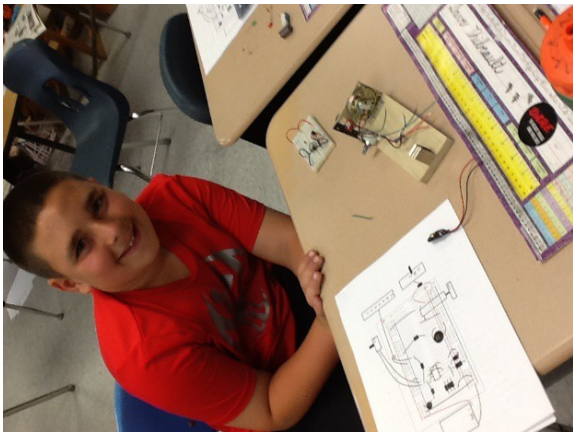


End of year STEM activity at Hudson's Nottingham West Elementary School

Hudson's Nottingham West Students in Mrs Ditolla and Mr Crivac's 5th grade classes participated in an end of year STEM activity on June 12th and 16th respectively. Each student assembled and tested an audio tone generator and then paired up to send and receive a Morse code message to each other. This project expands upon IEEE's Pre-U "Electric Messages: Then and Now" activity, <http://tryengineering.org/sites/default/files/lessons/electricmessages.pdf> by adding an audio tone to compliment the visual LED signal. The tone generator uses a 555 timer IC to generate a variable frequency signal that is tunable over the audial range.



Students quickly grasp the assembly process

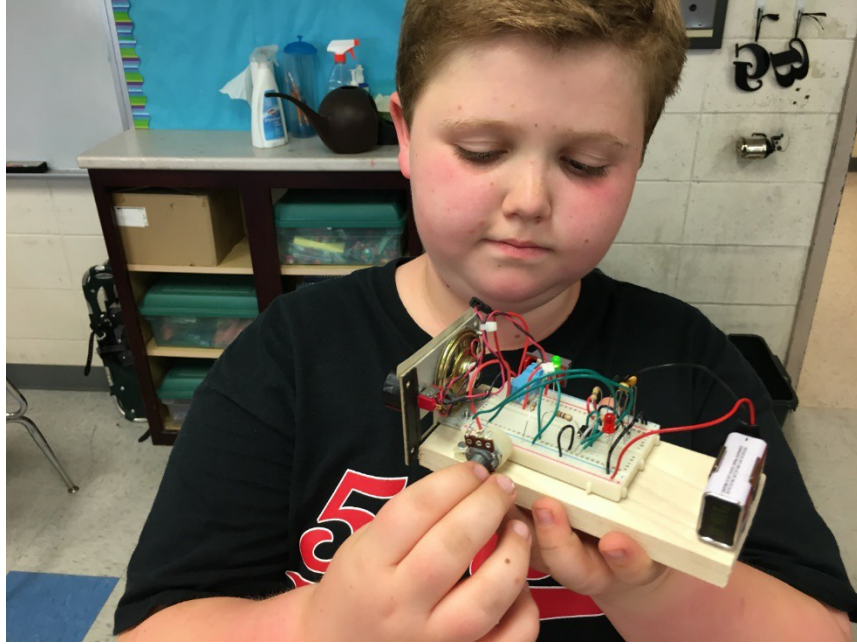
Each student receives a kit that contains leaded components, solderless breadboard circuit, mounting frame and assembly instruction sheet. Fifth grade students have the dexterity necessary to insert the small component leads into the solderless breadboard. They have covered X-Y graphs in their course work and are familiar with locating points on a graph. It helps that most are also familiar with the breadboard game Battleship which uses a grid to locate ships. The assembly process follows displayed diagrams that locate the mounting holes on the solderless breadboard circuit for each component.

The time required to step through assembling the two dozen or so components (including jumper wires) is about 90 minutes. Considerable time is taken up with the first couple of components to insure everyone understands and is comfortable with the assembly process. Additional time is also spent on introducing the resistor value color scheme and the use of exponents in identifying capacitor values. Fifth grade students are already familiar with exponents and caught on quickly.



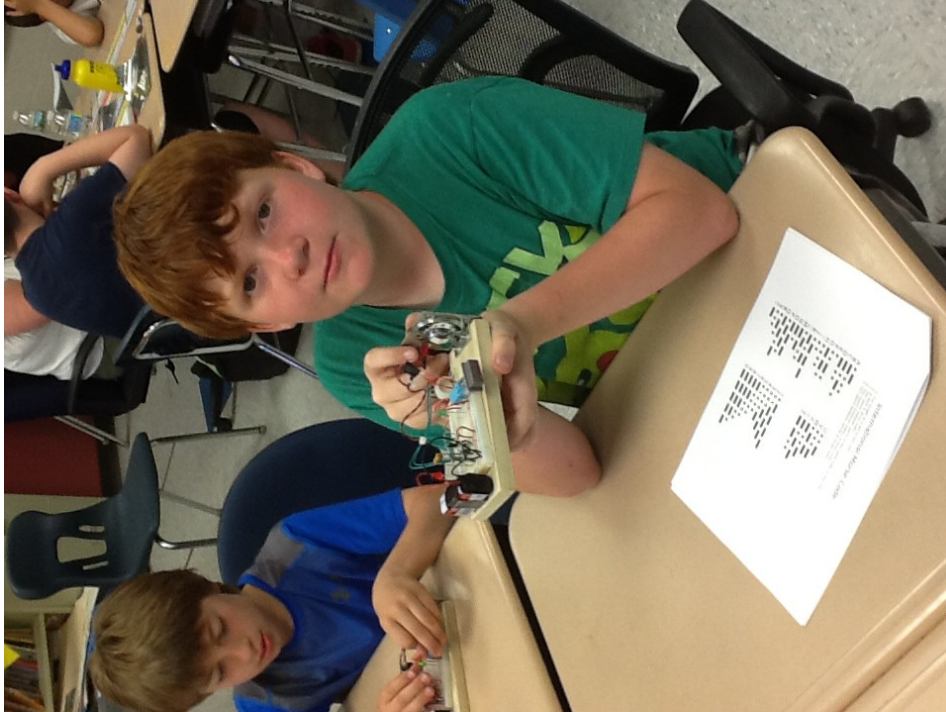
Students eagerly help class mates debug their circuits

Once completed, the breadboard circuits are temporarily mounted on the frame to attach the final few components and begin testing. Soon a cacophony of sound fills the classroom. First pass success is in the 60% to 70% range. Most of the issues can be attributed to miswiring such as a reverse biased LED or misplaced component leads. Emphasized is placed on explaining that debugging is a natural engineering process encountered in projects and a good learning experience. Students with working circuits were assigned to students with nonworking circuits to help with the debugging process. It was very rewarding and encouraging to see how eager the students were to help classmates get their circuits up and working.



Experimenting with the audio tone

When fully working, the breadboard back side adhesive tape is removed to firmly attach the circuit to the frame. At this point a bit of math was introduced with a short discussion on the equation relating the frequency to component values. Varying the potentiometer and parallel capacitor bank provided feedback to demonstrate this relationship.



Sending a Morse Code message

The students were paired up to send and receive a Morse Code message from each other. The circuit allows both audio and visual transmission. Most chose the traditional audio method. It was suggested to select a state name for the message, and short to keep it simple.

Many thanks and much appreciation are extended to Mrs. Ditolla and Mr. Crivac for permitting 2+ hours of classroom time for this activity. This additional time beyond a normal period allows all students to complete the debugging process and take a working unit home with them at the end of the day.