Letter from the LET'S GO Founder and Director

LET'S GO is a non-profit, education corporation. Our mission is to enable out-of-school organizations, especially those focused on the underserved, to deliver fun, hands-on, educational STEM activities to grow the number of under-served students entering technical career pathways. Science, Technology, Engineering, Math (STEM) is a critically important emphasis in education as our country is facing a shortage of technical professionals. The technical career field represents a significant upward mobility opportunity for underserved students.

The United States is facing a silent crisis. We do not have enough students born in this country entering the STEM education pipeline. Here are some relevant figures:

- Only 4.2% of the 4 million 9th graders in our country go on to a technical college and graduate with a Bachelors of Science degree in science, engineering, or math.
- Number of engineering college graduates per year:
    - China: 600,000
    - India: 310,000
    - United States: 70,000
- 50% of the scientists practicing in the US were not born in this country

The LET'S GO team has included a section in the appendix, 'Conversations about STEM Careers'. The intent is for the instructor/coach in charge of the STEM activity to discuss careers in science, engineering, and math with their students.

I am pleased that your organization has decided to use the LET'S GO S^2E^2 program to establish or enhance your STEM program. The LET'S GO help desk and training team stand ready to support you.

Clark 'Corky' Graham, PhD

LET'S GO Founder and Director

About The Author

I am a civil engineer and former naval officer who was inspired by Dr. Bill Miller and Dr. Angela Moran at the United States Naval Academy and the late Faye Daniel, the principal of Tyler Heights Elementary School, to create the S^2E^2 program. My idea was to create a fun, hands-on science and engineering curriculum that was easily delivered by any willing individual to expose young minds to the wonders of science and engineering.

With great joy, I have voluntarily taught *Simple Science and Everyday Engineering (S^2E^2)* – in a number of Annapolis elementary and middle schools as well as the Boys and Girls Club since early 2008 and it is now my honor to share it with you. Not only will you inspire the next generation of scientists and engineers, but you will garner immeasurable happiness from the screams of delight from your students as they discover that they can be mini-engineers and scientists while having a ton of fun.

Inspire, encourage, enjoy! Be safe and let me know how it goes.

Sharon Disher
Science and Engineering Director

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Northrop Grumman

LET'S GO Boys and Girls, Inc.

Boys and Girls Clubs of Annapolis & Anne Arundel County

Y of Central Maryland

United States Naval Academy

Simple Science and Everyday Engineering – S^2E^2

S^2E^2, (pronounced “S squared E squared”), is a fun, hands-on science and engineering program designed to plant the seed to become a scientist or engineer in the minds of young students. S^2E^2 encourages independent thinking and problem-solving through the use of sequential hands-on experiments that build on one another. Students develop teamwork and problem solving skills as they assist one another and share materials.

As part of the S^2E^2 program, engineering ethics are enforced with the **S^2E^2 Oath**. Students are encouraged to present “**Engineering and Science in the News”** topics at each session reinforcing their public speaking skills and they are introduced to **ancient and modern day engineers and scientists** who serve as role models,

To further enhance your S^2E^2 program, you might consider inviting local engineers or scientists into your classroom to talk to your students about their work and how they achieved their goals. LET’S GO can assist with the coordination of a Guest Speaker series if you are interested.

S^2E^2 is comprised of 16 **hands on experiments** divided into two volumes of 8 experiments each which can be offered a semester at a time for a full year of science and engineering programming.

Class sizes of 20 students or less is recommended due to the hands-on-nature of the program.

Grades 3-5 are the target audience for S^2E^2 but it can certainly be adapted for younger or older participants. Our goal is to grow the numbers of students entering the STEM (science, technology, engineering, and math) pipeline in our country. Any educator will agree that the earlier you can plant the seed, the better.

S^2E^2 is easily adaptable for use as an after-school program, an in-school program to augment existing learning, a summer camp or individual 2 to 3 hour workshops for students or teachers.

At the end of the S^2E^2 program, we ask instructors to identify specific boys and girls who are proficient or have an interest in science or engineering so that we can mentor and encourage them to pursue these fields as they progress through the school system. See your program manager for more details.

13-Electromagnets

Today’s Topic: To learn how an electric current produces a magnetic field by building an electromagnet.

Recommend this experiment be performed in teams of two.

Teacher Summary:

- Students will find out what an electromagnet is and how they work.
- Students will learn that an electric current produces a magnetic field.

Student Objectives:

- Students will build an electromagnet to learn that an electric current produces a magnetic field.
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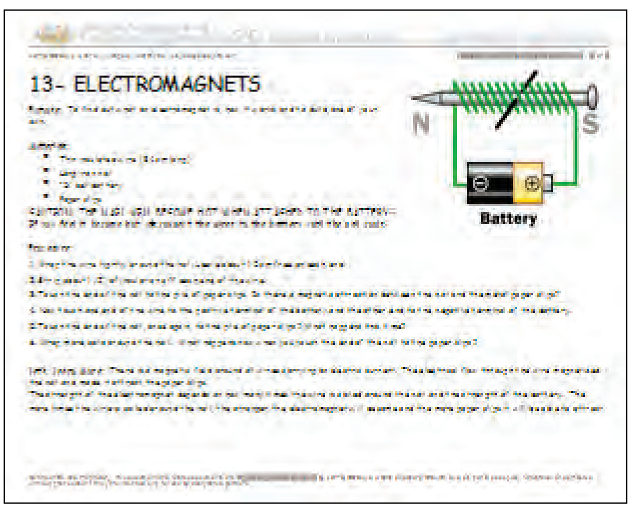
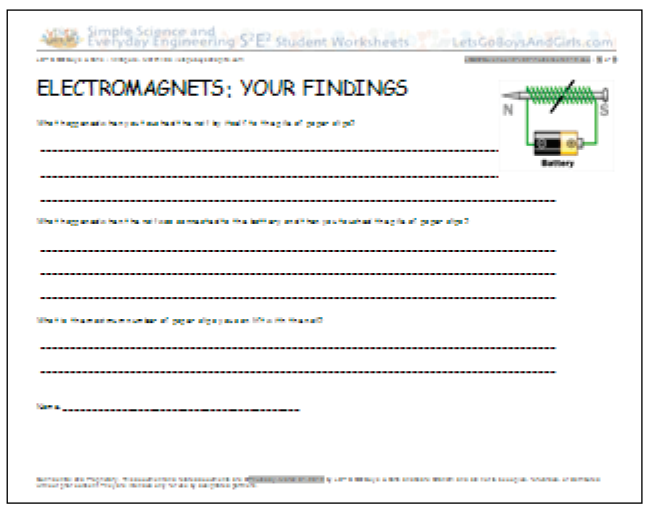
- Have fun!

Materials: (per 20 students)

- 10 pieces of thin insulated wire (84 cm or 1 yard long)
- 10 long iron nails (about size 16d – 16 penny or 3.5” long)
- 10 “D” cell batteries
- 400 metal paper clips
- 5 rolls of electrical tape
- 10 pairs of scissors
- 20 Student Worksheets





Room Setup

- Cut the wire into 1 yard pieces
- Place all materials on the front table

Opening

- Take attendance
- Hand out Student Binders
- Choose a student to lead the S^2E^2 Oath

- Have students present “Engineering and Science in the News” topics
- Brief review of last class topic
- Hand out Student Worksheets for this experiment

Introduce the Experiment

Terms to Tackle

Electromagnet – there is a magnetic field around any wire carrying electric current. If this wire is wrapped around an iron bar (or object like an iron nail), that bar will become an electromagnet that has magnetic properties.

Teacher Explanations:

1. Explain that there is a magnetic field around all wires carrying an electric current. Straight wires have a weaker magnetic field than a coil of wires. The stronger the electrical current, the stronger the magnetic field.
2. Encourage students to wrap a few coils of wire around the nail and then increase the number of coils and see what happens. (answer: the more coils, the stronger the iron nail magnet becomes so it will pick up more paper clips.)
3. Most electromagnets use soft iron for the core so that it loses its magnetism right away when the electricity is switched off. In this experiment, we are using a hard iron nail so there may be some residual magnetism once the battery is disconnected. See if that happens for you.
4. **Warn students to be cautious because the iron nail will become hot!! They should disconnect the battery when they feel the nail becoming warm.**
5. Perform the experiment.

Perform the Experiment

Have each student:

1. Wrap the wire tightly around the nail. Leave about 10 cm (4 inches) free on each end.
2. Strip about ½” of insulation off each end of the wire using scissors.
3. Touch the end of the nail to the pile of paper clips. Is there a magnetic attraction between the nail and the metal paper clips? (There will be none.)
4. Now tape one end of the wire to the positive terminal of the battery and tape the other end to the negative terminal of the battery. **DO NOT LEAVE THE ENDS TAPED FOR LONG AS THEY WILL GET HOT!**
5. Quickly, touch the end of the nail, once again, to the pile of paper clips? What happens this time? (The paper clips will be attracted to the nail.)
6. Have the students see how many paper clips they can lift with the nail.
7. Next have the students unwrap four or five coils of wire from the nail. Have them see how many paper clips they can pick up now. It should be less than before.
8. Have students wrap more wire around the nail than they did initially and see how many paper clips they can pick up. They should be able to pick up more and more paper clips the more wrappings or coils of wire are around the nail.