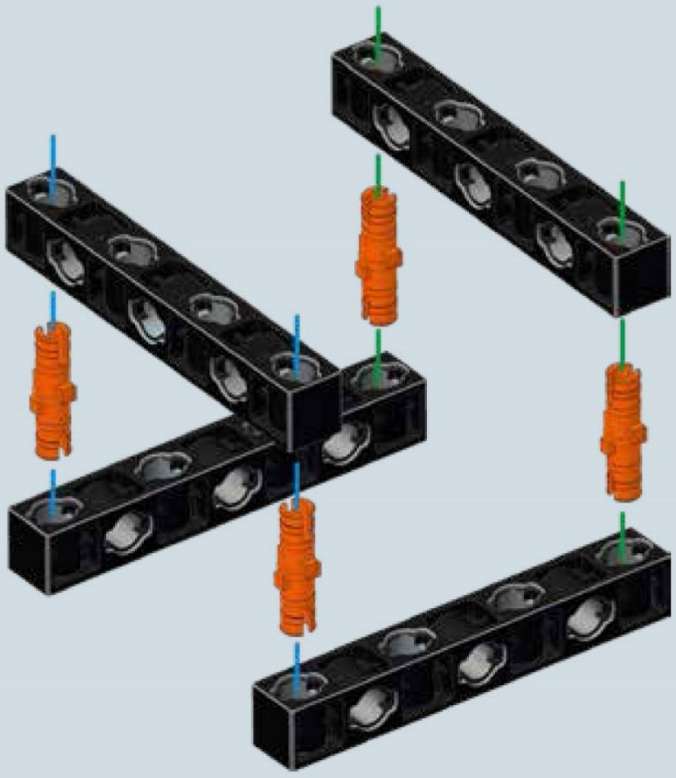


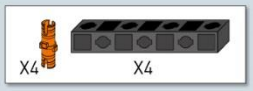




Assembled beams

7 Build a square with beams

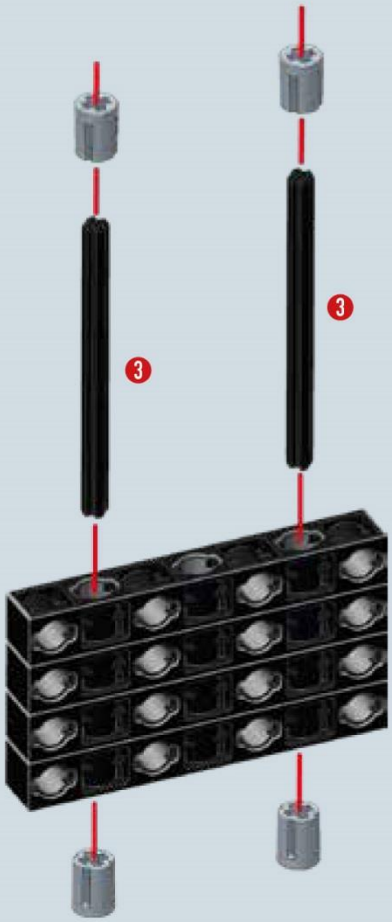


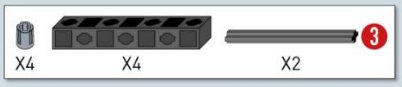




Final assembled model

8 Stacking four beams

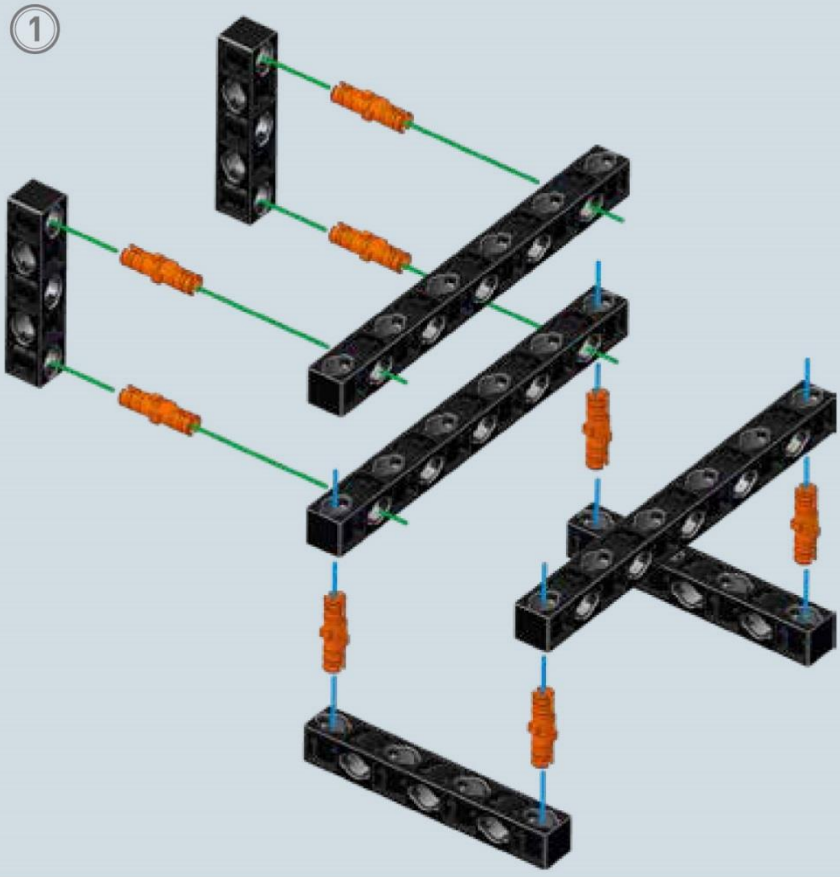


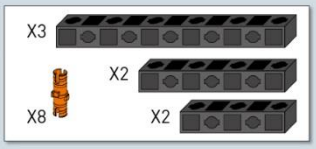




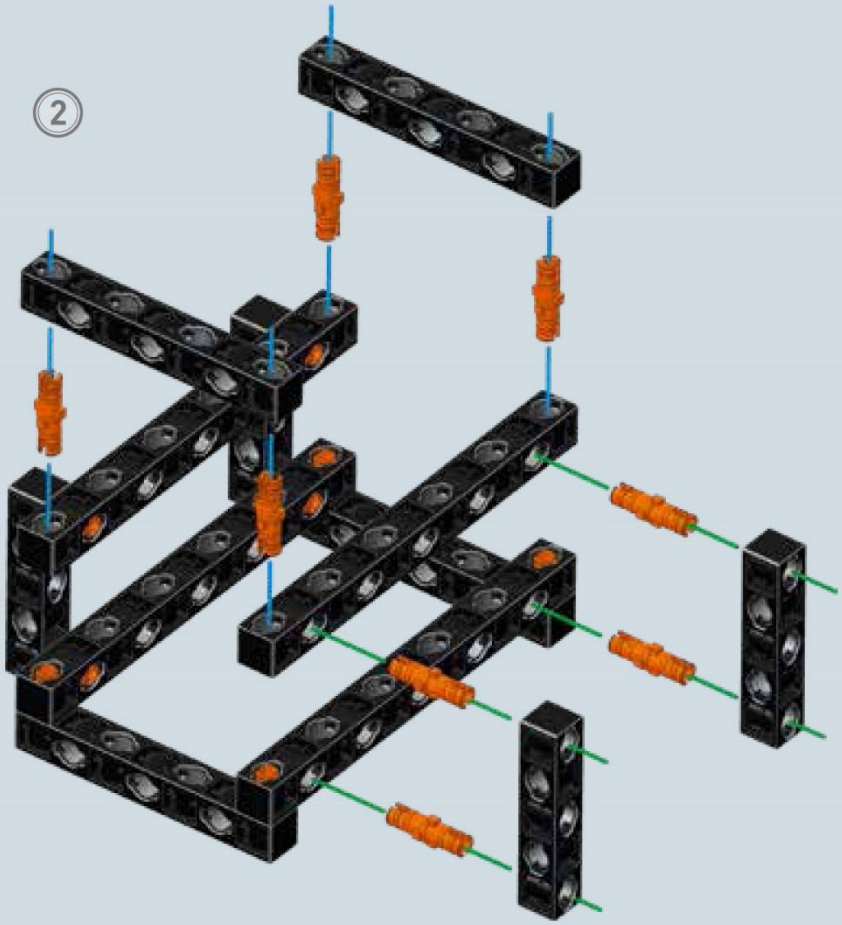
Final assembled model




1


X3
X2
X8
X2


Semi-assembled model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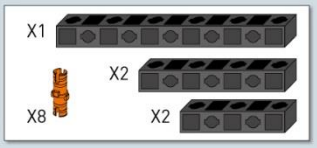
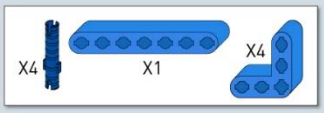
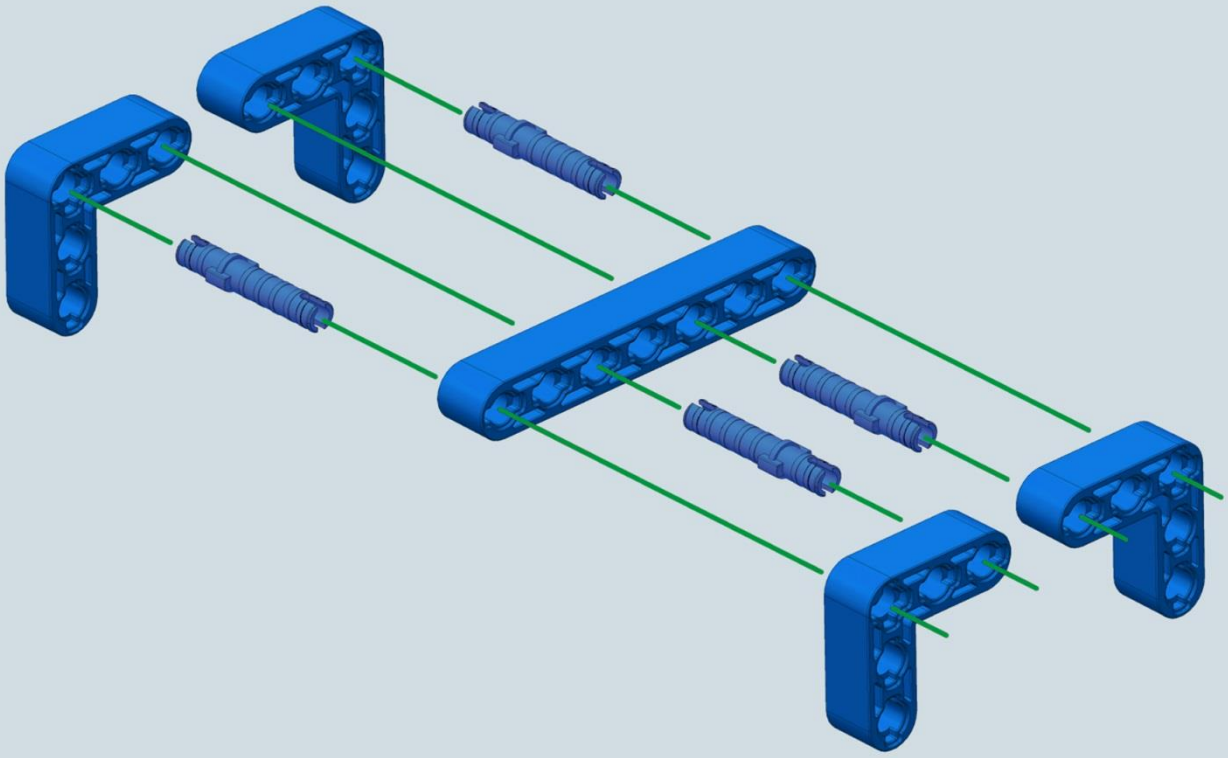
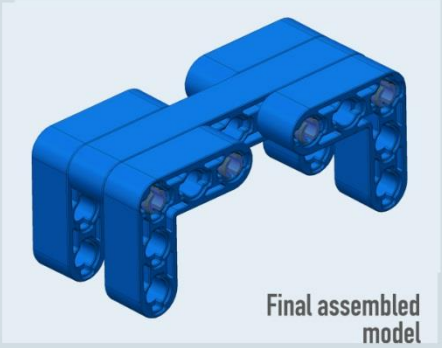

X1
X2
X8
X2


Final assembled model


X4
X1
X4

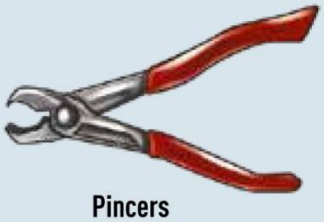



Final assembled model

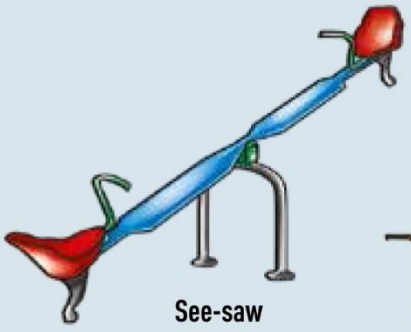
Since ancient times humans have made use of many of these mechanisms to increase their strength and enable them to accomplish great feats which can still be admired today.



Wheelbarrow



Pincers



See-saw



Nutcracker



Balance



Pulley

A simple machine is an instrument that allows for balancing and overcoming **RESISTANCE** (weight, resistance force = **R**) with **EFFORT** (manpower = **E**).

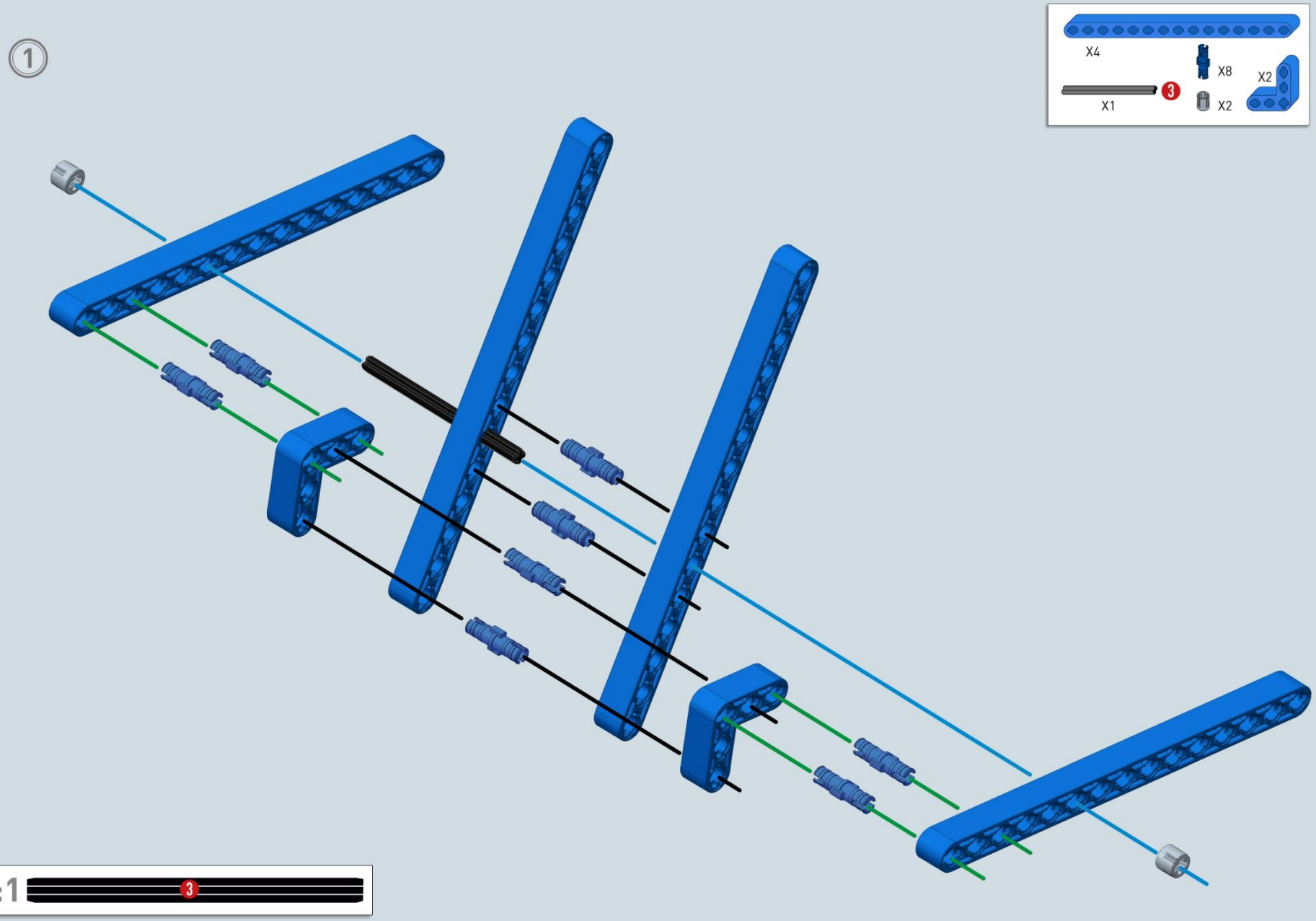
LEVERS

A lever is a simple machine that is made up of a rigid bar which can rotate around a fixed point called the fulcrum.

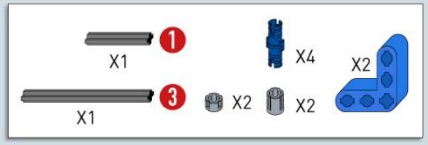


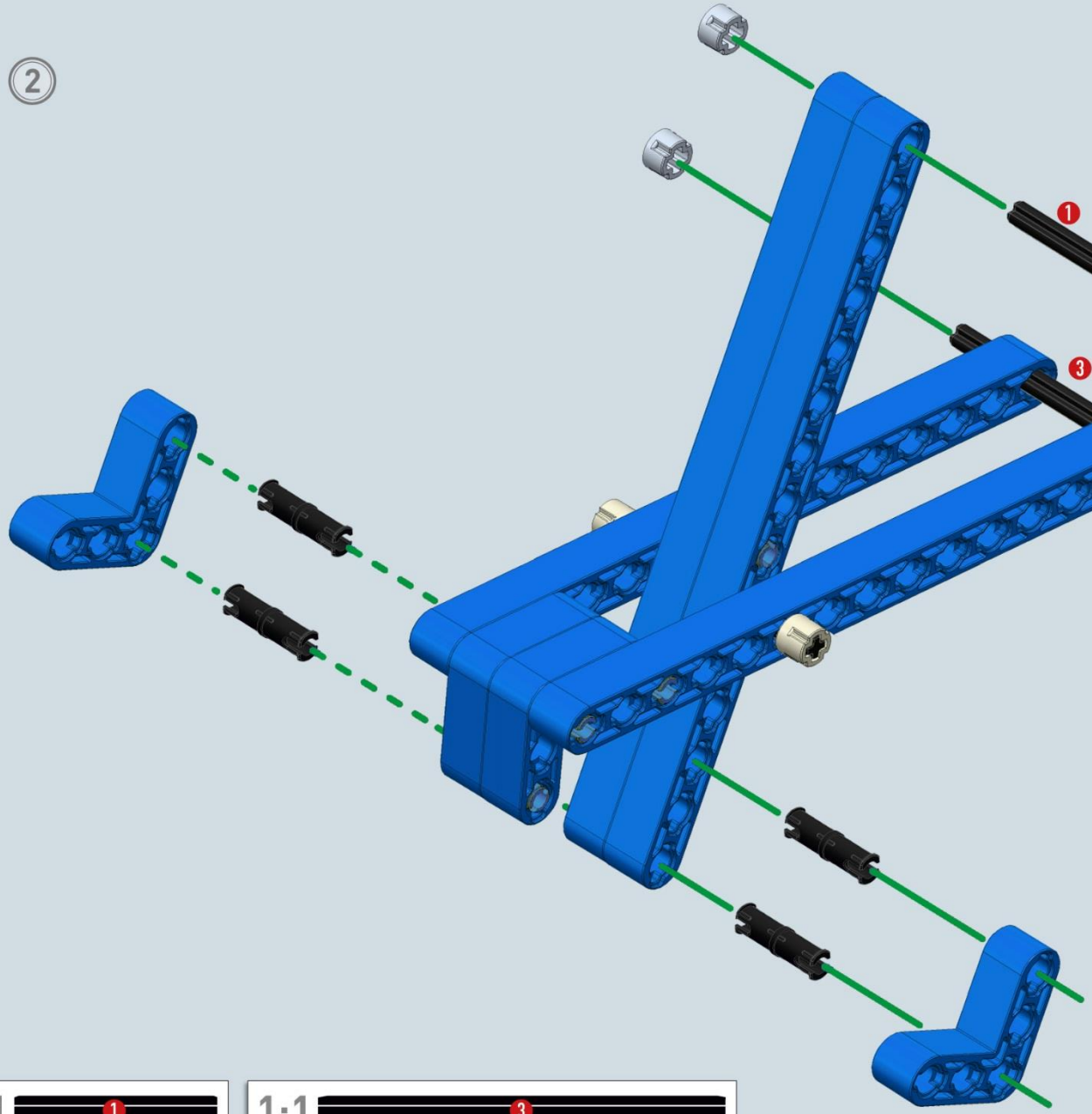
RESISTANCE **FULCRUM** **EFFORT**

- Pairs of levers also obey this principle.
- Levers are classified by the relative positions of the **EFFORT**, **RESISTANCE** and FULCRUM.

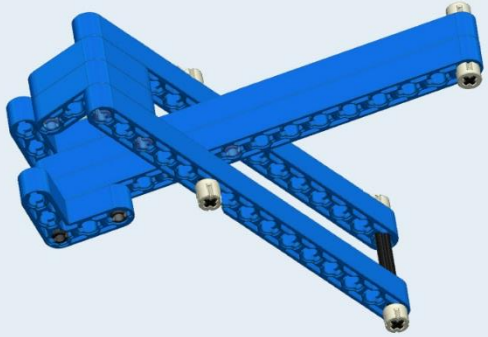

1
X4
X8
X2
3
X1
X2
1:1
3

2





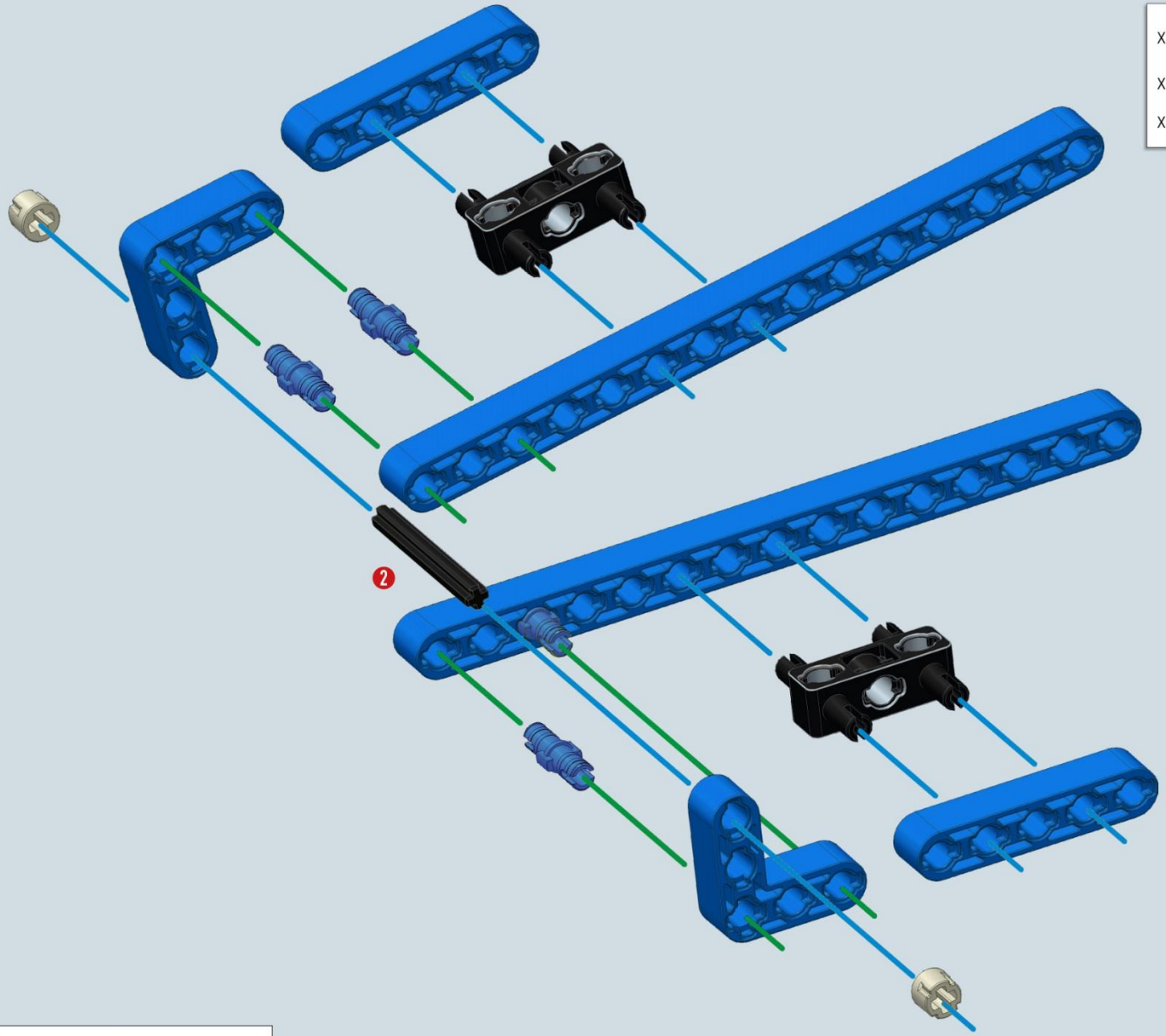
The FULCRUM lies between the RESISTANCE and the EFFORT.

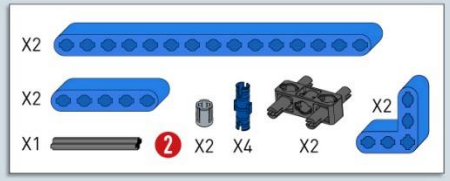


Final assembled model

1:1 1

1:1 3



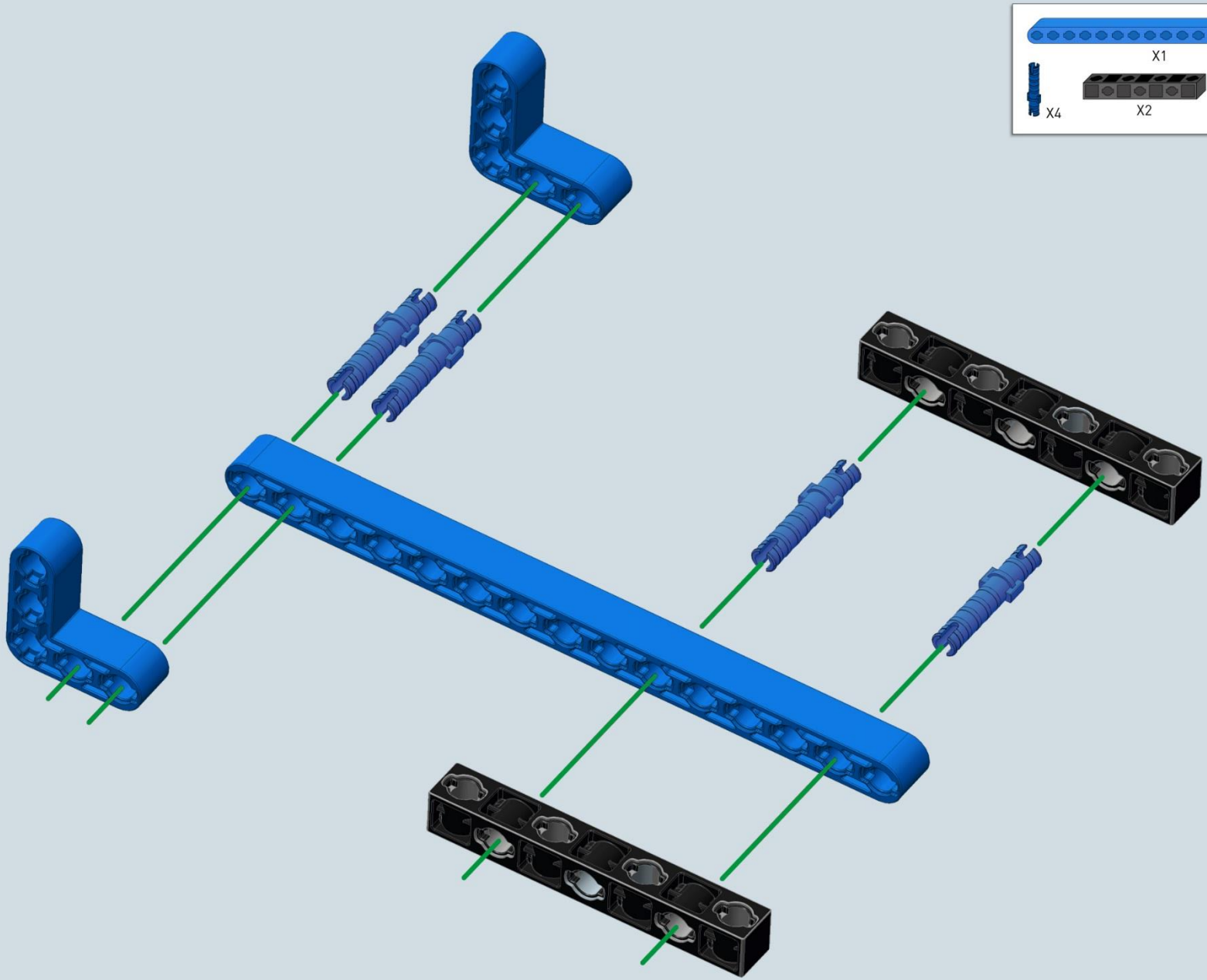


The RESISTANCE lies between the EFFORT and the FULCRUM.

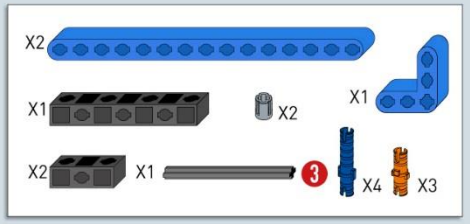


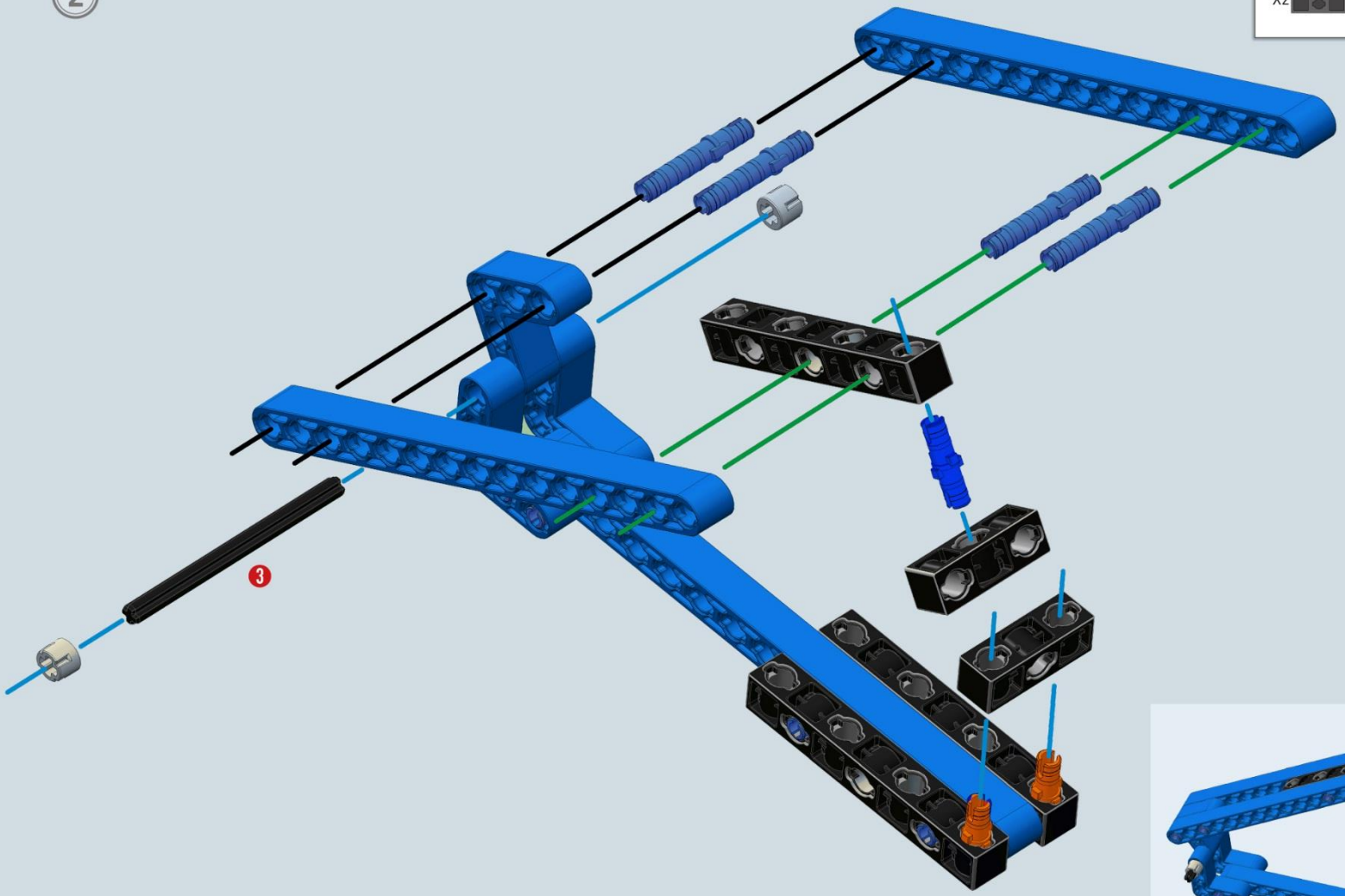
Final assembled model

1:1 2


1
X1
X2
X4
X2

2





1:1 3

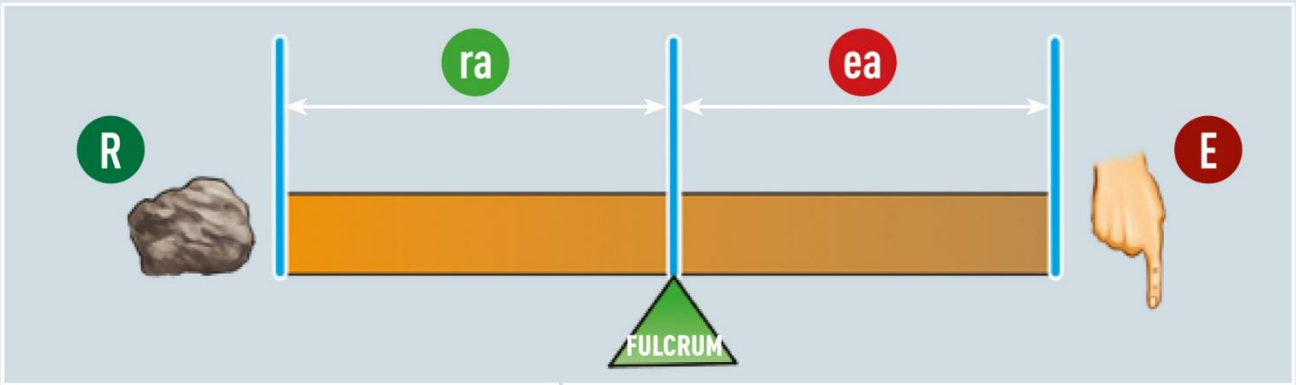


The EFFORT lies between the RESISTANCE and the FULCRUM.

Final assembled model

Scientific analysis: mechanical advantage with levers

The lever is a simple machine built by man to perform work by reducing the force required. Two forces are applied on the rod: EFFORT and RESISTANCE. Using a lever, therefore, we have a MECHANICAL ADVANTAGE that can be calculated by considering also the length of the EFFORT and RESISTANCE arms. In the lever, the lengths of the arms correspond to the distances from the fulcrum.



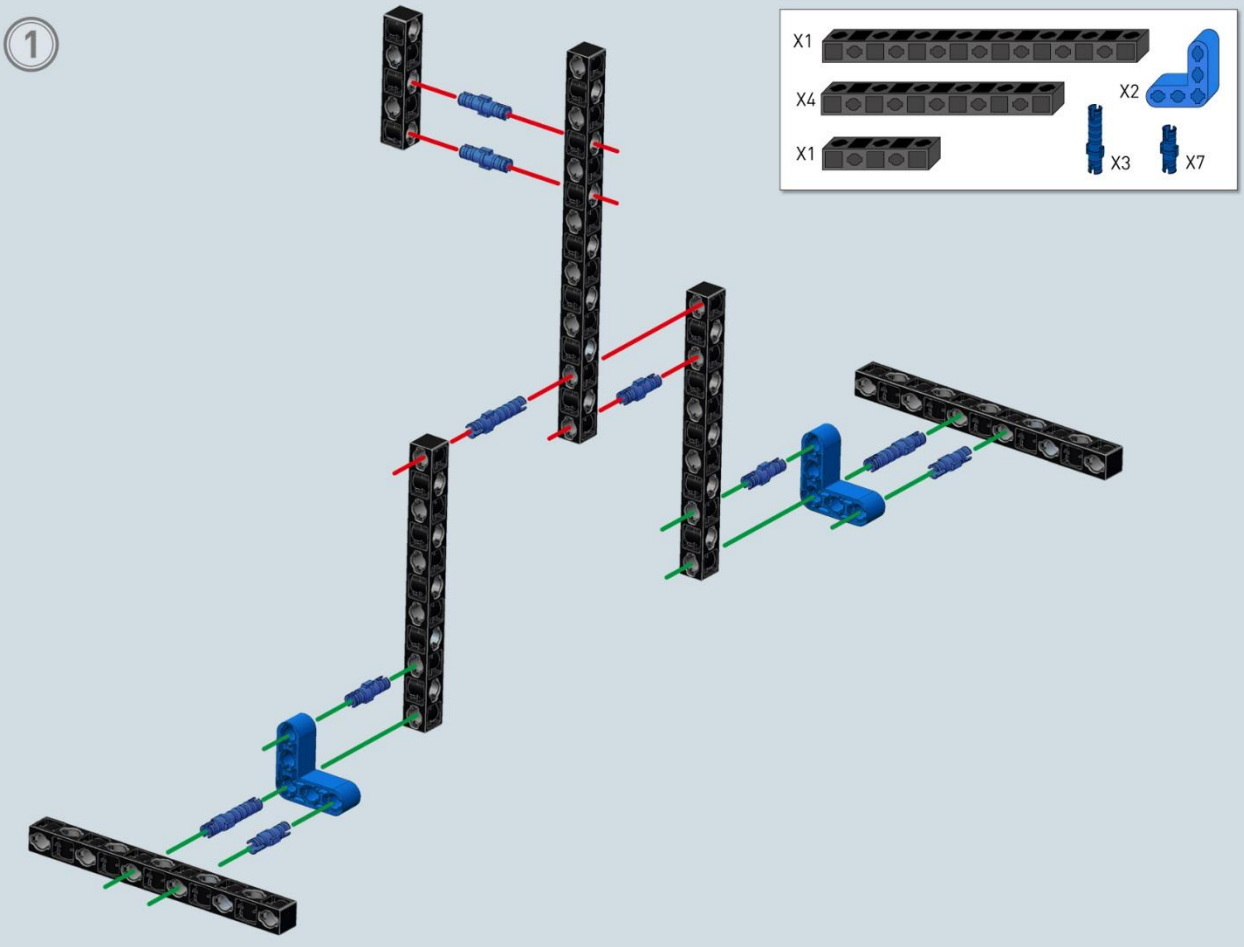
Key:
- ea = EFFORT arm
- ra = RESISTANCE arm
- E = EFFORT force
- R = RESISTANCE force

EQUILIBRIUM CONDITIONS: ra x R = ea x E

MECHANICAL ADVANTAGE: A = R / E

ASSEMBLE AND TEST THE LEVERS

15 Build the lever's fulcrum and weight



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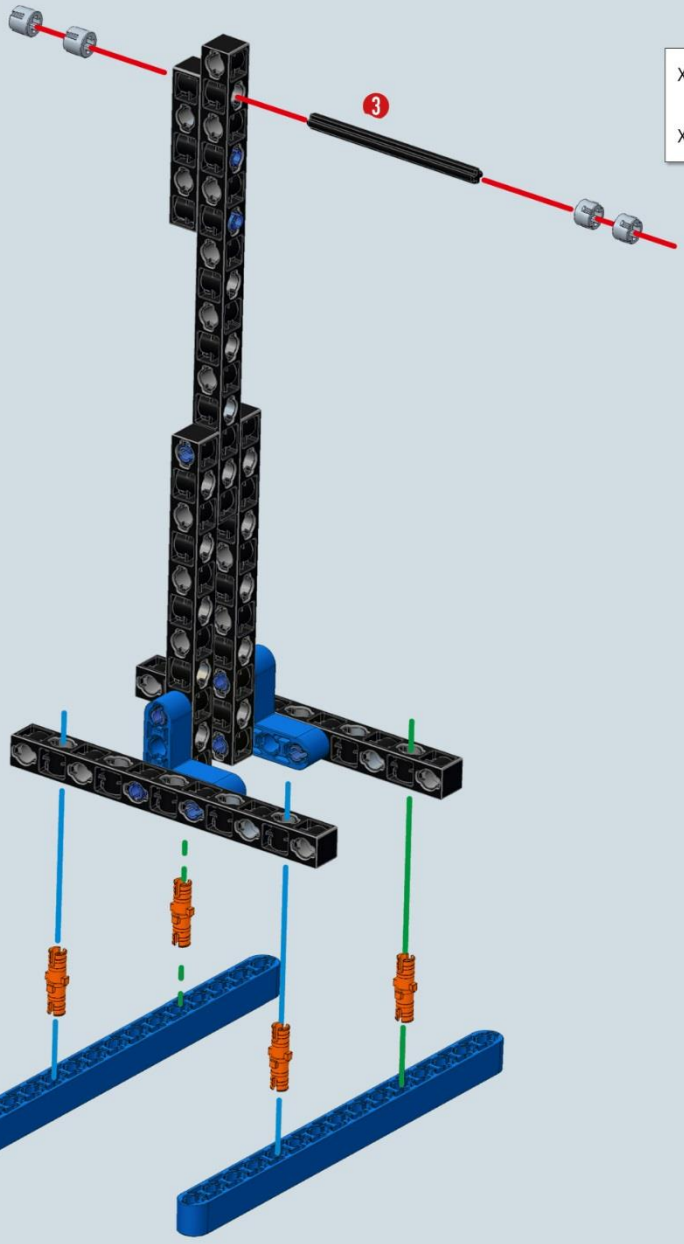
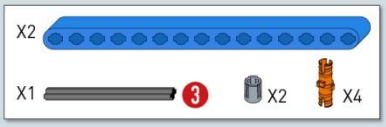
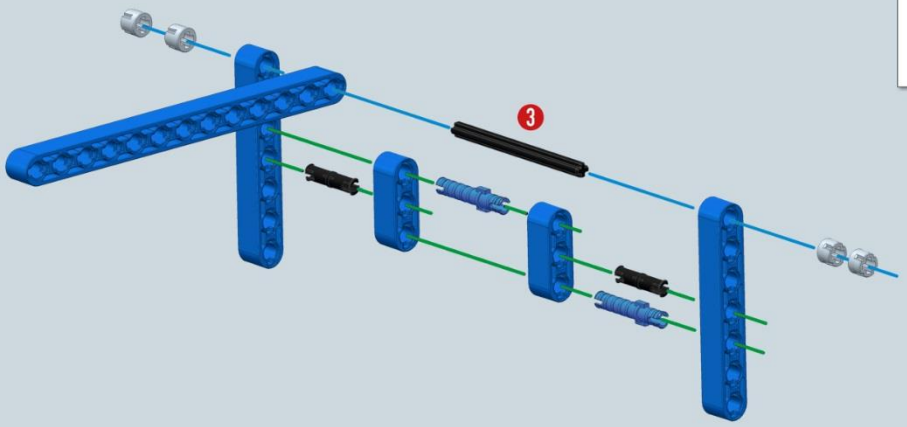
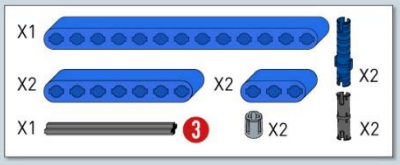




ASSEMBLING THE WEIGHT







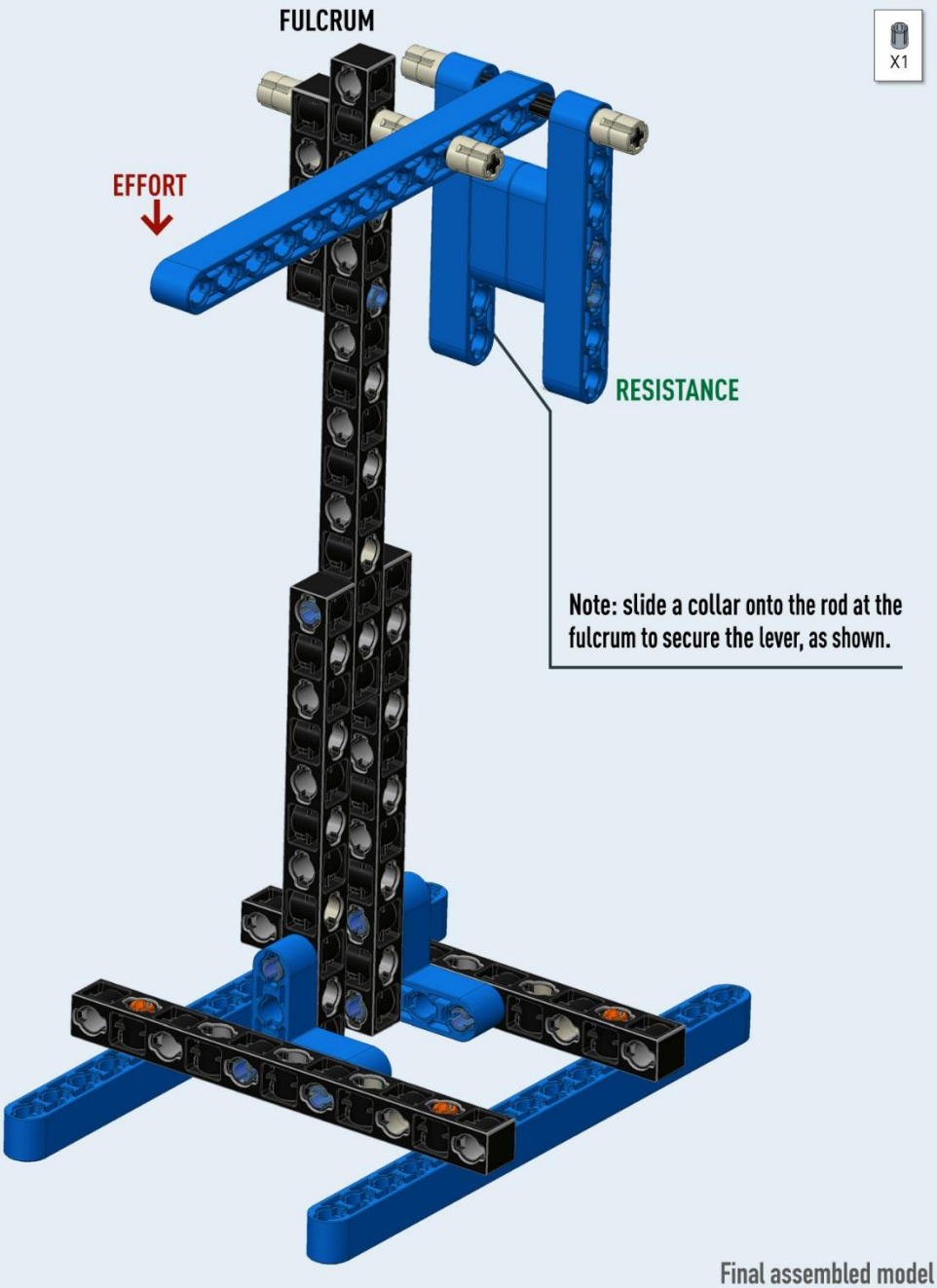
In Activities 16-17-18 try moving the fulcrum and then applying downward pressure to the EFFORT arm with your hand to see the differences between the levers.

Find the equilibrium of this type of mechanical device: position the weight (RESISTANCE) on one side of the lever and gently press down with your hand (EFFORT) on the other side.

Note the position of the fulcrum!

- The EFFORT arm is longer.
- The EFFORT is **less** than the RESISTANCE.

TRY IT OUT!



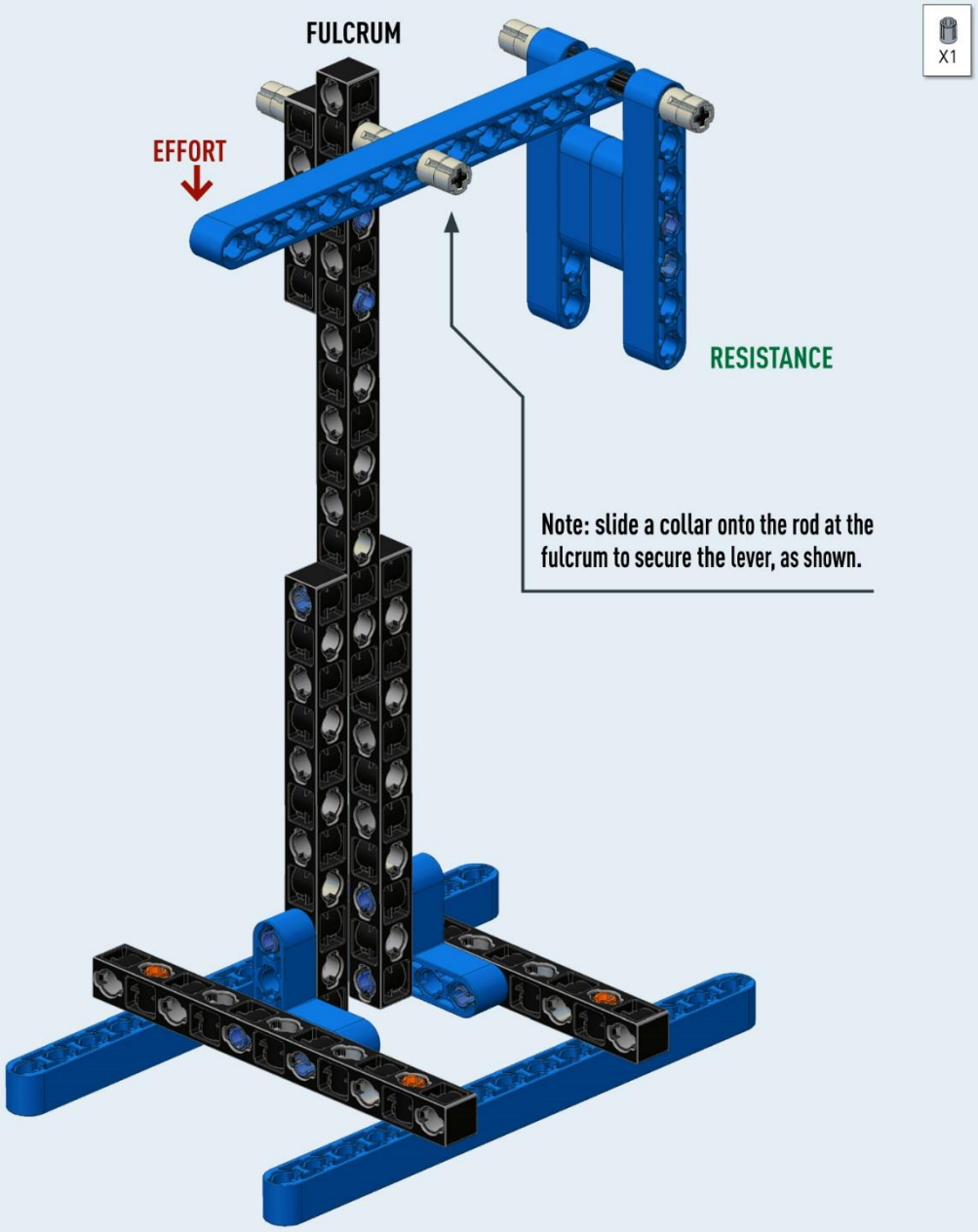
Final assembled model

Find the equilibrium of this type of mechanical device: position the weight (RESISTANCE) on one side of the lever and gently press down with your hand (EFFORT) on the other side.

Note the position of the fulcrum!

- The arms are the same.
- The EFFORT is **equal** to the RESISTANCE.

TRY IT OUT!



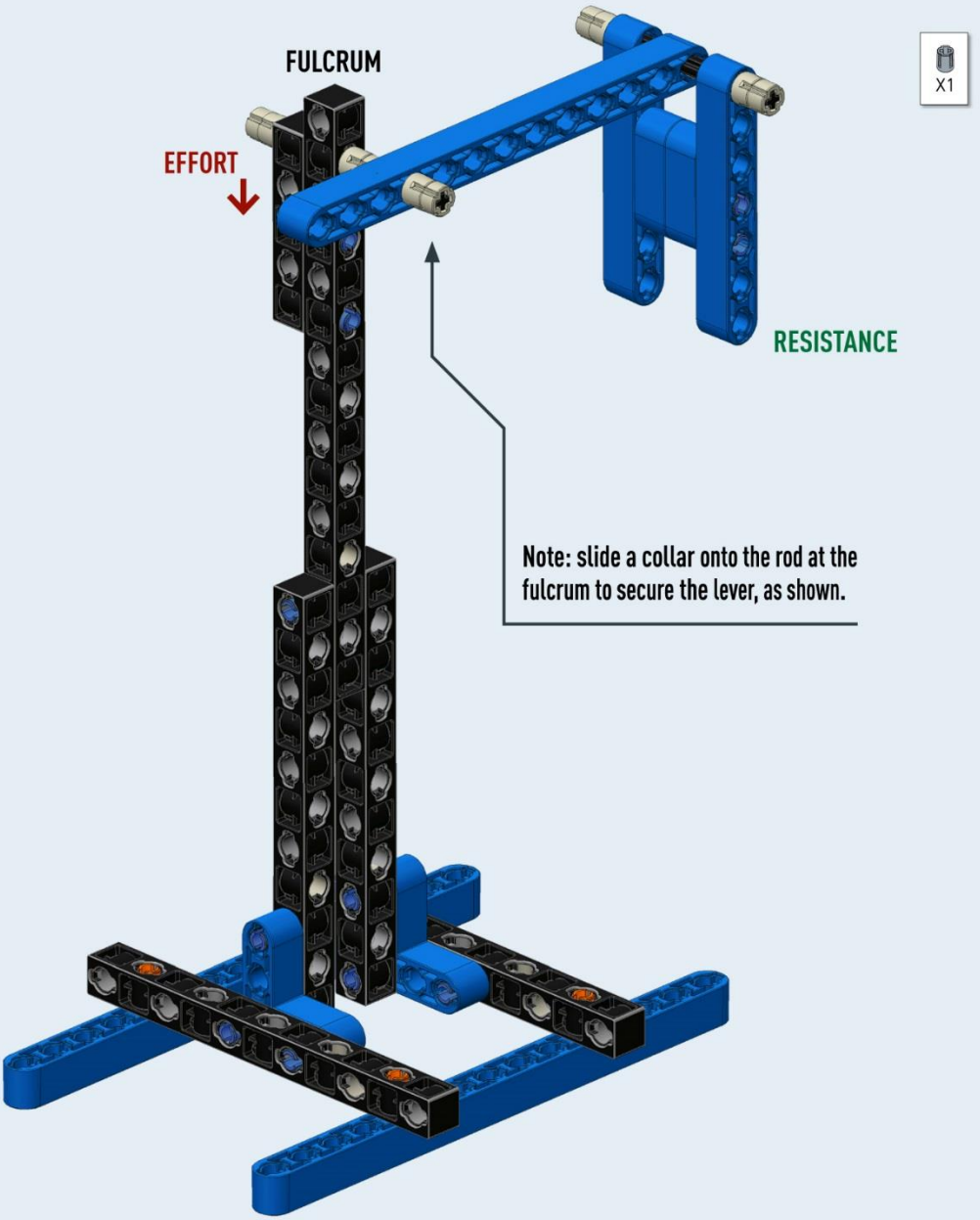
Final assembled model

Find the equilibrium of this type of mechanical device: position the weight (RESISTANCE) on one side of the lever and gently press down with your hand (EFFORT) on the other side.

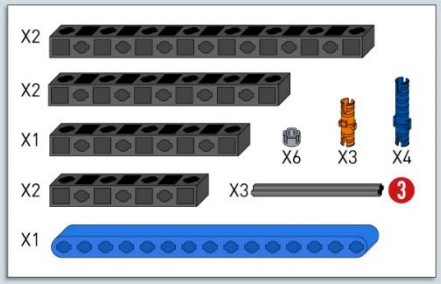
Note the position of the fulcrum!

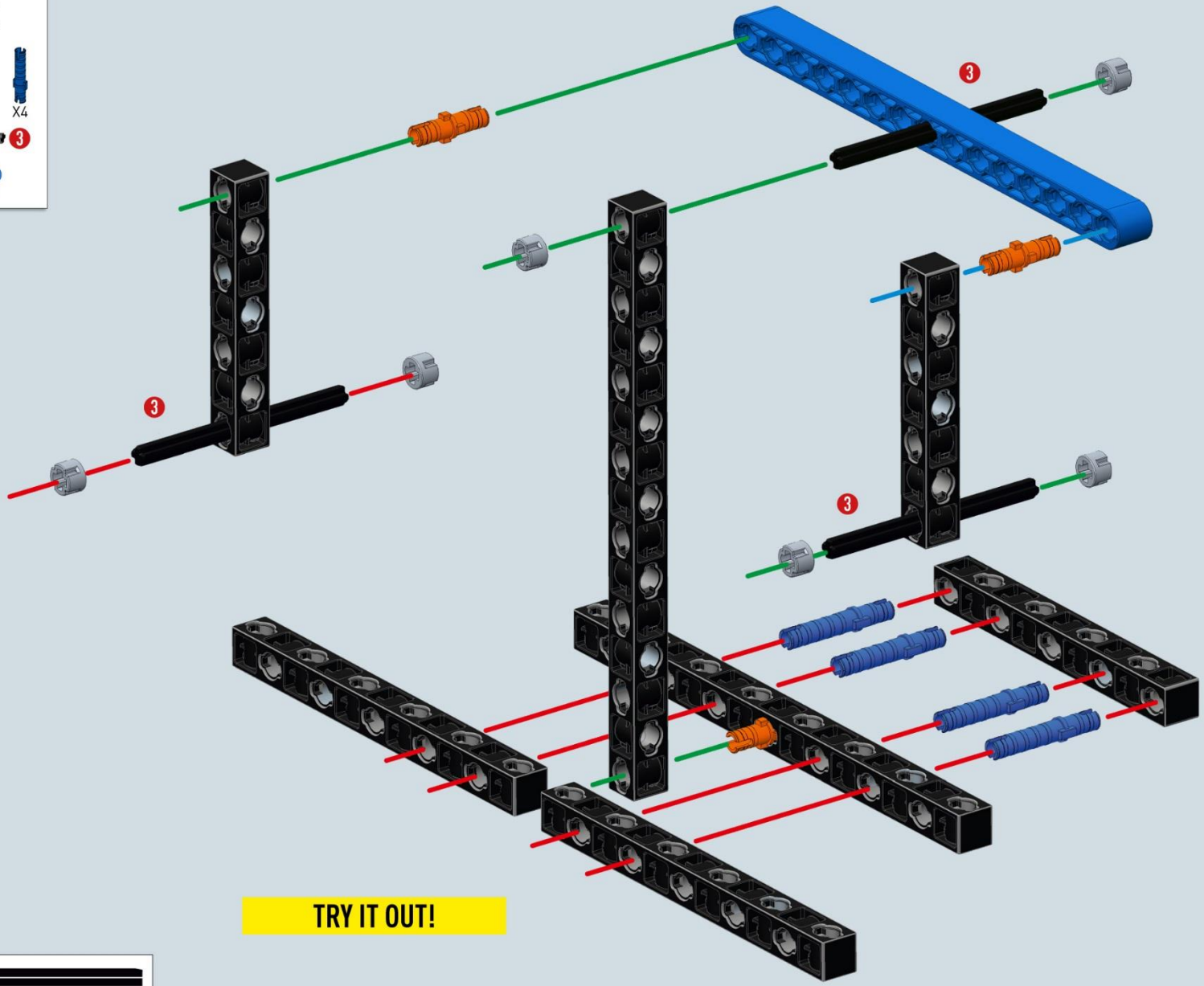
- The RESISTANCE arm is longer.
- The EFFORT is **greater** than the RESISTANCE.

TRY IT OUT!



Final assembled model





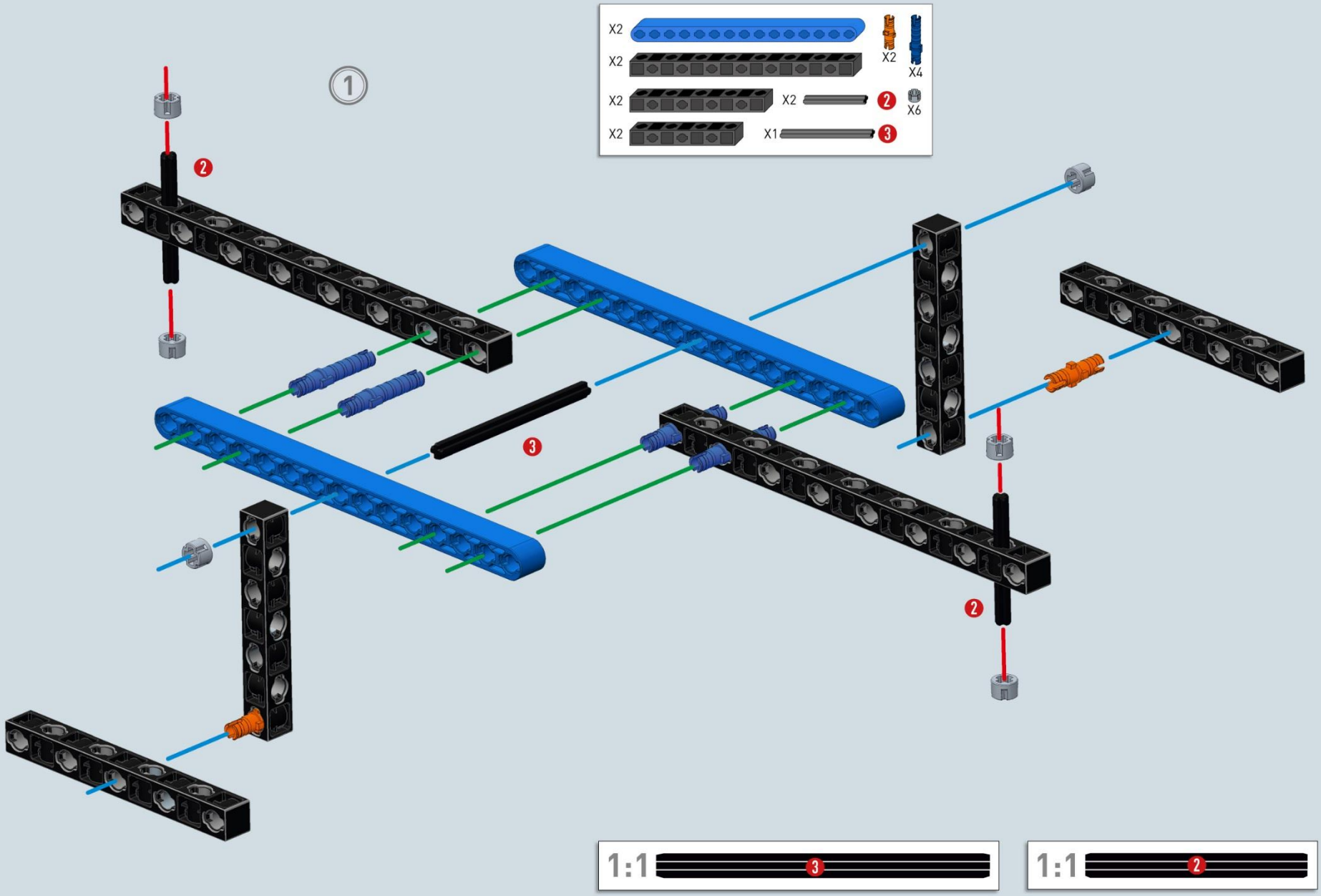
The balance is a class 1 lever



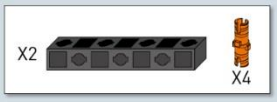
Final assembled model

TRY IT OUT!




X2
X2
X2
X2
X2
X2
X4
X2
X6
X1
1
2
3
2
1:1
3
1:1
2

2



In the third century BC, Archimedes was a great scientist and experimenter with levers.

Note: the lever of the see-saw must rotate freely around the fulcrum.

Try it yourself: find the equilibrium of the see-saw by varying the weight and distances from the fulcrum of the Resistance and Effort forces.

TRY IT OUT!

The see-saw is a class 1 lever



Final assembled model