Start by building the example, then turn it into your own unique design.

For use with TeacherGeek Electromagnet Activity, or Maker Cart. Find documents and activity materials at teachergeek.com.
You will need these TeacherGeek components:
Below is the list of “ingredients” you’ll need to build an Electromagnet. It includes some extra components to allow you to create your own unique design.

1 - Wire Roll
  colors vary
  SKU: 1821-43

1 - Battery Holder
  w/ Switch & Leads
  SKU: 1821-63

1 - Block
  SKU: 1821-34

1 – 50mm Screw
  #10 (2in)
  SKU: 1821-27

You will need these tools, they can be shared:
Tools available at teachergeek.com

Wire Strippers
  SKU 1823-95

Screwdriver
  SKU 1823-90

Pliers (optional)
  SKU 1823-86

You will need these non-TeacherGeek supplies:

Masking Tape

2 AA Batteries

Small Paper Clips and Other Materials
  Erasers, Washers, Staples, Candy, Pennies, etc. for magnetic testing.
Make the Magnet

1. Turn a 5cm long screw into a block.

2. Uncoil a wire roll.

3. Measure 60cm from one end of the wire. Fold a piece of tape there, over the wire.

4. Wrap the wire, as shown below, 150 – 200 times around the screw (this will create several layers).

Quick Tip
To keep wire from unwinding, wrap a few times in the slots.

More wraps make a stronger magnet, but you need about 60cm of extra wire to mount it to your crane.

Don’t cut the wires! Use the entire length or it will overheat.

60cm Side of Wire

5cm Screw

Block

60cm (24in)

Extra Wire
5. Strip (remove) 1cm of plastic insulation from the wire ends.

6. Twist the stripped wire from step 5 with the stripped battery holder wires.

7. Wrap the twisted wire ends with tape. This will keep them together, and keep them from touching.

Don’t Short Circuit
Keep the red and black wires from touching. The battery will heat up and die (nothing fun).
Put 2 AA batteries into the battery holder. Turn it on and try to pick up some paper clips.

Yes… You should have extra wire on one side.

Congratulations! Your electromagnet is finished. It’s time to turn it into a crane on the next page.

Do not keep your electromagnet turned on. It will get hot and drain your battery.
You will need these TeacherGeek components for the Crane:

Below is the list of “ingredients” you’ll need to build an Electromagnet. It includes some extra components to allow you to create your own unique design.

- 1 - Connector Strip
- 1 - Dowel 300mm (12’’)
- 1 - Hole Plate
- 1 - Block
- 2 - 6mm Screw #6 6mm (¼’’)
- 2 - 25mm Screw #10 25mm (1’’)
- 1 - Nut #10
- ≥ 2cm Slide Stop (≥ ½in)

You will need these tools, they can be shared:

Tools available at teachergeek.com

- Multi-Cutter SKU 1823-81
- Screwdriver SKU 1823-90
- Pliers SKU 1823-86
- Reamer SKU 1823-87

You will need these non-TeacherGeek supplies:

- Tape
- Magnetic Materials
  Erasers, Washers, Staples, Dimes
  Candy, Pennies, etc.
1. Cut a 12cm dowel.

2. Tap or push the dowel into a corner of a hole plate.

3. Ream one hole of a block.

4. Cut two 1cm sections of slide stop.
5 Place one of the slide stop sections onto the dowel.

6 Put the dowel through the reamed block hole. Use a slide stop section to hold it on.

7 Use a 25mm screw to attach a connector strip to the block. This will become the crane arm.

8 Use a 25mm screw and nut to attach your electromagnet to the arm.
Finish your example Electromagnet Crane by attaching the **battery holder** and taping loose **wires**.

From the underside, use a **6mm screw** to attach the **battery holder** to the **hole plate**.

This example crane works okay, but you can make it work much better. It is time for you to redesign it. Start onto an Electromagnet Crane Engineering Challenge.
The Challenge: Redesign your crane to pick up as many paper clips as possible, in two minutes.

Difficulty: Easy

This is not a good crane design (it’s the example). You can redesign it to reach more areas.

Use any cup or container.
**The Challenge:** Redesign your crane to hang as many paper clips as possible, in two minutes.

This is not a good crane design (it’s the example). Can you redesign it so it can pick up things near and far away, without moving the crane base?

Optional: Make the challenge more difficult by requiring that the crane base stay in one place.

Prepare for the challenge by creating a “tree” or structure to hang paper clips on. The tree branches are opened paper clips.

Other documents and activity components at teachergeek.com.

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**The Challenge:** Design an Electromagnet Crane to sort as many materials in 2 minutes as possible.

**Difficulty:** Medium

Redesign your crane to reach all the sorting areas. The example crane will not work.

Add parts to your crane to help you move non-magnetic materials.

Move materials from the pile in the center, to the correct sorting areas.
Single Player Arena
Design and build an electromagnetic crane to sort as many materials in 2 minutes as possible.

Criteria (rules):

1. Only the crane arm may enter the sorting area during the challenge. It may not be lifted up.
2. Crane base must stay inside this rectangle. It may not be moved by electromagnet.
3. Crane may not use sharp points to pick up materials.
4. Magnetic materials may only be used by electromagnet.
5. All materials must start in the center circle.
6. Only TeacherGeek-recycled, and approved materials may be used.
7. The example electromagnet crane arm will not reach all of the sorting areas. You need to redesign the arm so that it will.

Scoring Points:

+2 Add 2 points for every magnetic material properly sorted.
+1 Add 1 point for every non-magnetic material properly sorted.
-2 Subtract 2 points for every material in the wrong recycling area.
CRANE MAY ENTER THIS AREA
CAUTION: ONLY CRANE MAY ENTER THIS AREA

Sort Pile
Place all materials here to start.

Paper

Staples

Teachergeek.com
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Two Player Arena
**TEAM #2**

**Criteria (rules):**

1. Only the crane arm may enter the sorting area during the challenge.
2. Crane base must stay inside this rectangle. It may not be lifted up.
3. Crane may not use sharp points to pick up materials.
4. Magnetic materials may only be moved by electromagnet.
5. All materials must start in the center circle.
6. Only TeacherGeek, recycled, and approved materials may be used.

The example electromagnet crane arm will not reach all of the sorting areas. You need to redesign the arm so that it will.

**Scoring Points:**

- Add 2 points for every magnetic material properly sorted.
- Add 1 point for every non-magnetic material properly sorted.
**Scoring Points:**

Add 2 points for every magnetic material properly sorted.

Add 1 point for every non-magnetic material properly sorted.

**Criteria (Rules):**

1. Only the crane arm may enter the sorting area during the challenge.
2. The crane base must stay inside the rectangle. It may not be tilted up.
3. Crane may not use sharp points to pick up materials.
4. Magnetic materials may only be moved by electromagnet.
5. All materials must start in the center circle.
6. Only Teachergen, recycled, and approved materials may be used.

Design and build an electromagnetic crane to sort as many materials in 2 minutes as possible. Compete against another crane for the most points.

**Team:**

Cut and attach to center sheet.
Sort Pile
Place all materials here to start.
Class: _______________________________________________________
Set: _________________________________________________________

**Points Scored**

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