The Hammer

Design and technology
- Using mechanisms – levers, cams and inclined plane
- Properties of materials
- Product safety testing
- Combining materials
- Mechanical programming of actions

Science
- Recording data
- Friction
- Force
- Momentum
- Scientific investigation

Vocabulary
- Cams
- Sequencing
- Friction
- Product safety

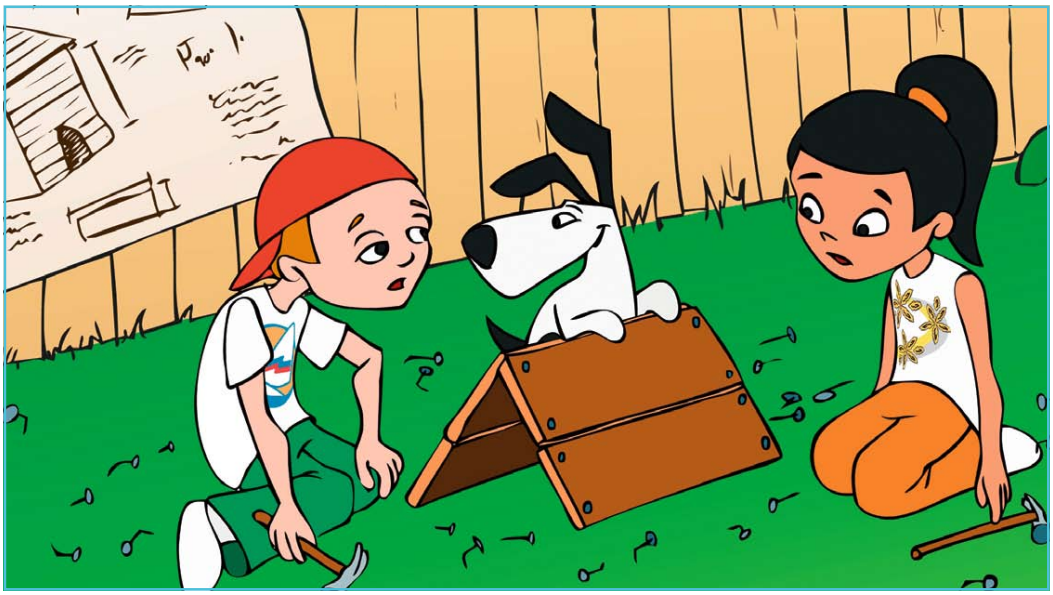
Other materials required
- Decorative materials: wool, foil, card
- Scissors
- Sticky tape

Connect

Jack and Jill are having fun hammering! They are trying to build a little shed for Zog the Dog, but the wood they are using is very hard and they need to use a lot of nails to make it hold.

After a while they are exhausted and try to think of simpler ways to Hammer the nails into the wood. Two brains work better than one, they think, so together they try to solve the problem. Can you help them test a solution that will work and make the hammering much easier for them?

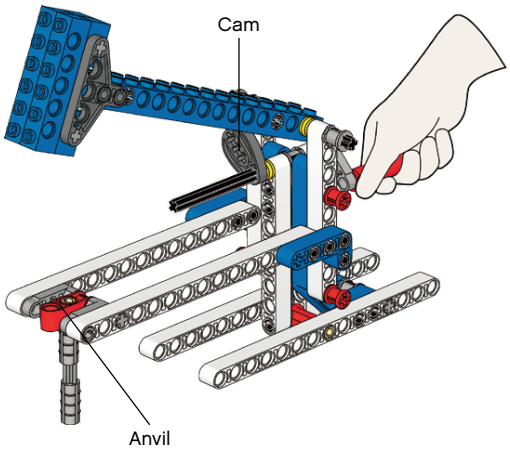
How can you make a Hammer machine that will efficiently hammer nails into different surfaces? Let's find out!



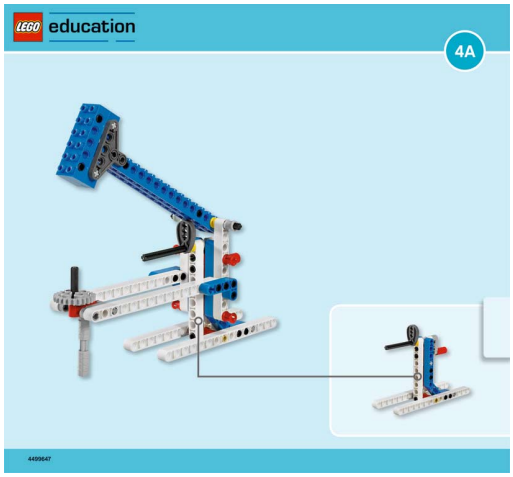
Construct

Build the Hammer
(all of book 4A and book 4B to page 11, step 14).

Testing
Turn the handle of the Hammer by hand. Does it rise and fall smoothly?

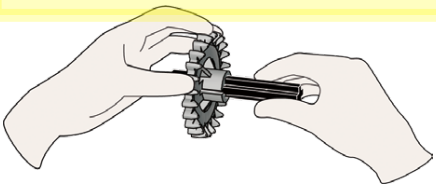


Did you know?
The LEGO® research labs make sure every element has exactly the right amount of grip for the job it does and for safe handling by children.
We call it 'clutch power' and it is measured very carefully!

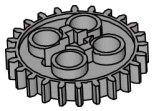


Contemplate

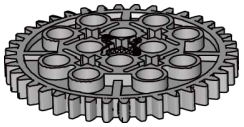
Can you measure grip forces by hand?
Push the axle into each gear in turn – and pull it all the way through. Can you arrange them in order from most grip (most friction) to least grip?




8-tooth
spur gear

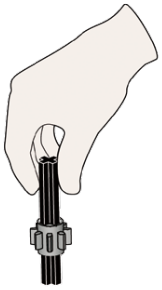

24-tooth
spur gear

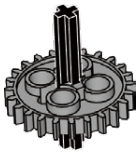

24-tooth
crown gear

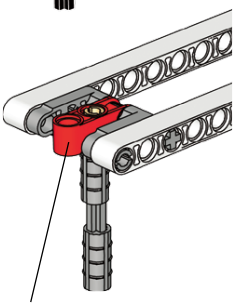

40-tooth
spur gear

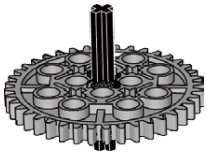

4-module axle
Black

How can we measure the clutch power more accurately?
- Use the same size axle to test each gear
- Turn the handle to hammer the axle down
- Count how many hits until the axle touches the tabletop for each gear






About 5 mm to
go into the hole
of the anvil



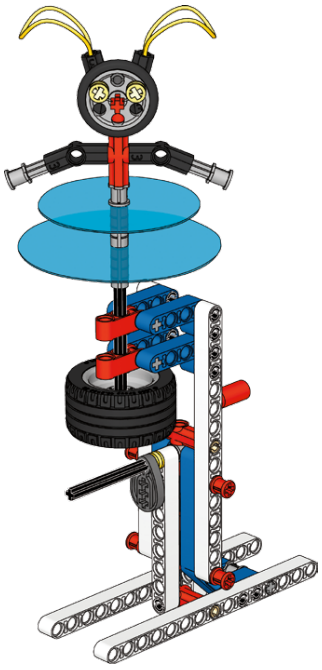
Is the Hammer a better test of axle friction than testing by feel?
If you hammer each gear several times, you will find very similar results each time. This Hammer is a real scientific instrument and much better than guessing. The LEGO® labs have huge machines that do the same job, but much more accurately.

What else can the cam do?
On page 14, step 18 the Hammer hits twice for each turn of the handle. Also change the axle position through the cam to make different actions and timings. Try making a slow rise and fast drop, or fast rise and slow drop.

Optional: Using a heavier Hammer
It will drive the axles through more quickly. You need to put in more energy to lift the Hammer, but it drops with more force. It has more momentum. The smooth cam edge is an inclined plane, which make it easier to lift heavier weights.

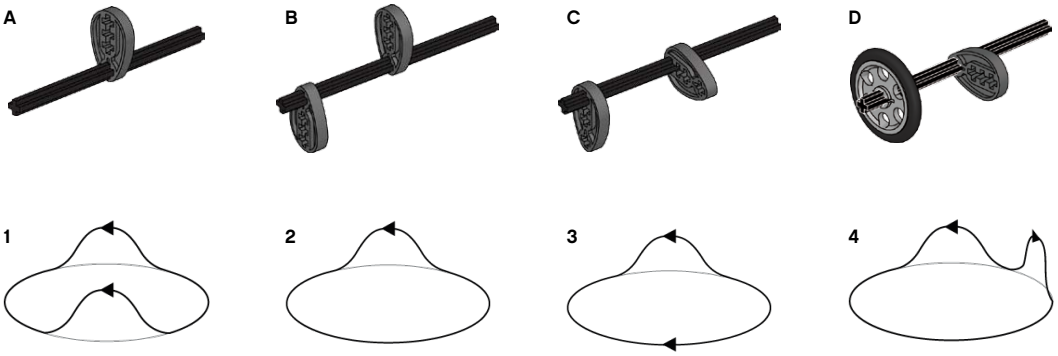
Continue

Bouncing Ballerina!
(book 4B page 23, step 21)
- Predict, then test what happens when you turn the handle



Did you know?
Cams work inside car engines, clocks, toys, sewing machines, and locks – in fact anywhere complex timed actions are required. Bring in clocks, toys, locks and other things that contain cams. Disassemble them and see how cams move.

- Can you predict the 'dancing' action made by the cam shaft arrangements shown
- Now try them and see



NB.
The wheel is in fact a round cam. It spins the dancer but does not lift her.

Deco-rotate-her!
Add your own fun decorations. Make a card screen to hide the cams. Can anyone else work out your cam 'dance program' just by watching her dance? Make her arms fly out as she pirouettes.