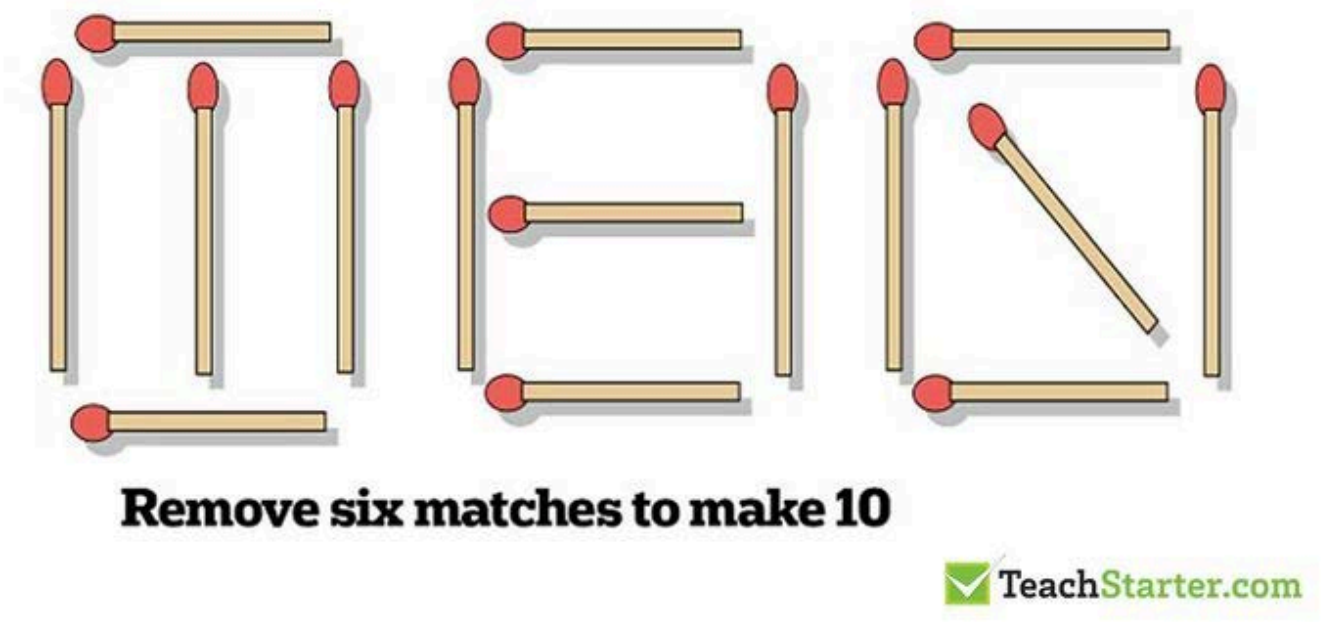
Tech Club
Class 4: Tech Level-Up

VOCABULARY:

- **Buzzer:** An electronic component that makes a buzzing sound.
- **Capacitor:** Device used to store an electrical charge.
- **Fractal:** A never ending pattern that repeats itself at different scales.
- **Photoresistor:** A resistor whose resistance depends on the amount of light shining on it.
- **Tetrahedron:** A pyramid with 4 triangular faces.
- **Transistor:** An electronic component that acts as a switch or amplifier.



BREADBOARDS STRIKE BACK

BACKGROUND:

Today you will continue to work on building breadboard circuits. There are many new components to add today, button switches, buzzers, photoresistors, capacitors, and transistors. Each component allows you to do something different with your circuits, from turning an LED on with the push of a button to changing how bright an LED is depending on the light in the room.

ENGINEER SPOTLIGHT:
Diana Iracheta, Engineer

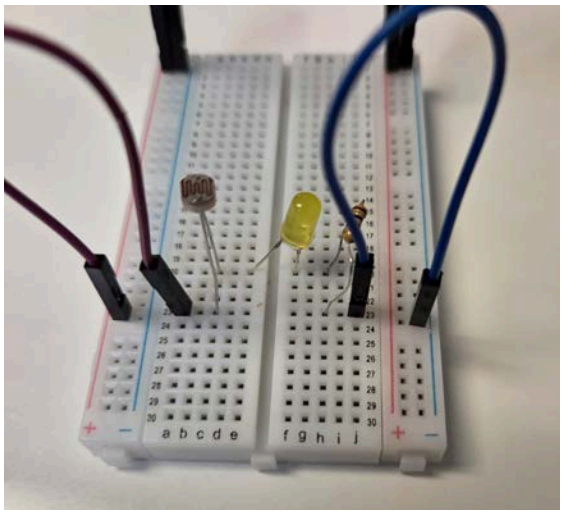
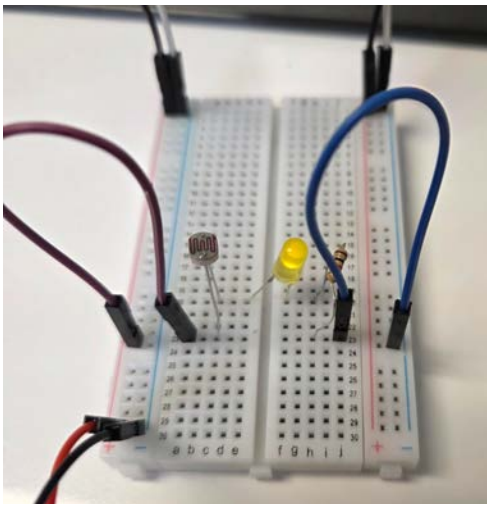
Diana Iracheta is a Latina engineer focused on increasing the number of Latinas in engineering. Ms. Iracheta immigrated to the United States from Mexico when she was 12 and is the first person in her family to attend college in the US. She currently works on product design and career support for young Latina students and professionals. Let's be engineers like Ms. Iracheta and continue working on our breadboards.

STEPS:

1. Your Class Leader will return your **breadboards** to you. Remove the components from the box and place them on your desk or table.
2. Look at the **Breadboard Diagrams, Class 4 packet**. The diagrams are the same style as last week but with new circuits to build.
3. Your breadboards should still be set up with the parallel circuit from last week. Remove the LED plugged into E23 and F23.
4. Remove the resistor plugged into C23 and C20.

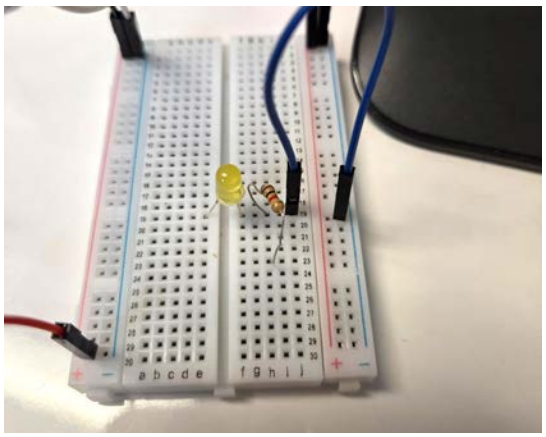
5. Look at the **photoresistor**. Hypothesize about what this resistor will do in a circuit. Write your hypothesis here.

6. Insert the legs of the photoresistor into C23 and C20, then reconnect the battery pack.

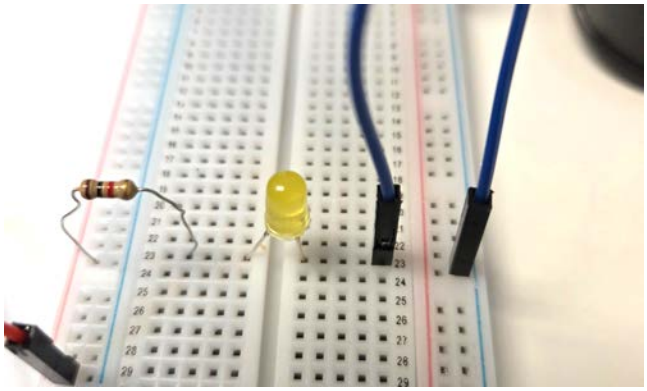



7. Cover the photoresistor with a finger - what happens?

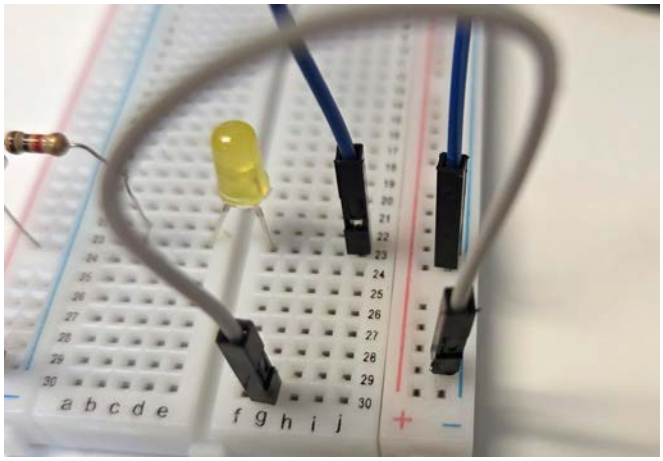
8. Now you are going to try adding a button switch to the circuit. This switch will turn the circuit on only while the button is pressed down.
9. Unplug the negative battery wire. Remove the photoresistor and the jumper wire plugged into the positive rail and A23.



10. Take the resistor out of H23 and H20. Insert the resistor's legs into the positive rail and A20.

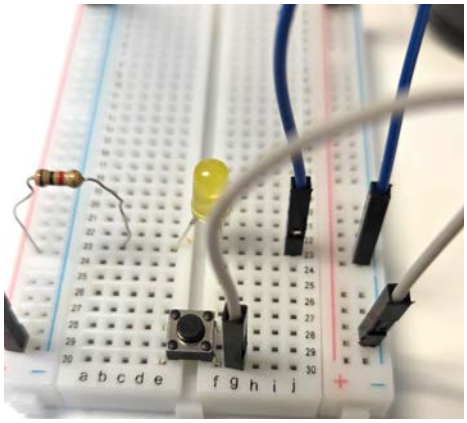


11. Connect the jumper wire that was just removed to the negative rail and G30.

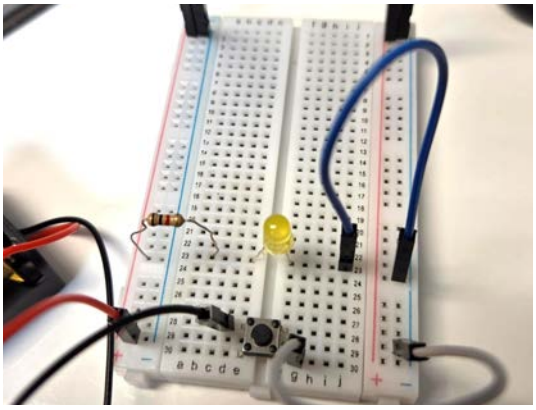


12. You will receive a button switch. Look at the switch closely. It has 4 legs that are connected into sets of 2. Notice that two sides of the switch have the legs protruding from them and the other two sides do not.

13. Plug the switch into the board so that the leg sides are facing to the right and left of the board, legs plugged into E30, E28, F30, F28.

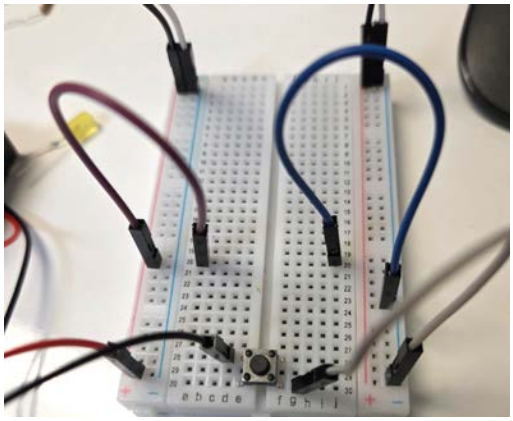


14. Connect the negative (black) wire of the battery holder to D28. The LED should not light up.

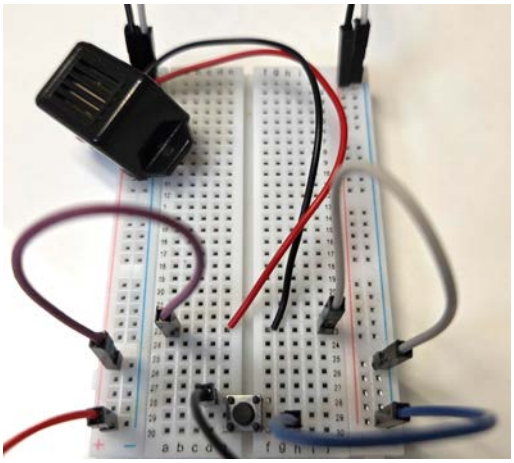


15. Press the button - does the LED light up?

16. You can change what the switch controls - replace the resistor with a jumper wire.

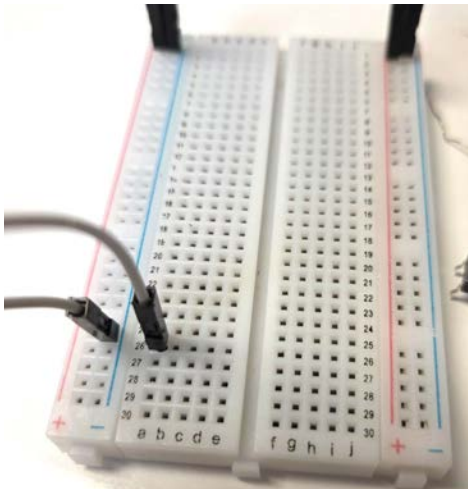


17. Remove the LED and plug the red positive wire of the buzzer into E20, the black negative wire into F20. The buzzer has polarity just like the LED and battery holder.

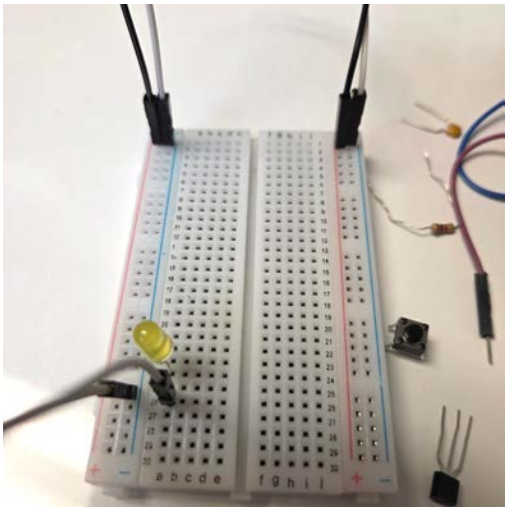
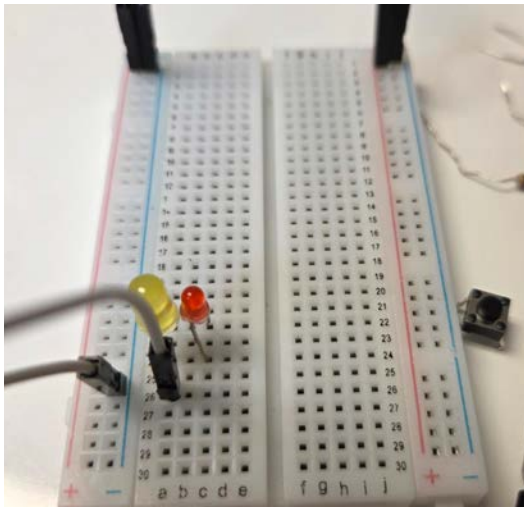


18. If you want to connect 2 LEDs to the switch you will need a transistor. The transistor can amplify the circuit, giving enough power to light up both bulbs.
19. Remove all components from the breadboard except the wires that connect both sides together.

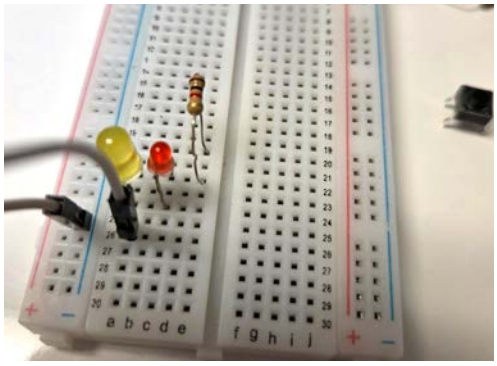
20. Connect one jumper wire from the negative rail to A26.



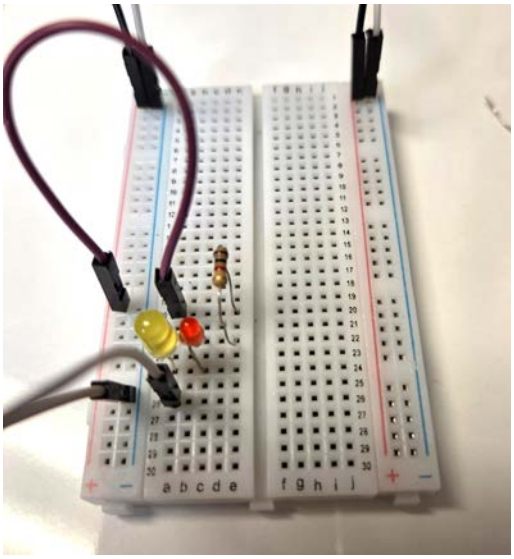
21. Plug one LED into the breadboard with the positive leg in A22, negative leg in A24. Plug a second LED into the breadboard, positive leg into C22, negative leg in C24.

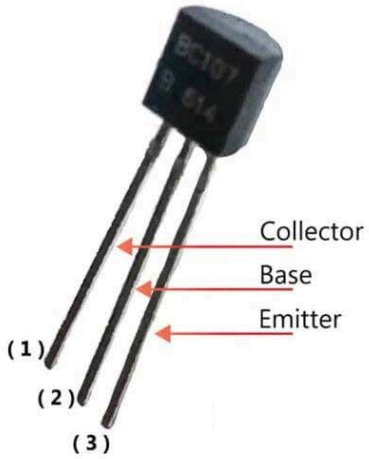
22. Insert a resistor into E22 and E20.



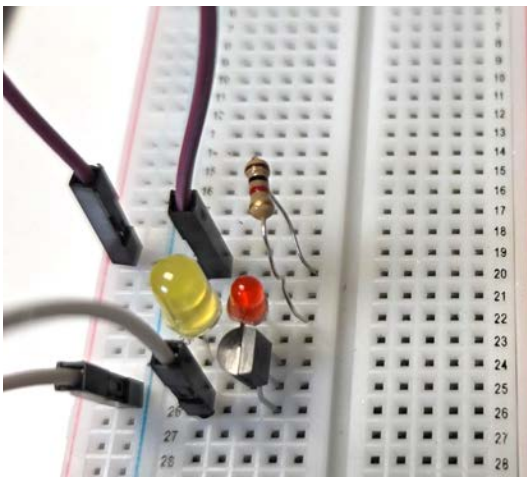
23. Connect a jumper wire from A20 to the positive rail.



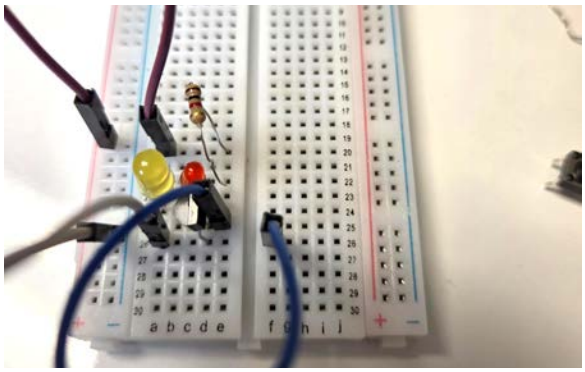
24. You will be given **a transistor**. The transistor has a flat face and a rounded back, along with 3 pins or legs. When looking at the flat face, the leg on the left side collects the charge and is called the collector. The pin on the right is the emitter, which releases the charge. The middle pin is the base, which controls the amount of charge being sent by the emitter.



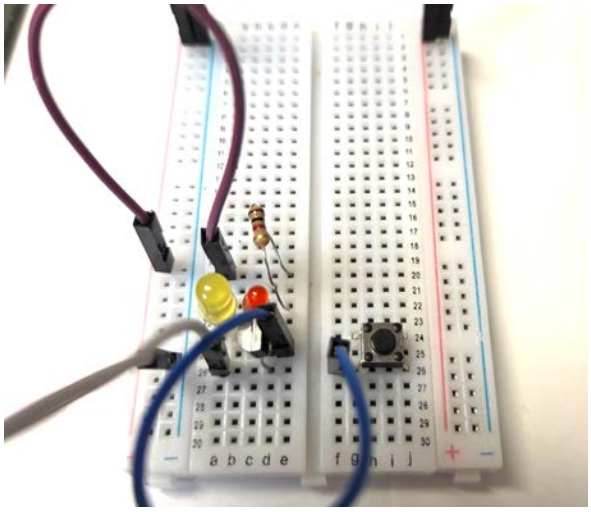
25. Place the transistor in the breadboard with the collector (left) leg in D26, the base pin in D25, and the emitter pin in D24.



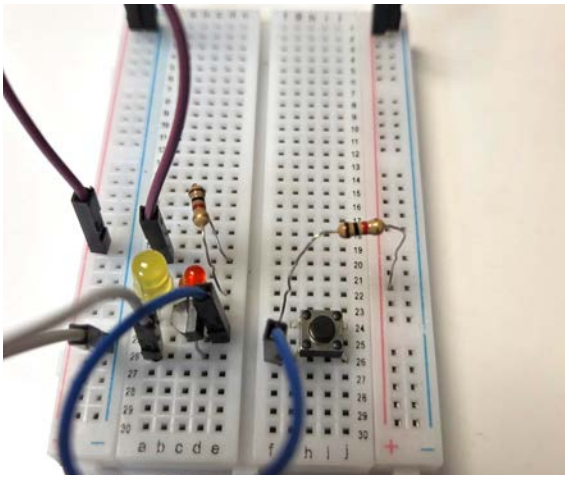
26. Insert a jumper wire in E25 and F26.



27. Place the button switch with its legs in G 26, G24, J26, and J24.



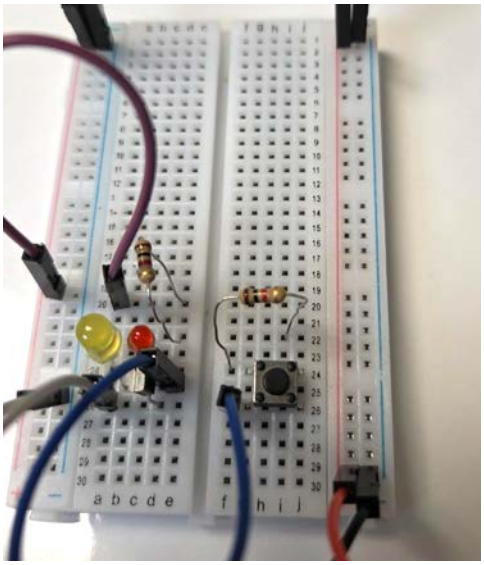
28. Insert a resistor into F24 and the positive rail on the right side of the breadboard. You may need to stretch the legs apart some.



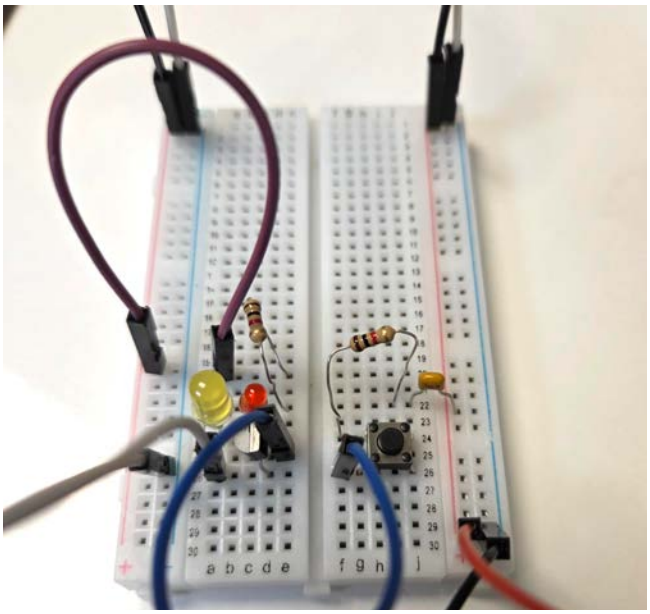
29. Reconnect the battery holder and press the button. Do the LEDs light up?

30. There is one more component to try, and that is the capacitor. Capacitors store electrical charge when connected to a circuit. The ones you have in class are very small, but you can see one take the charge from the circuit by watching the LED.

31. Move the resistor from F24 and the positive rail to F24 and I22.



32. You will receive **a capacitor**. Place the capacitor on the breadboard in J22 and the positive rail.



33. Remove one of the LEDs.
34. Making sure to watch the LED, press the button. The LED should blink once quickly, then turn off. The capacitor is now charged.
35. When finished, store your breadboard in your box. Don't forget to unplug the battery holder!

FUN WITH FRACTALS

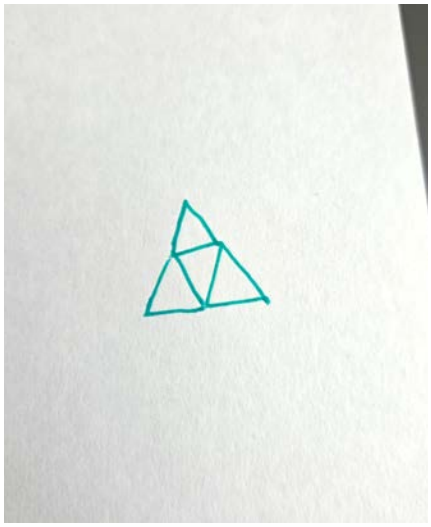
BACKGROUND:

The Sierpinski triangle is a fractal, which is defined as a complex geometric pattern that is infinitely self similar. It was named after Polish mathematician Wacław Sierpiński, though the shape has appeared in architecture and designs far before he ever defined it. Fractals can be constructed in many ways, from logic gate tables, to Pascal's triangle, or constructed out of a curve. In this lesson you will teach the engineers how to make one in a simple way, introducing the concept of the Sierpinski triangle.

STEPS:

1. Many patterns in nature are fractals. Fractals are patterns that repeat over and over, until the pattern is so small you can't see it. There is a famous fractal called the Sierpinski triangle that divides a triangle into smaller and smaller triangles.
2. There are two ways to draw a Sierpinski triangle. The first is to add triangles in a specific pattern.
3. Start by drawing one small triangle on your paper.

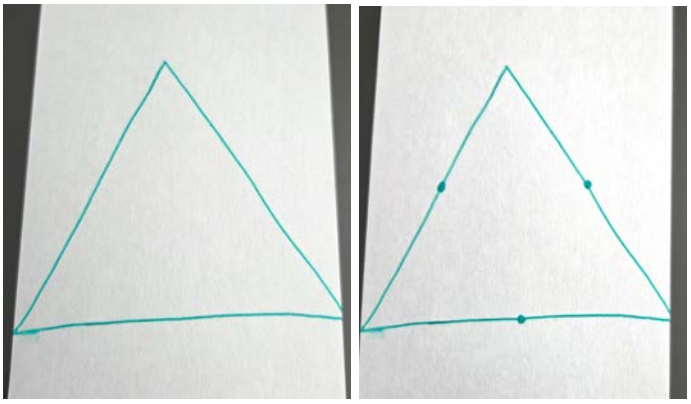
4. Next, draw two more triangles of the same size and direction underneath the first triangle, their top corners touching the bottom corners of the first triangle, with the corners that are facing each other touching.



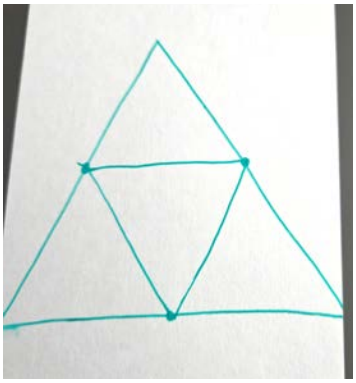
5. How many triangles do you have now?
6. Can you see that there is now a bigger triangle, one with a triangle pointing down cut out of the middle? Put two of the big triangles underneath the new big one, with the same triangle pointing down in those

7. This is the basic pattern of a Sierpinski Triangle, which contains a version of itself within itself. Repeat the process of making the triangle bigger and bigger with this method. Can you fill the page?
8. There is a different method of drawing a Sierpinski triangle that works by dividing a large triangle into smaller ones.

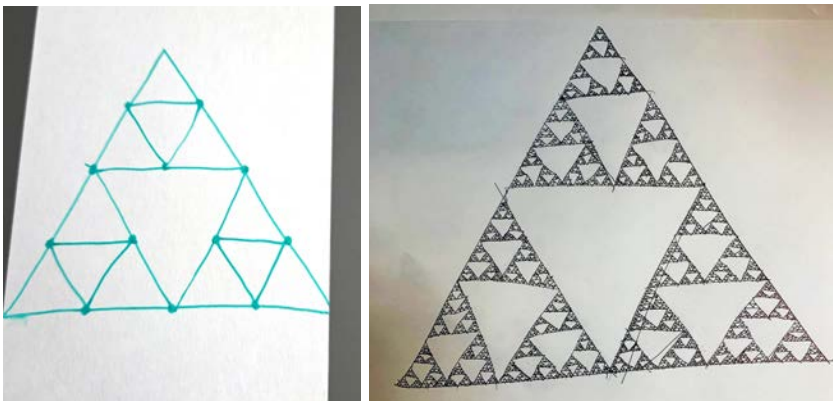
9. Draw a large triangle with about equal sides with one corner pointing up that fills up the page. Find the approximate middle of one side and put a dot there, then repeat on the other sides.



10. Connect the points with straight lines. You have just "cut" that middle triangle with one corner pointing down out of the big triangle with one corner pointing up, and now there are four triangles pointing up, one big one, and three smaller ones.



11. Now find the middle of the sides of the three smaller triangles and connect them like they did the big one. Don't divide the triangles with one point down - those always stay empty, no matter the size. Keep dividing the triangles until they are too small to continue.



BUILDING SIERPINSKI TETRAHEDRA

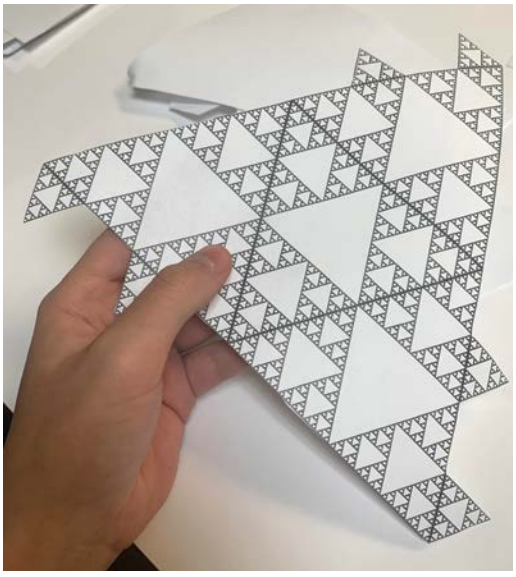
BACKGROUND:

Now that you know what a Sierpinski triangle is, you can explore the Sierpinski tetrahedron. The Sierpinski tetrahedron is a three-dimensional version of the Sierpinski triangle, made out of a bunch of tetrahedra instead of triangles. Just like the triangles, the tetrahedra can be continuously added together to make a never-ending fractal.

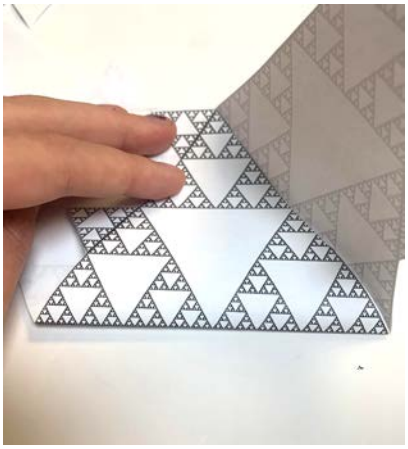
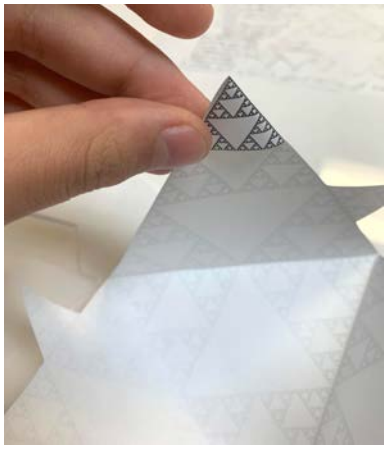
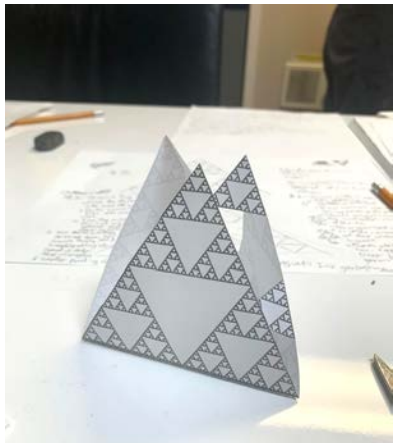
STEPS:

1. Make a hypothesis- is it possible to make a 3D Sierpinski triangle?

2. You will receive **scissors and four Sierpinski tetrahedra**.
3. Cut out the shape, then fold along the edges of each large triangle with the design on the outside. Make sure not to cut off the tiny triangles on the edges, they're needed to keep the shape together!

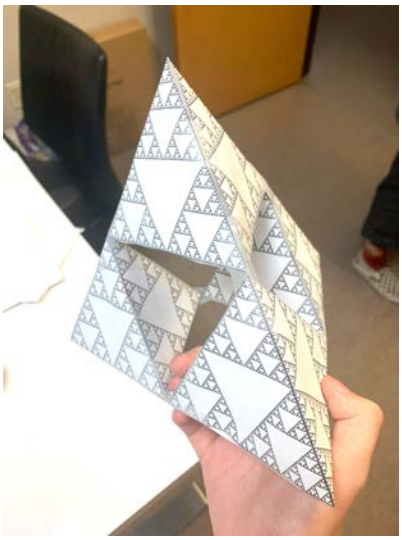


4. Form the tetrahedron, a 3D shape composed of 4 triangles, by using crisp folds to hold it in place. If needed, add tape.

5. Cut out and assemble the other 3 tetrahedra.

6. Use tape to create a larger tetrahedron out of the 4 smaller ones.

7. How many tetrahedra can you combine?

FOR FUN! Solve the sudoku - your goal is to have the numbers 1 through 9 in every column, in every row, and in every smaller box of nine (outlined by the bolder lines) without any duplicates.