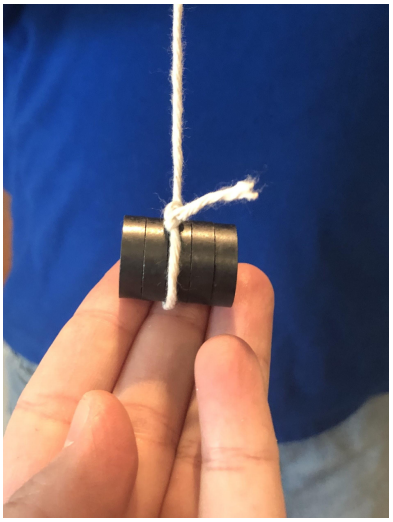
Lesson 3 Lab: Additional tips and notes to make it successful

In lesson 3, students investigate a coil of wire three times. First, they play around on their own to see if they notice pushes and pulls between the coil and a magnet. They shouldn't because the wire is not connected to an electrical source. Then, they use **Investigation: Magnet and coil of wire *(*Lesson 3: Handout 1)** to take data more systematically about the pushes and pulls with the magnet. Finally, they use **Investigation: Materials that interact with the coil (Lesson 3: Handout 2)** to test for pushes and pulls between the coil and other objects, such as paper clips, coins, and nails. For the first two investigations, students are encouraged to develop their own procedures for observing pushes and pulls:

"Allow students to develop their own procedure for observing the movement of the coil, such as pushing it around on the table and observing the distance it travels, or suspending it from the tip of a pencil and making it swing back and forth."

If students are struggling with this, suggest hanging the magnet and/or the coil from a thread to minimize the effect of friction, and to remove the effect of a wobbly hand. This will make the subtle movements of the coil and/or the magnet more clear. If there is not thread available, students can hang the coil and/or the magnet from a pencil, and tape the pencil to a book to reduce the contact surface.



If you have magnets without holes, tie the thread as shown in the picture to the right.

The instructions in **Investigation: Materials that interact with the coil (Lesson 3: Handout 2)** explicitly suggest that students place the objects on a table:

1. Place your copper coil on the table. Carefully attach the each end of the copper coil to each terminal of the battery with tape. **CAUTION: The coils can get hot. Disconnect the coil of wire from the battery when you are not actively testing something.**
2. Test the coil with the magnet quickly to make sure it has an electrical current running through it. Then put the magnet to the side.
3. For each test object, do the following:
    a. Place the object on the table near the coil.
    b. Move the object incrementally closer to the coil until either the coil moves toward the object, or the object moves toward the coil. Stop when they end up touching. Record your observations in the table below.
    c. If the coil and object moved closer to one another, then touch the coil to the object and slowly lift up the coil. Record your results in a row in the table below and add any observations that stand out to you.

This will increase the force of friction, and make the acceleration of the object more difficult to observe. It is difficult to feel pushes and pulls between the coil and some of the objects as well, if students pick them up. The compass should work well, because the needle of the compass is low mass, which increases the acceleration of the needle (F=ma), and because it has very little friction in the opposite direction of the magnetic force. However, **the paperclip *will not move* on the table. If students are struggling to observe an effect, encourage them to rewrite the procedures to reduce friction using a pencil, or thread.**