WiTT STEM Kit
Brush Motor

Build a brush motor and learn how it works

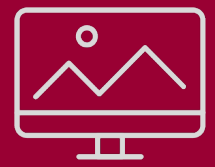
Alice Rende

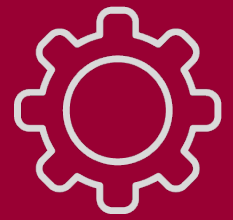
What is STEM?

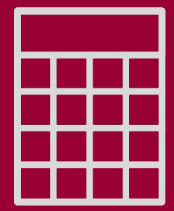
- STEM stands for Science, Technology, Engineering and Mathematics

- The aim of STEM is the integration of these four disciplines together in teaching and learning. As, in the real world, these four disciplines rely heavily and seamlessly on each other.

- STEM helps strengthen key life skills such as analytical thinking, problem solving, creativity, teamwork and technical skills







Curriculum Points

Grade 9, Academic. Page 48. Part A. Scientific Investigation Skills and Career Exploration. Subsection A1. Scientific Investigation Skills. Section A1.4-Safe operation of electrical equipment. Subsection A2. Career Exploration. Section A2.1-identify and describe a variety of careers related to the fields of science, such as electrical engineer, and electrician.

Grade 9, Academic. Page 57. Part E. Physics: The Characteristics of Electricity. Subsection E2. Developing Skills of Investigation and Communication. Subsection E2.1-learn and use terminology for labeling a brush motor. E2.5- draw the circuit diagram of the brush motor, measure the current, potential difference and resistance with the motor connected to power source and disconnected. E2.8-with measurements taken calculate and prove the quantitative relationship V=IR.

Grade 9, Academic. Page 57. Subsection E3. Understanding Basic Concepts. Section E3.1-use of proper electrical quantities, symbols and SI Units when making calculations. Section E3.4 – identify the components of the brush motor and explain their functions. Section E3.5 – explain the characteristics of electric current, potential difference, and resistance in simple series and parallel circuits, noting how they differ in the two circuits. E3.7 – use a multimeter to measure different values in the circuit.

What is WiTT?

- WiTT stands for Women in Technology and Trades

- WiTT is a group that increases opportunities and supports for women in technology and trades in all fields, through a rich networking and support community

- WiTT welcomes industry, staff, students and faculty across all areas of the college and all genders, backgrounds, races and orientation to become involved and contribute to the support of women in technology and/or trades.

Brush Motor Kit

- In this kit students will learn about how a brush motor works and apply that information to use the included pieces to build their own working brush motor.
- They will then use it to measure voltage, amperage and resistance.
- Students can also wire another battery in parallel or series and see how this effects these values by graphing them.
- Find the best combination of 4 batteries to lift a pencil using a string attached to the shaft.

Brush Motor Kit Requirements

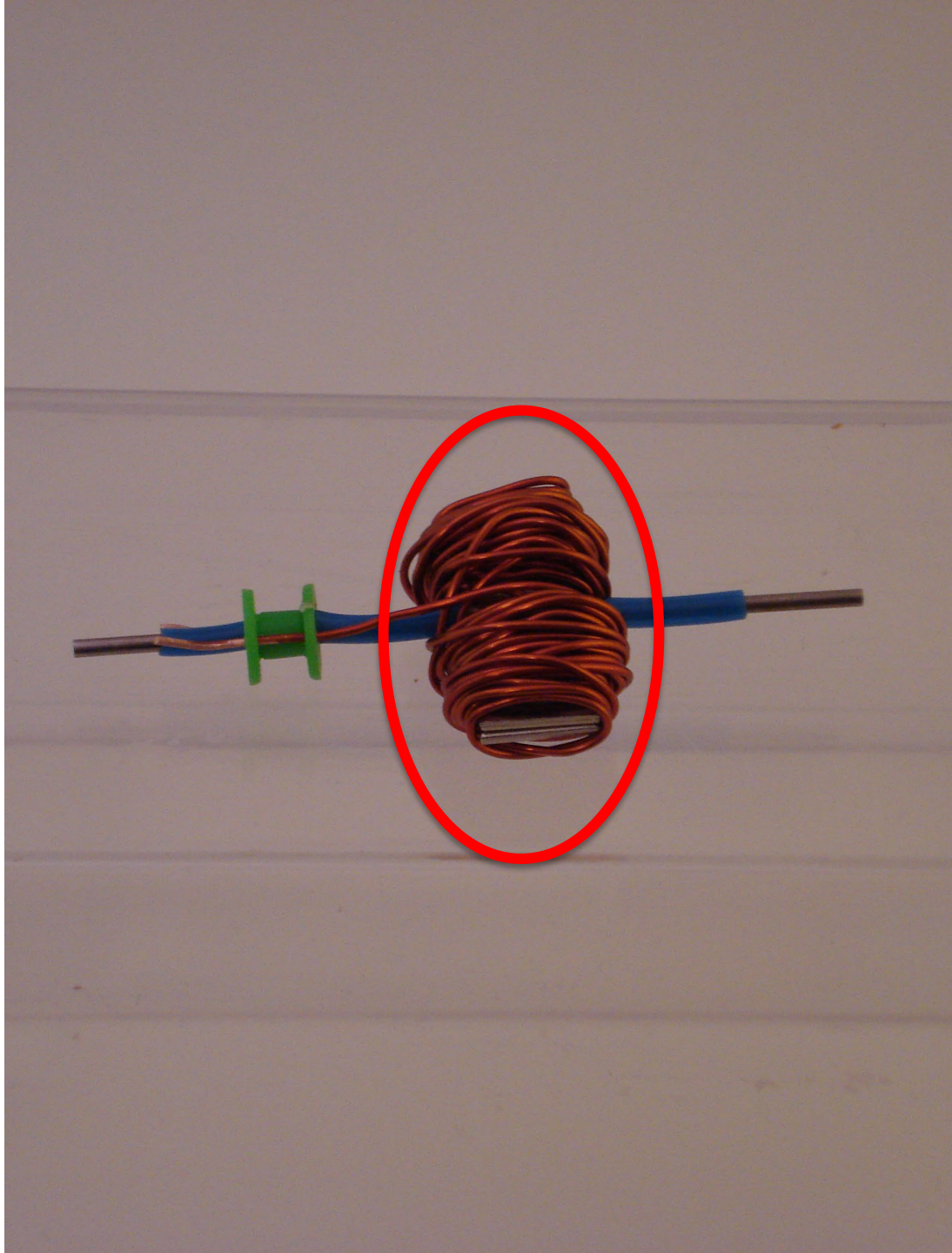
- Toy Motor Kit:
  - Armature/windings
  - Stator/field poles
  - Commutator
  - Brushes
  - Power source with battery holder
  - Shaft
  - Shaft supports
  - Mounting bracket
  - Plastic base
  - Fasteners
  - Sandpaper

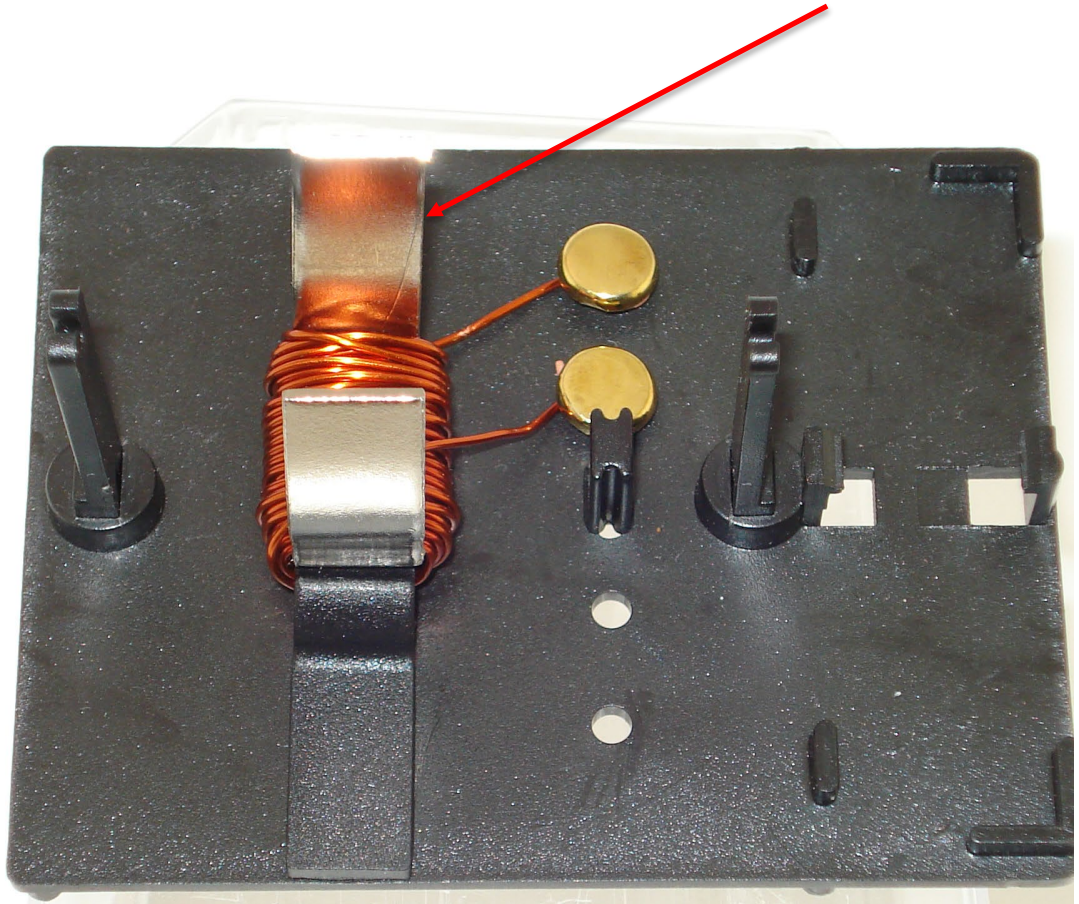
Brush Motor Kit Requirements

- Wire cutter/stripper
- Ruler
- 4 new AA batteries, high quality alkaline
- Pencil
- String
- Electrical tape
- 3 Extra battery holders
- 8 Banana plugs
- 2 Alligator clips
- Small Phillip's head screwdriver

Armature/Windings

This is the rotating part of the motor. It is attached to the shaft and has copper wire coiled around it, known as windings.



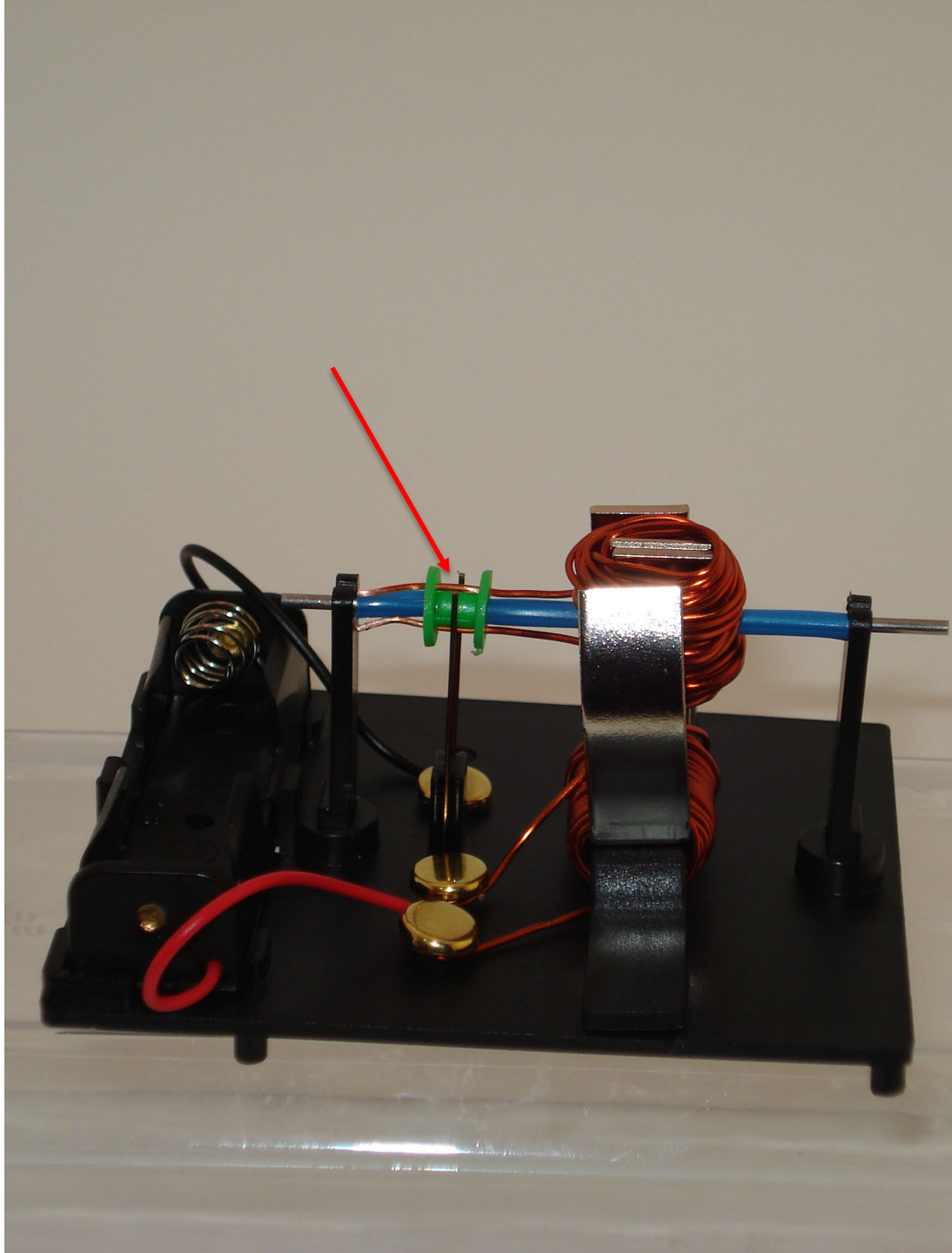


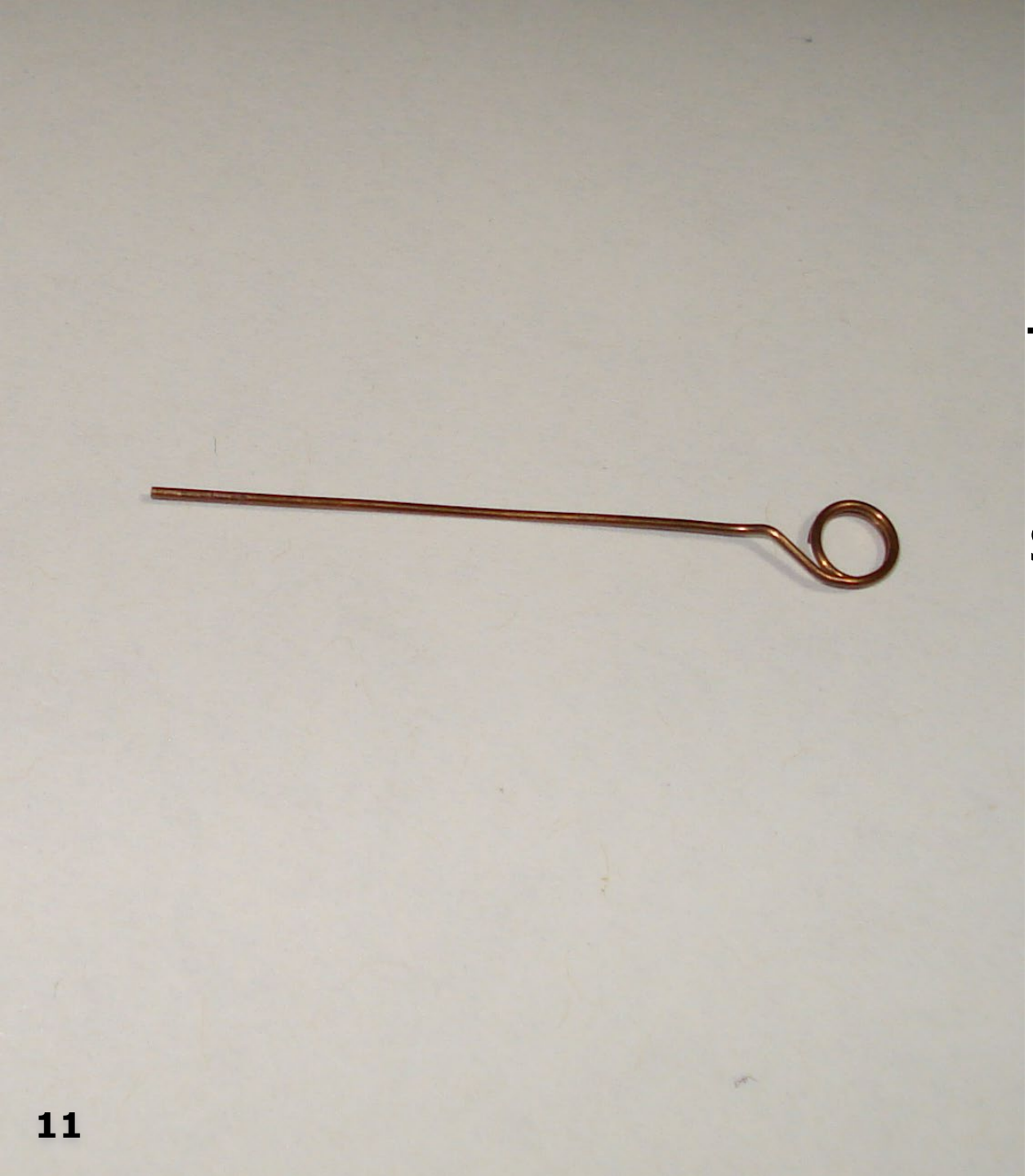
Stator/Field Poles

A stationary magnetic field around the armature. The coil winding creates the magnetic field.

Commutator

The connection made between the armature coil and brushes. This is broken into at least 2 segments around the shaft, depending on how many coils there are.



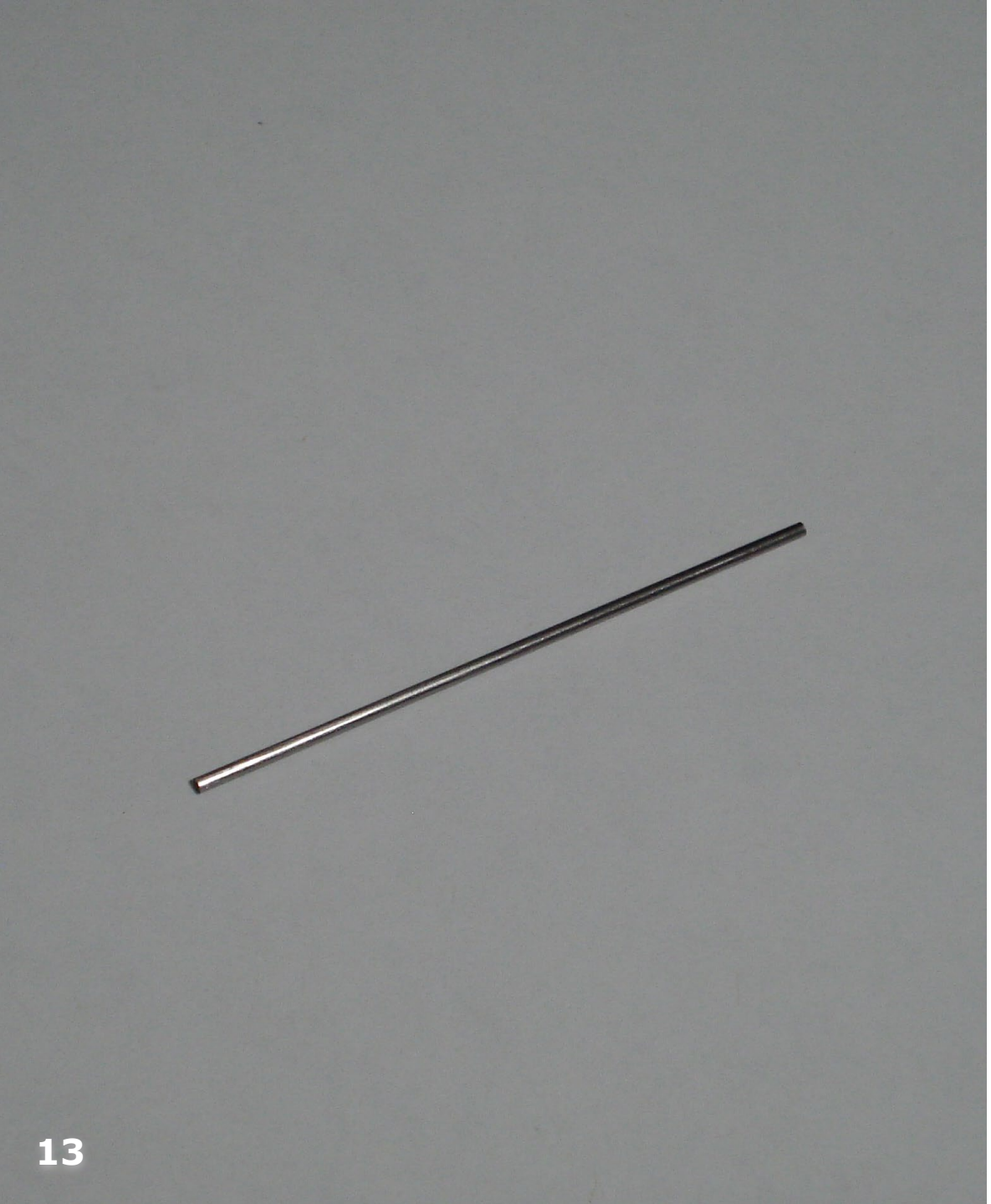


Brushes

These are the connection points from the power source to the commutator.

Power Source

An electric motor needs a source of power in order to work. In this case we are using a battery.



Shaft

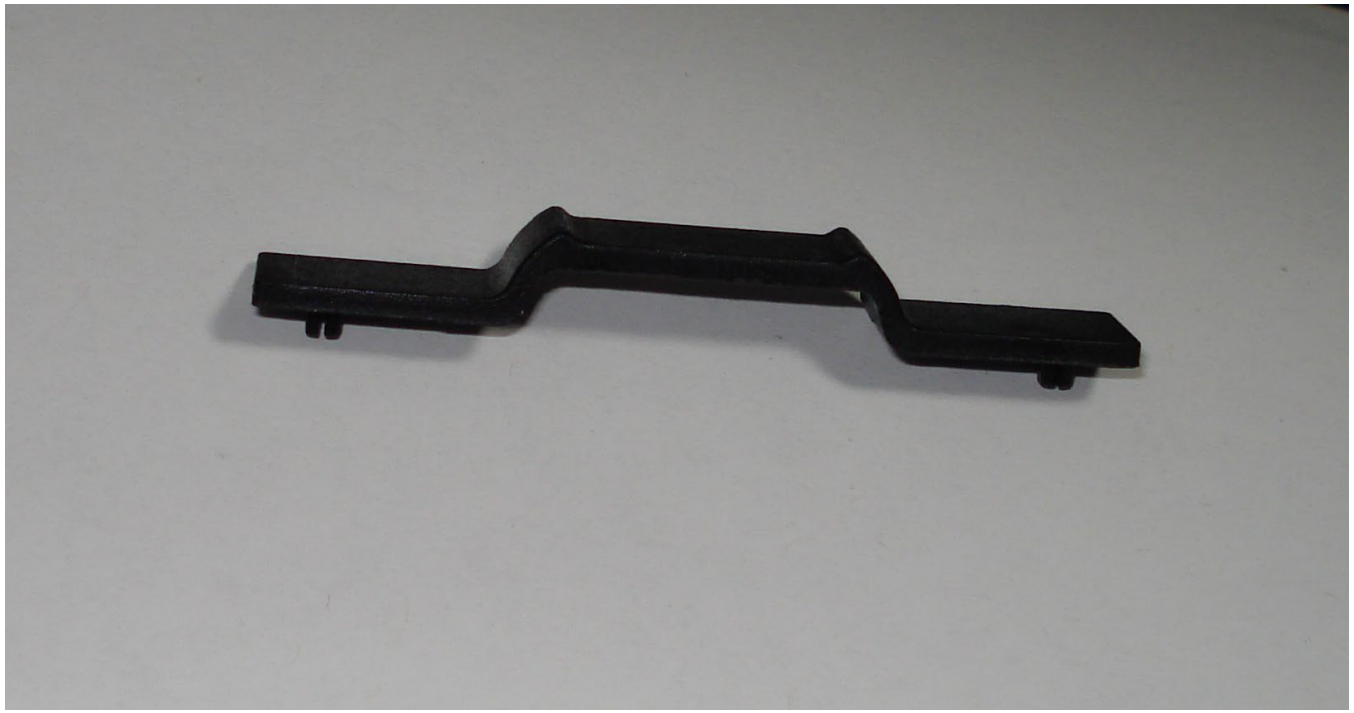
This is the central turning part of the motor that allows the turning power of the motor to be used.

Shaft Supports

Used to support motor shaft.

Mounting Bracket

Used to mount the field pole to the base.



Plastic Base

Used to keep all the parts in place.

Conductive Fasteners

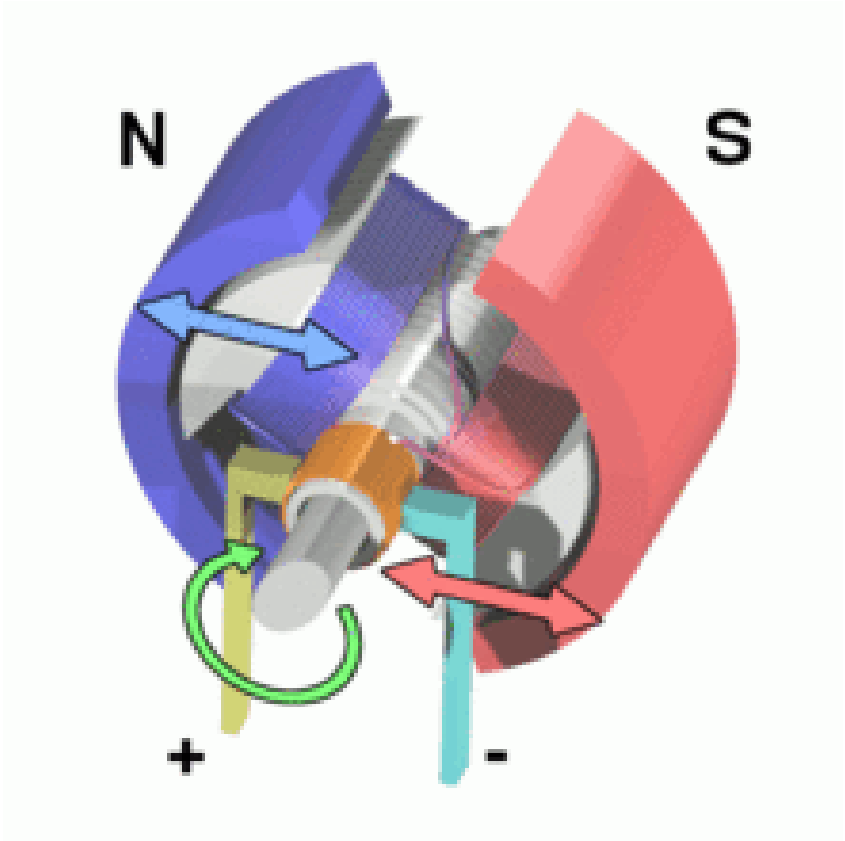
Used to fasten pieces in place and to complete circuits.

How a Brush Motor Works

- Brush motors work on the basis of a changing magnetic field rotating inside a stationary field, where one side is negative and the other positive.
- An electrical field is generated at the armature when a voltage is applied to the brushes. This voltage is then transferred into the commutator.

How a Brush Motor Works

- When this magnetic field is generated, the left side of the armature is repelled from the left stator magnet and attracted to the right. The same happens to the right side of the armature.
- As the armature turns it disconnects from the power source and reconnects after a half turn. The magnetic field collapses and reforms again, and the cycle is continued.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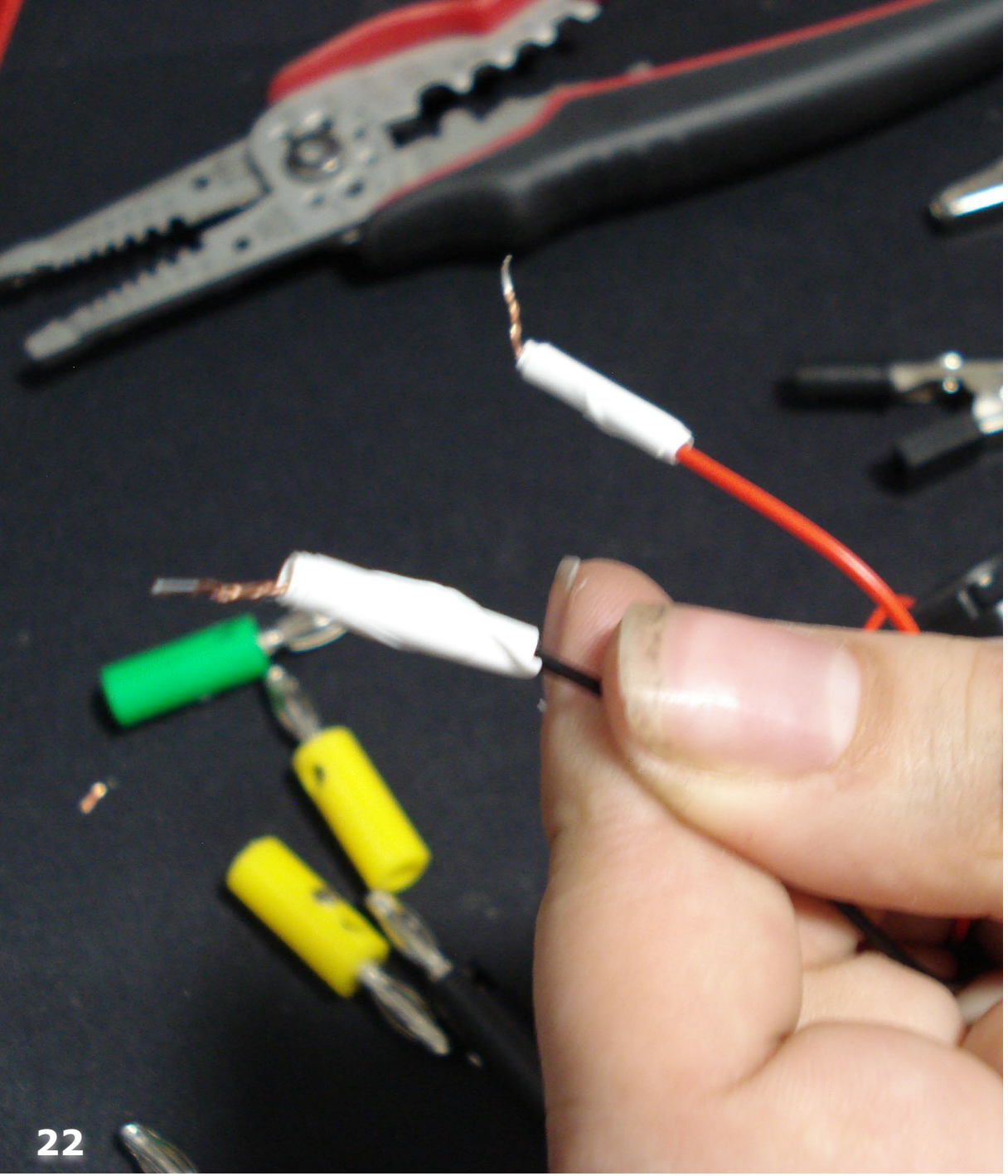
Experiments and Activities

Once the motor is completed, using a multimeter, measure resistance, voltage and amperage.

Draw and label a wiring diagram of the brush motor.



How to Use Banana Plugs and Alligator Clips

1. Strip off insulation from each end of wire from battery holder. Make sure you have at least ½” of wire exposed.
2. With 1” of electrical tape, wrap the ends of the wire around the insulation. This will make a better fit for the banana plugs.

How to Use Banana Plugs and Alligator Clips

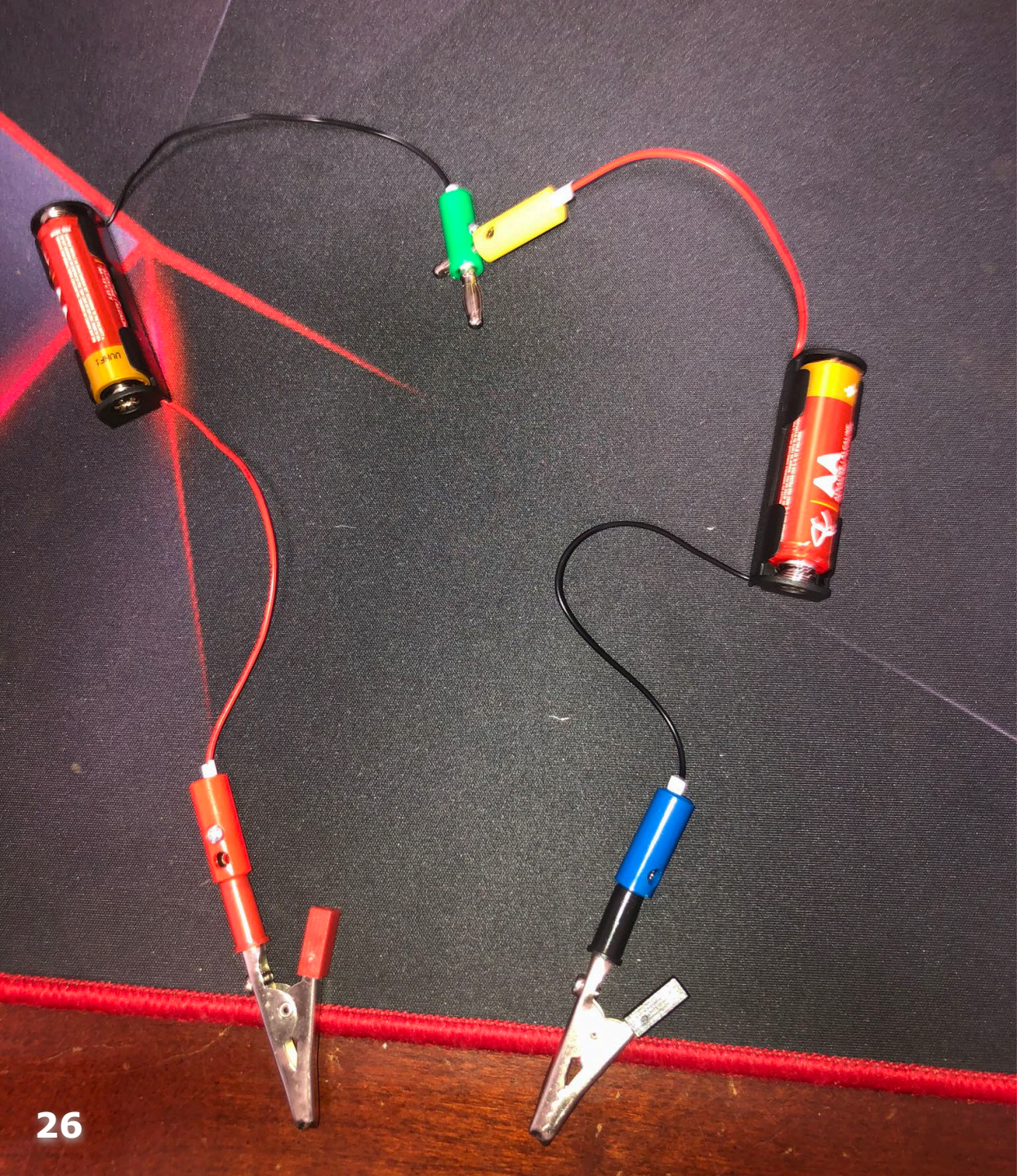
3. Loosen screw on banana plug and insert wire. Make sure it is push in, so the wire is in contact with the banana plug.

How to Use Banana Plugs and Alligator Clips

4. Tighten the screw on the banana plug. Make sure the wire is properly secured. Repeat for other wires.

How to Use Banana Plugs and Alligator Clips

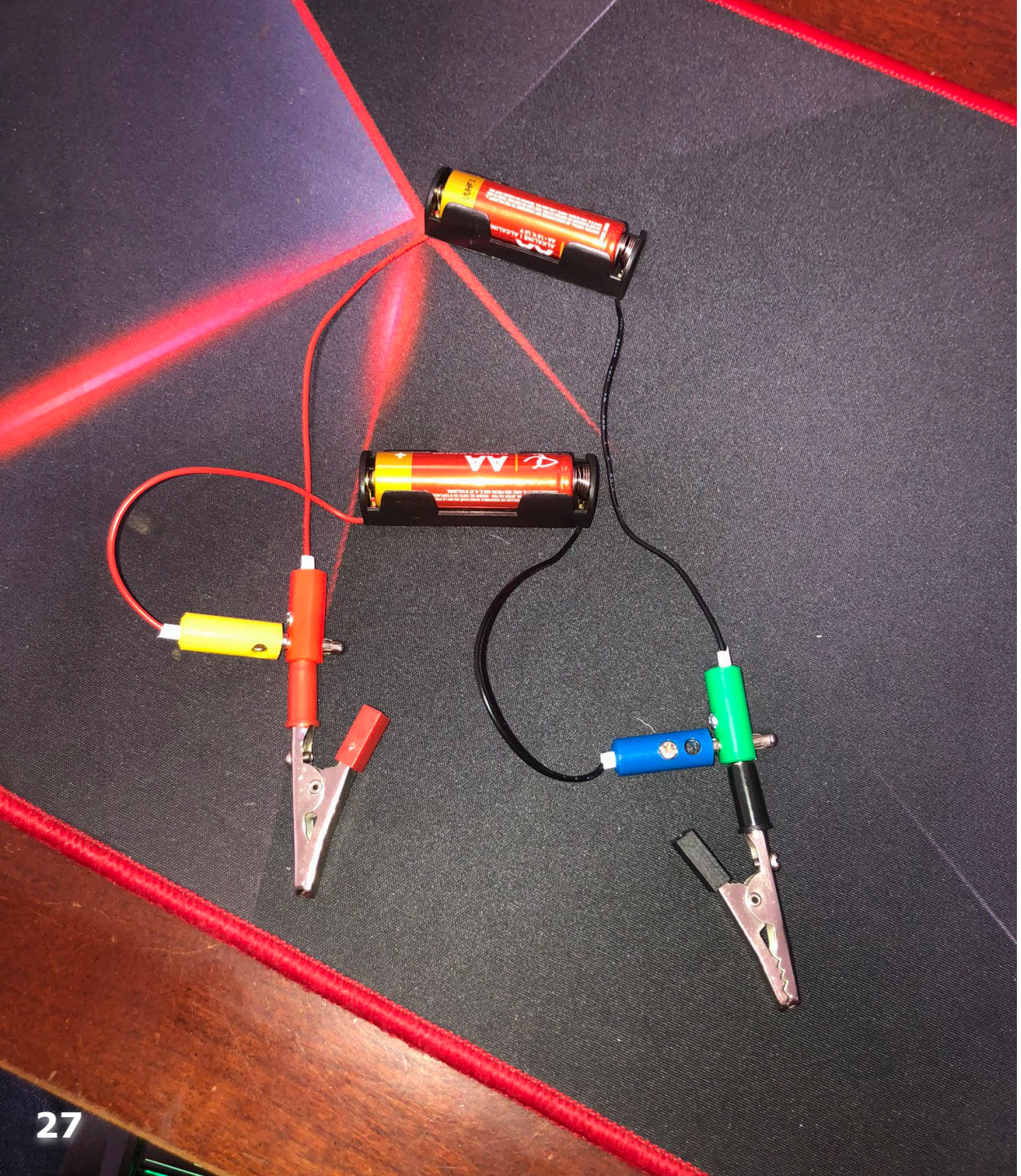
5. To connect an alligator clip, push the end of the banana plug into the hole on the end of the alligator clip.



How to Wire in Series

Connect batteries using banana plugs from positive to negative.

Then connect alligator clips at the ends of each battery.



How to Wire in Parallel

Connect the positive side of the first battery to the positive side of the other battery.

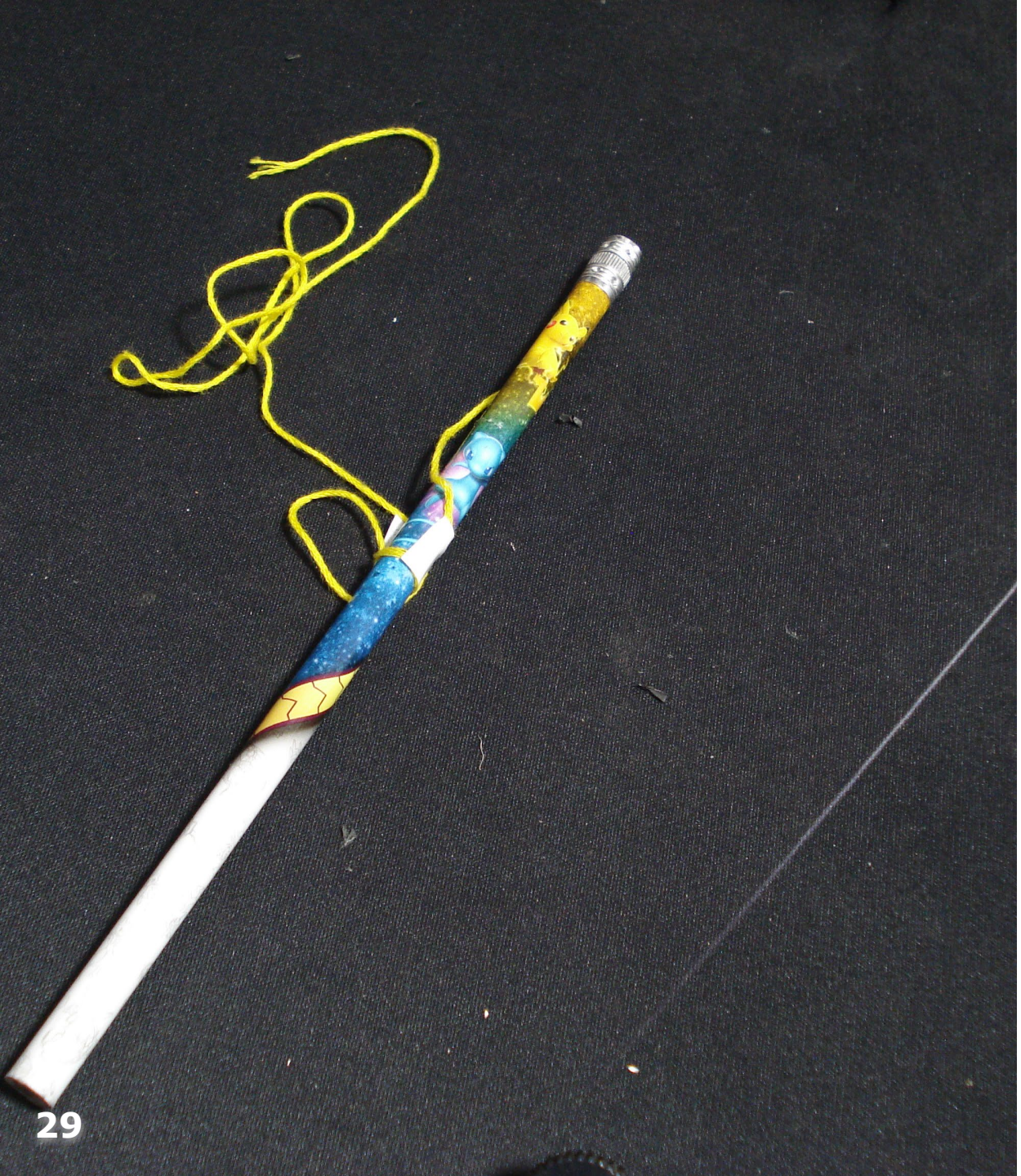
Connect the negative side of the first battery to the negative side of the other battery.

Connect alligator clips to the ends of the second battery.

Experiments and Activities

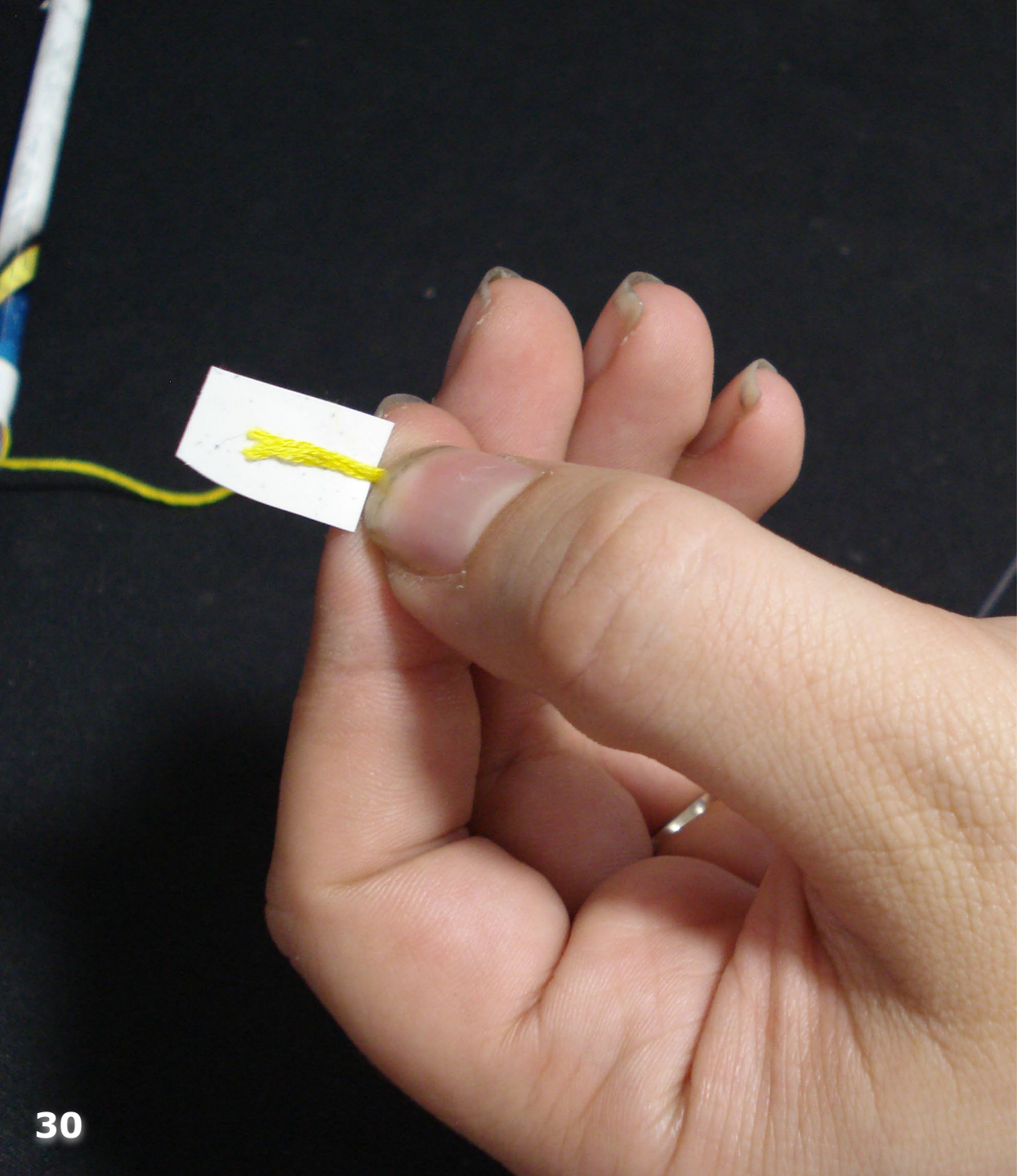
Challenge: With 4 batteries, use your motor to lift a pencil attached by a string.

What configuration (series/parallel) of 4 AA batteries connected will raise the pencil?



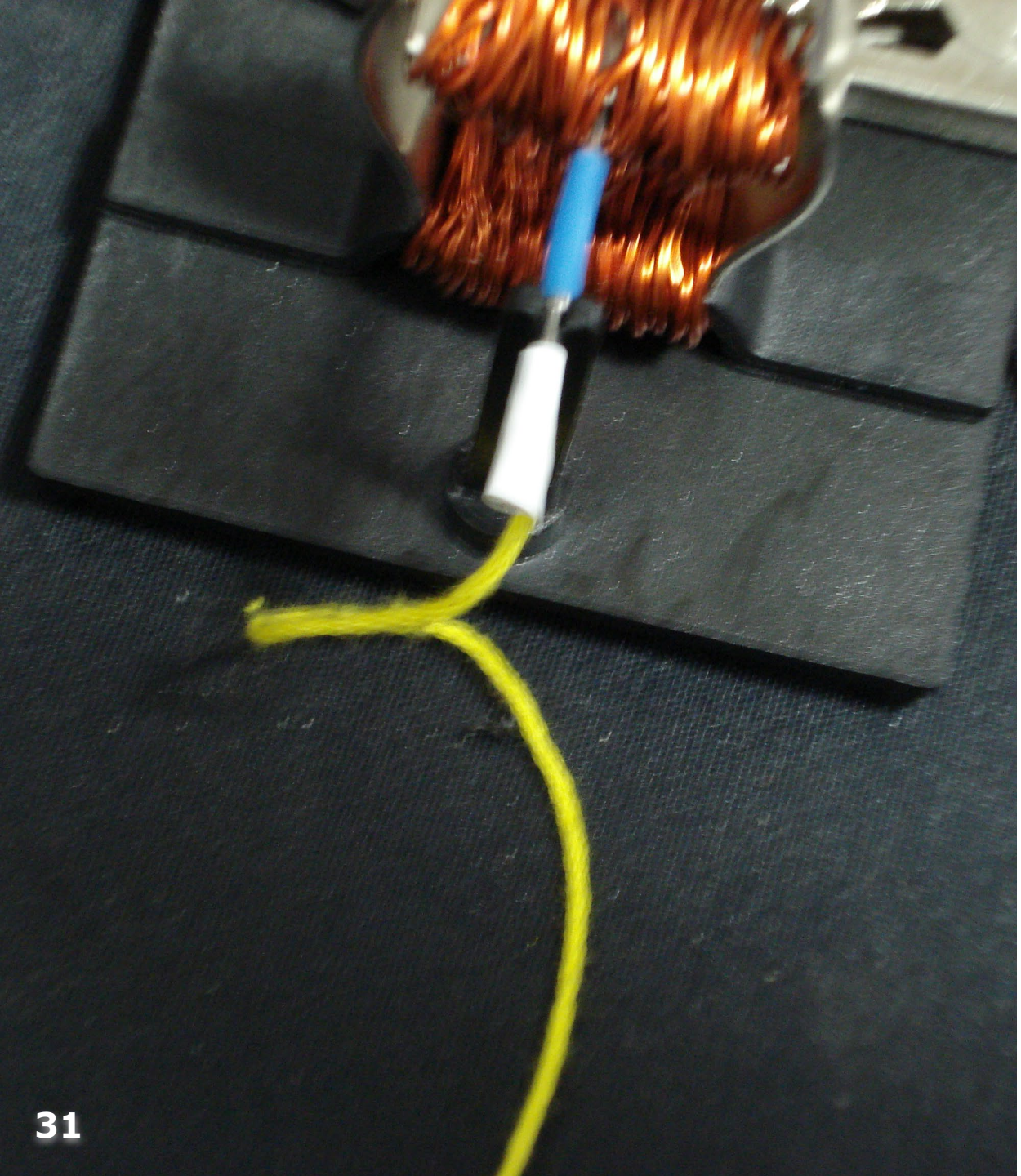
How to Attach Pencil with String to Motor Shaft

Tape a 10” piece of string to a pencil.



How to Attach Pencil with String to Motor Shaft

Put a small piece of tape on the other end of the string.



How to Attach Pencil with String to Motor Shaft

Wrap the piece of tape with the end of the string on the end of the shaft.

Allow the pencil to hang free. Start motor with your combination of series/parallel to see if you wired it correctly.

Thank you for building this kit

If you have any questions, please contact me at alice.rende@mohawkcollege.ca

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RBC is supporting all of Mohawk College's Women in Technology and Trades initiatives as part of their Future Launch Program

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https://www.mohawkcollege.ca/women-technology-and-trades