

ROBÓTICA Y NEUMÁTICA

Ref 9641 + 9686



Notas para el profesor

4 proyectos:

- **Brazo robot**
- **Mano robótica**
- **Elevador en tijera**
- **Prensa de estampado**



Robot Arm

Science

- Area
- Behaviour of gases under pressure
- Friction
- Scientific investigation

Design & Technology

- Assembling components
- Control of mechanisms
- Evaluating
- Testing before making improvements
- Using mechanisms – levers

Vocabulary

- Area
- Cylinder
- Grip
- Levers
- Manometer
- Mass
- Pressure
- Pump
- Valve

Other materials required

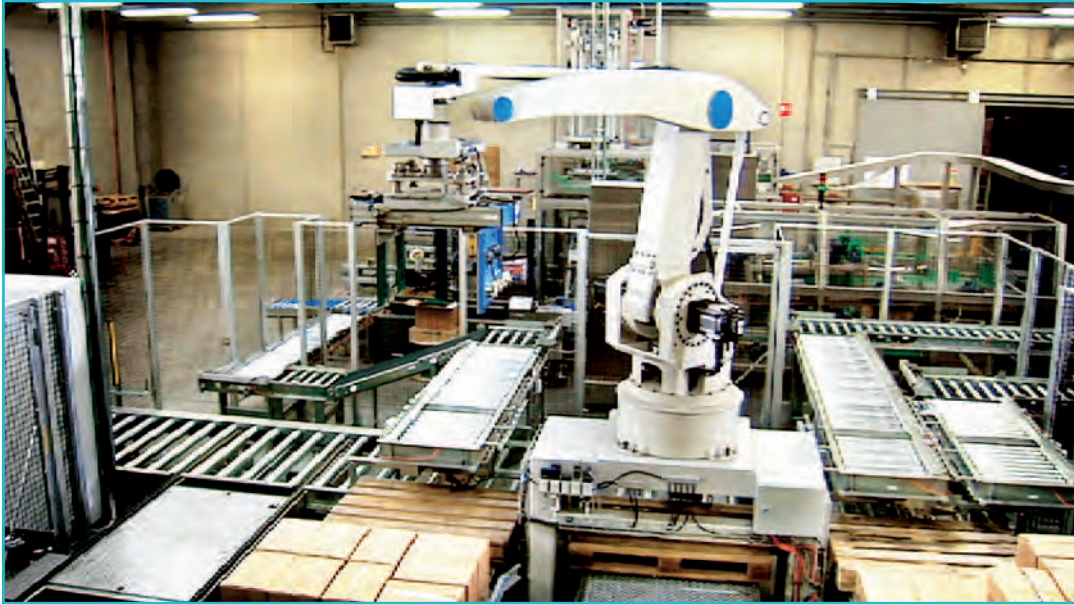
- A collection of small objects of different size and weight
- Graph paper
- Several small pieces of crumpled up paper



Connect

Robotic arms are used for jobs that involve picking up, moving and placing objects. Usually they do jobs which are difficult or repetitive, and need to be done quick and efficiently. To achieve maximum efficiency, the picking and placing sequence needs to be decided beforehand.

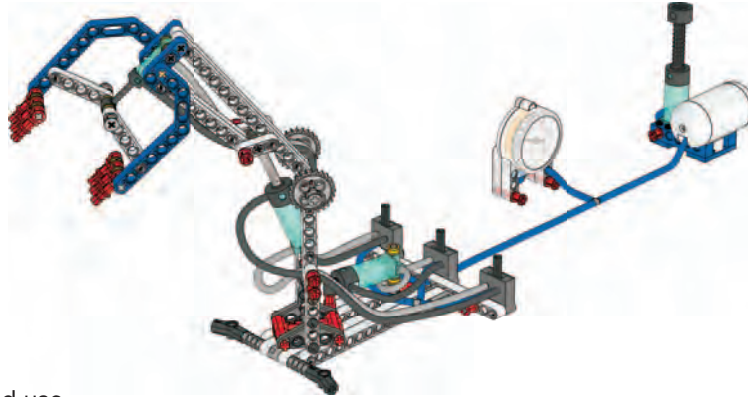
Build the Robot Arm and investigate how to make the most energy efficient sequence of strokes. Let's find out!



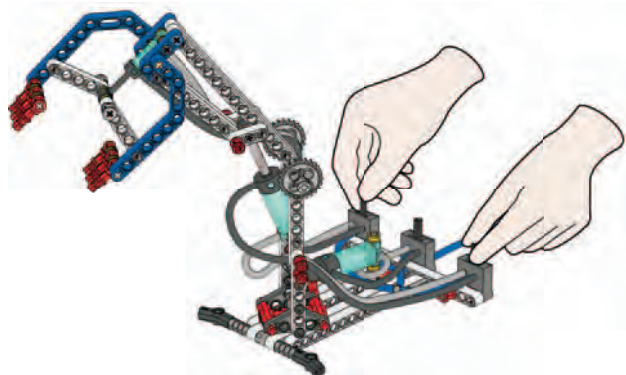
Construct

Build the Robot Arm.

(All of book 4A and book 4B to page 19, step 19)



- Pump air into the system and use the manometer to detect whether there is an air leak
- Try all valve settings and check all moving parts to ensure that they move freely



- Then turn the arm to its resting position: turned to the far right, arm up and grippers open, and empty the air tank



- ◀ **Hint**
The easiest way to empty the air tank is to disconnect the tube going from the air tank to the valve.

Contemplate

What is the most energy efficient sequence?

Find out which sequence is the most energy efficient for picking and placing objects.

First, predict which sequence of strokes is the most energy efficient at picking and placing a pellet of paper. Your sequence has to start in the resting position, use all six movements at least once and then return to the resting position.

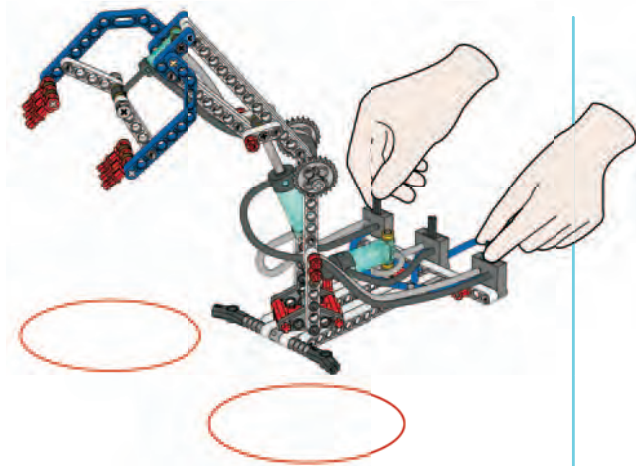
Record your predictions on the worksheet.

Then, test your sequence of strokes and note the loss of pressure after each stroke.

Start with 2.5 bars of pressure.

Record your findings on the worksheet and graph paper.

Test several times to make sure your results are consistent.



Stroke	My sequence
A	Arm down
B	Grip close
C	Arm up
D	Arm turn left
E	Arm Down
F	Grip open
G	Arm up
H	Arm turn right

Have the students reflect on their investigations by asking questions such as:

- What did you predict would happen and why?
It takes eight strokes to complete the work cycle and back to the resting position. If the object is dropped without lowering the arm it can be done in six strokes.
- How does the Robot Arm work?
The gripper is a complex third class lever linkage. The arm lift is a third class lever too.
- Can you explain any features of the pressure graph?
The small cylinder uses much less air resulting in less pressure loss than the big cylinders. See stroke B and F.



Continue

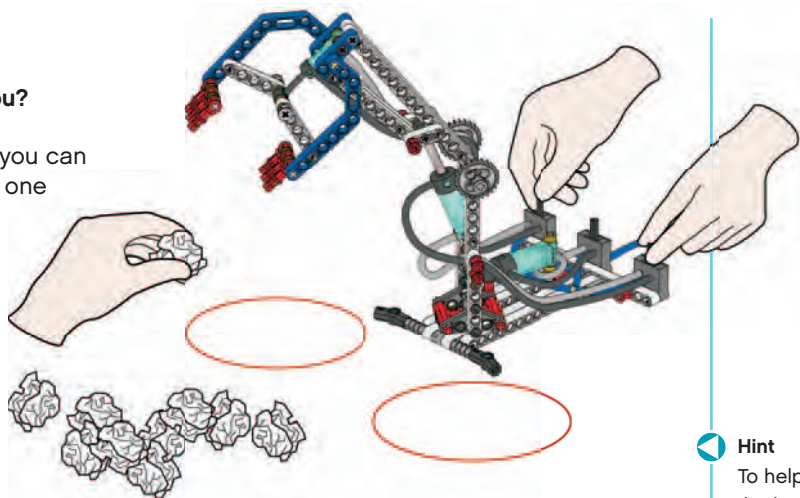
How good of a robot operator are you?

Find out how quickly and accurately you can pick and place pellets of paper from one circle to another

First, predict how many pellets you can accurately place within the circle in 30 seconds.
Record your predictions on the worksheet.

Then, test how many pellets you actually place accurately within the circle in 30 seconds.
Record your findings on the worksheet.

Repeat the test three times to see if your speed and accuracy improve.



Hint
 To help overcome the loss of pressure, you could build a compressor.



Optional: How about new grippers?

Design and make your own grippers that will help you to pick and place different objects of your choice.



Robot Hand

Science

- Behaviour of gases under pressure
- Forces
- Friction
- Measuring weight
- Scientific investigation

Design & Technology

- Assembling components
- Evaluating
- Testing before making improvements
- Using mechanisms – levers

Vocabulary

- Circumference
- Cylinder
- Force
- Grip
- Levers
- Manometer
- Mass
- Pressure
- Pump
- Valve
- Weight

Other materials required

- A collection of small objects of different size and weight
- Plastic cup

Optional

- Modelling clay
- Rubber bands
- Weighing machine

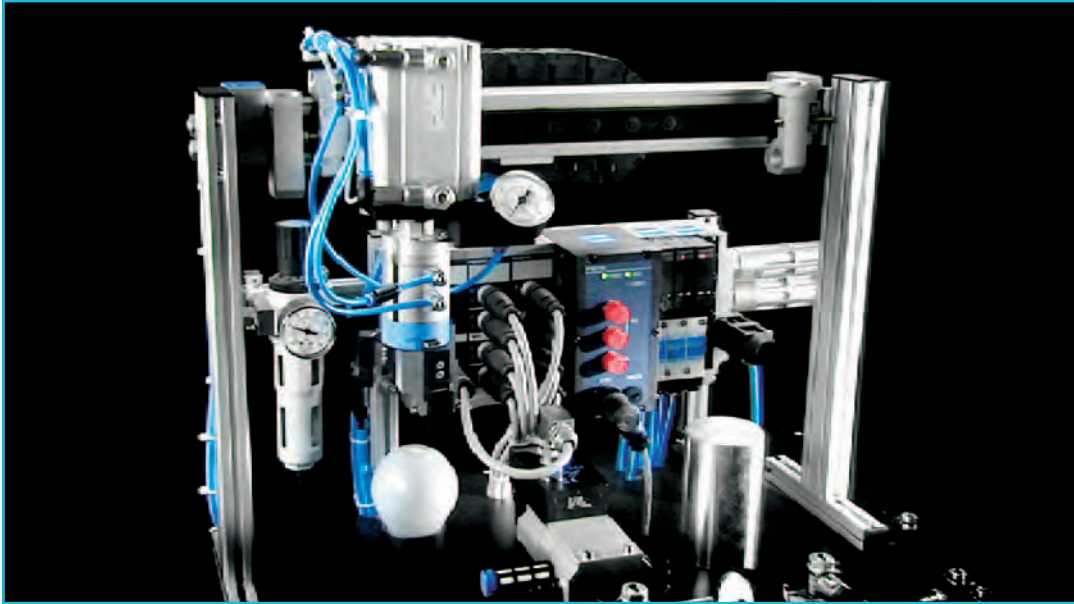
Robótica y Neumática



Connect

Industry and hospitals often need to handle and move objects that can be dangerous to touch by hand. Metal objects and fragile glass containers, for example, are often handled using pneumatic hands or grippers.

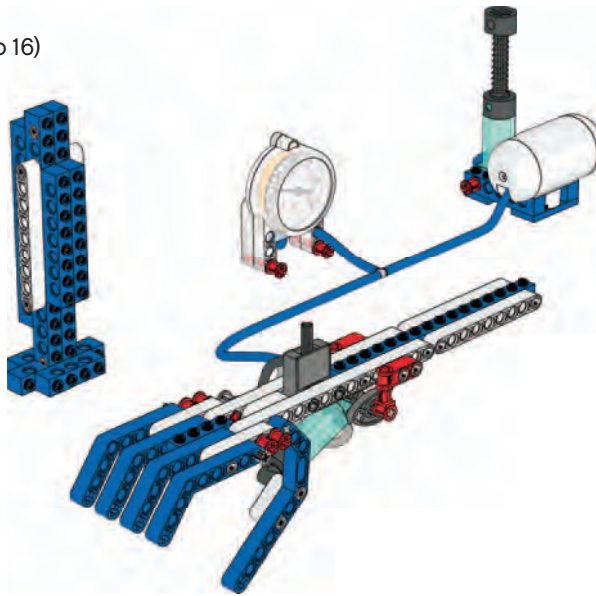
**Build the Robot Hand and investigate what pressure is needed to hold different objects without dropping or crushing them.
Let's find out!**



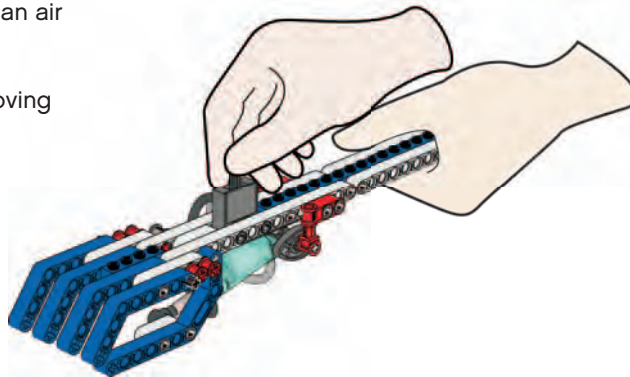
Construct

Build the Robot Hand and the carrier.

(All of book 2A and book 2B to page 10, step 16)



- Pump air into the system and use the manometer to detect whether there is an air leak
- Try the valve settings and check all moving parts to ensure that they move freely



- Then open the hand and empty the air tank



Hint
The easiest way to empty the air tank is to disconnect the tube going from the air tank to the valve.

Contemplate

How good a grip?

The Robot Hand can pick up the carrier from two different sides – the smooth white side and the studded blue side. Find out how much pressure the Robot Hand needs to pick up the carrier.

First, predict how much pressure the Robot Hand needs to lift carrier A.

Record your findings on the worksheet.

Then, test how much pressure is needed.

Record your findings on the worksheet.

Next, follow the same procedure for Robot Hands B, C and D.

Test several times to make sure your results are consistent.

Robot Hand A (page 10, step 16) needs a pressure of about 0.5 bar

Robot Hand B (page 10, step 16) needs a pressure of about 0.4 bar

Robot Hand C (page 12, step 18) needs a pressure of about 1.2 bars

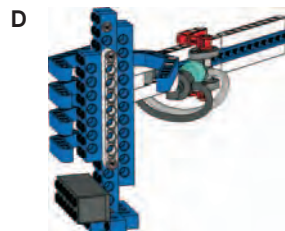
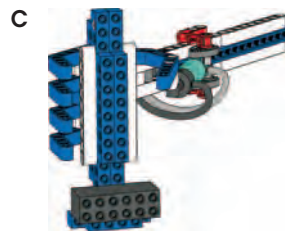
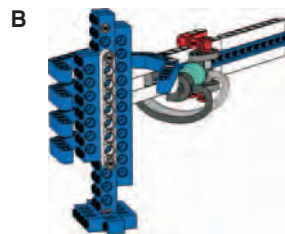
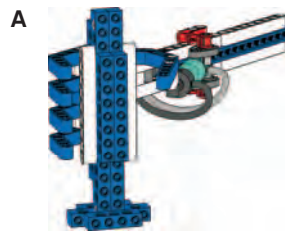
Robot Hand D (page 12, step 18) needs a pressure of about 1.0 bar

Does weight have an effect?

When carrying extra weight, the type of surface does matter. Extra friction and gripping points on the load mean less crushing pressure is needed. This is safer and more efficient.

Have the students reflect on their investigations by asking questions such as:

- What did you predict would happen and why?
- How does the Robot Hand work and what type of lever system does it use?
*The gripping thumb is a third class lever.
The pivot is at the wrist.*
- What are the limitations of the Robot Hand's grip?
*The fingers and thumb are too slippery and do not have enough friction.
The fingers do not bend in and grip like real fingers.*



Continue

What else can the Robot Hand hold?

Prepare a fragile paper or plastic cup. Find a variety of different objects to put in the cup. Find out how much pressure is needed for the Robot Hand to pick up the cup.

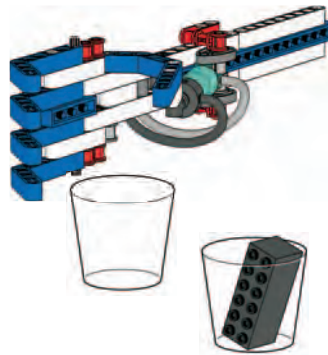
First, predict how much pressure the Robot Hand needs to lift the different objects without damaging them.

Record your prediction on the worksheet.

Then, test how much pressure is needed.

Record your findings on the worksheet.

Test several times to make sure your results are consistent.



Hint

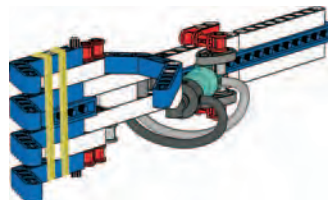
Make an egg-shaped object out of modelling clay. Marks on the clay's surface can be used to record damage caused by pressure.

But remember to wrap it in cling film to keep the elements clean.

Optional: Further investigations

Need a better grip?

Experiment by adding different materials to the Robot Hand for a better and safer grip that also causes less damage.





Scissor Lift

Science

- Area
- Behaviour of gases under pressure
- Forces

Design & Technology

- Assembling components
- Control of mechanisms
- Evaluating
- Using mechanisms – levers

Vocabulary

- Compression
- Cylinder
- Force
- Levers
- Manometer
- Pressure
- Pump
- Valve
- Weight



Connect

Scissor lifts are designed for easy and safe access to elevated positions and are often used where ladders are not an option. A scissor lift's work platform provides space for tools and movement, and can lift a heavy load.

Build the Scissor Lift and investigate how its function is influenced by weight and height. Let's find out!

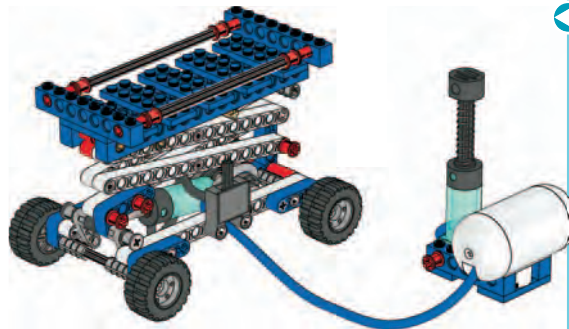


Construct

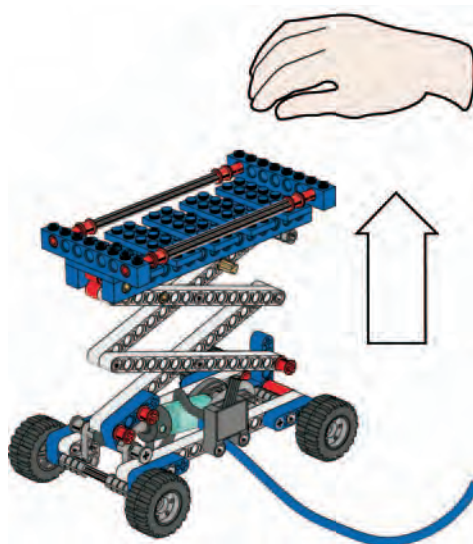
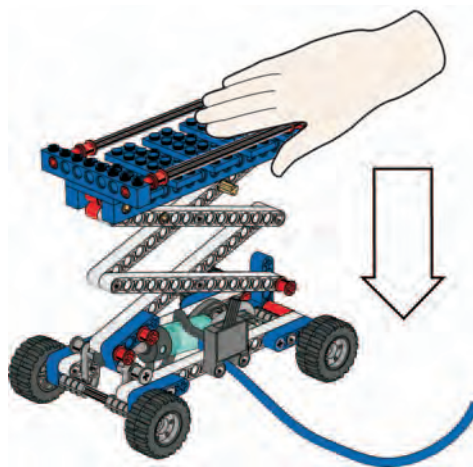
Build the Scissor Lift.

(All of book 1A and book 1B to page 11, step 15)

- Pump air into the system and make sure the Scissor Lift raises smoothly
- Press down on the platform of the raised Scissor Lift



- When you let go, the platform should bounce back up again. If not, check for air leaks
- Then lower the Scissor Lift and empty the air tank



Hint
The easiest way to empty the air tank is to disconnect the tube going from the air tank to the valve.

Contemplate

Going Up?

Find out what influence weight and height have on the number of pumps needed to raise the Scissor Lift to its maximum height.

First, predict how many pumps are needed to raise Scissor Lift A to its maximum height. *Record your predictions on the worksheet.*

Then, test how many pumps are needed. *Record your findings on the worksheet.*

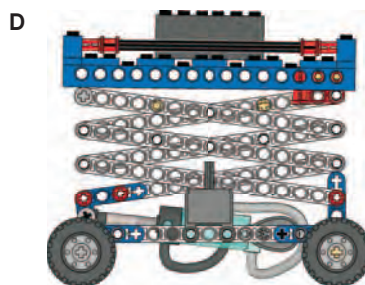
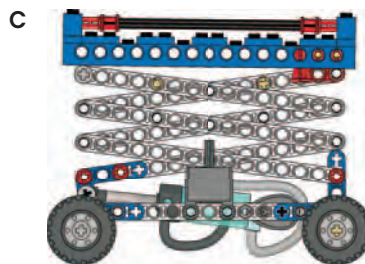
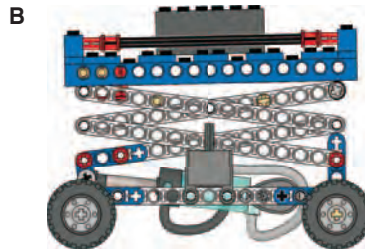
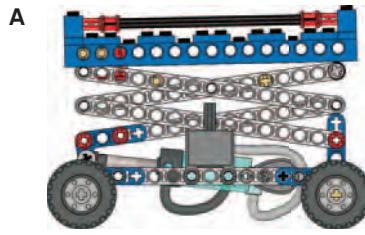
Next, follow the same procedure for Scissor Lifts B, C and D. Test several times to make sure your results are consistent.

Scissor Lift A (page 11, step 15) needs about 12 pumps

Scissor Lift B (page 12, step 16) needs about 20 pumps

Scissor Lift C (page 17, step 21) needs about 17 pumps

Scissor Lift D (page 18, step 22) needs about 28 pumps



Have the students reflect on their investigations by asking questions such as:

- What did you predict would happen and why?
- How does the Scissor Lift work?
It is a series of first class levers each squeezing the next one. The pivot points are the pegs in the centre of the beams.
- How did you make sure the tests were fair?
Did you empty the air tank?



Continue

How much pressure is needed?

You know how many pumps are needed to raise the Scissor Lift to its maximum height. Now add the manometer and find out how much pressure is needed (page 20, step 24).

First, predict how much pressure is needed to raise Scissor Lift A to its maximum height. Record your prediction on the worksheet.

Then, test how much pressure is needed. Record your findings on the worksheet.

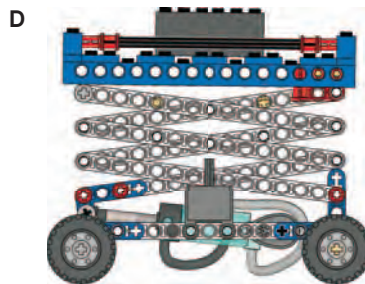
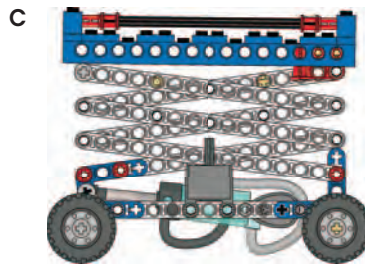
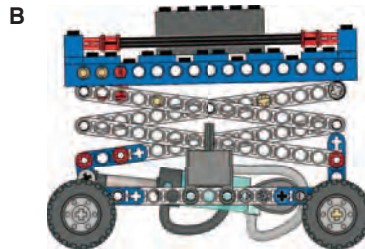
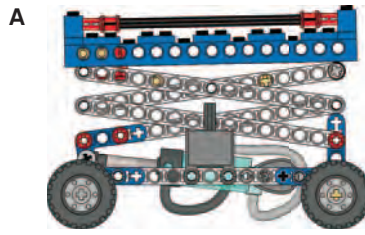
Next, follow the same procedure for Scissor Lifts B, C and D. Test several times to make sure your results are consistent.

Scissor Lift A (page 11, step 15) needs a pressure of about 1,0 bar

Scissor Lift B (page 12, step 16) needs a pressure of about 1,5 bars

Scissor Lift C (page 17, step 21) needs a pressure of about 1,4 bars

Scissor Lift D (page 18, step 22) needs a pressure of about 2,1 bars



Optional: Further investigations

- Why does the pressure drop immediately after the Scissor Lift has reached its maximum height?
When the cylinder piston extends the total area for compressed air has increased. The pressure adaptation the new total area results in a small pressure drop.





Stamping Press

Science

- Area
- Behaviour of gases under pressure
- Forces
- Scientific investigation

Design & Technology

- Assembling components
- Control of mechanisms
- Evaluating
- Properties of materials
- Using mechanisms – levers

Vocabulary

- Area
- Cylinder
- Efficiency
- Force
- Levers
- Manometer
- Mass
- Pressure
- Pump
- Valve

Other materials required

- Aluminium foil or cling film
- Clay or small pieces polystyrene foam
- Graph paper
- Stopwatch or timer



Connect

A stamping press stamps or presses a material into a new shape or size. To be as efficient as possible, the process needs to use the least amount of energy possible, yet work as fast as possible.

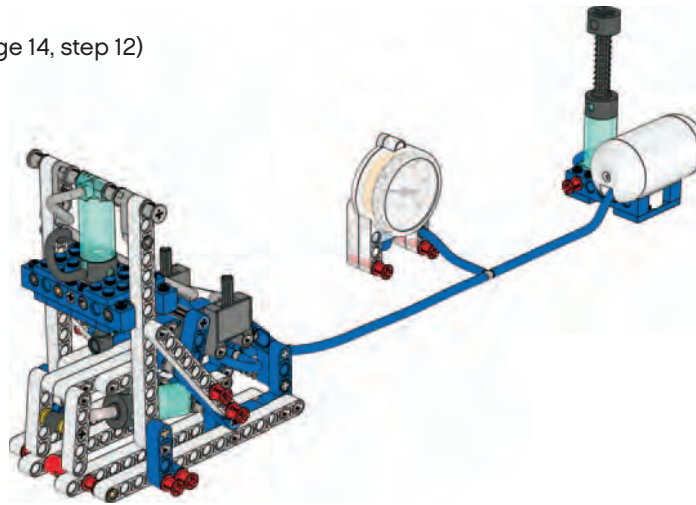
**Build the Stamping Press and investigate how energy efficient it is.
Let's find out!**



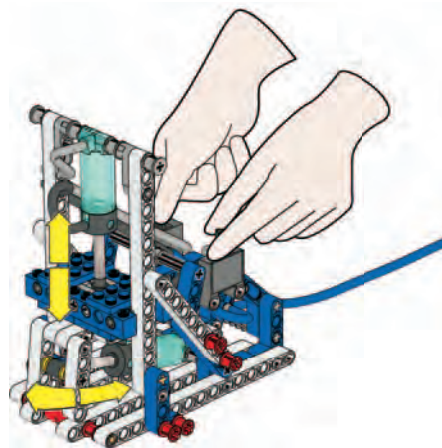
Construct

Build the Stamping Press.

(All of book 3A and book 3B to page 14, step 12)



- Pump air into the system and use the manometer to detect whether there is an air leak
- Try all valve settings and test if the Stamping Press can do all four possible strokes; press down, press up, ejector down, and ejector up. Make sure all moving parts move freely



- Then move the press up, the ejector forward and empty the air tank



Hint
The easiest way to empty the air tank is to disconnect the tube going from the air tank to the valve.

Contemplate

How energy efficient is your press?

One complete work cycle is four 'strokes' in sequence; press down, press up, ejector down, and ejector up. Find out how repeated work cycles affect loss of pressure.

First, predict how repeated work cycles affect the loss of pressure when working with empty Stamping Press A.

Record your predictions on the graph paper as a dotted line starting at 2.5 bars and ending near zero bar. Remember it doesn't have to be a straight line.

Then, test how Stamping Press A's repeated work cycles actually affect the loss of pressure.

Start with 2.5 bars of pressure.

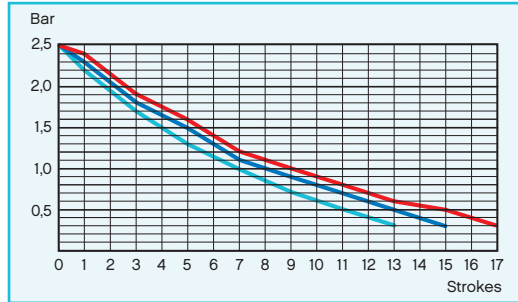
Record your findings on the graph paper.

Next, follow the same procedure for Stamping Presses B and C.

Test several times to make sure your results are consistent.

Have the students reflect on their investigations by asking questions such as:

- What did you predict would happen and why?
- How does the Stamping Press work, and which type of lever is used?
The stamper delivers a direct press and the ejector uses a complex second class lever.
- How many complete work cycles can you do when starting with 2.5 bars of pressure?
About three complete work cycles.



Hint
For a more accurate graph, record your findings after each stroke.

	A	B	C
1	2.2	2.3	2.3
3	1.7	1.8	1.9
5	1.3	1.5	1.6
7	1.0	1.1	1.2
9	0.7	0.9	1.0
11	0.5	0.7	0.8
13	0.3	0.5	0.6
15		0.3	0.5
17			0.3



Continue

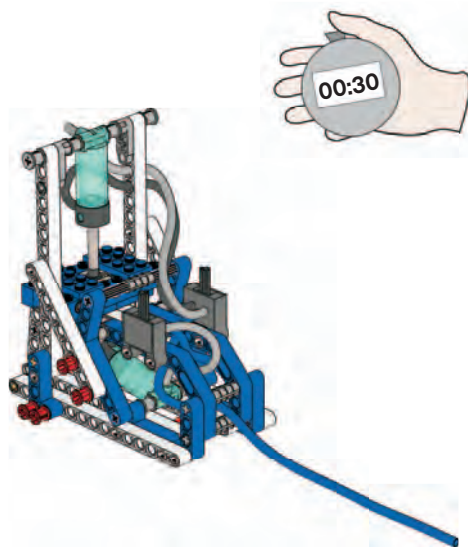
How good of a press operator are you?

The faster you can operate the empty Stamping Press, the more cost efficient it will be. Find out how many complete work cycles you can finish in 30 seconds.

First, predict how many complete work cycles you can finish in 30 seconds when using an empty Stamping Press.
Record your predictions on the worksheet.

Then, test how many complete work cycles you actually finished.
Record your findings on the worksheet.

Next, try pressing different objects of your choice and compare the number of complete work cycles you are able to finish.



Hint
Before you start, it is a good idea to decide if you are starting with an empty or full air tank.

Hint
To help overcome the loss of pressure, you could build a compressor.



Notas para el profesor

4 proyectos:

- Brazo robot
- Mano robótica
- Elevador en tijera
- Prensa de estampado



Robótica y Neumática