

# Supporting Material for “Flash Rocks from Green Chemistry and LEGO Brick Perspectives”

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## **Instructions for building six-atom LEGO piezoelectric structure model**

### **Supplies needed**

- 6 blue 1 peg x 6 peg bricks
- 9 red 2 peg x 2 peg bricks
- 12 red 2 peg x 2 peg bricks
- 9 white 2 peg x 2 peg bricks
- 12 white 2 peg x 2 peg bricks
- 3 small red rubber bands (all same size)
- 3 small yellow or white rubber bands (all same size)
- 2 water bottle caps
- permanent markers

### **Assembly (please refer to Figure A below for additional details)**

1. Assemble the bottom part of a LEGO brick cluster representing an atom. Place two white 2 peg x 4 peg bricks side by side to form a 4 peg x 4 peg platform and place this over a white 2 peg x 2 peg brick. Add another white 2 peg x 2 peg brick to the center top of this platform.
2. Assemble the top part of a LEGO brick cluster representing an atom. Place two white 2 peg x 4 peg bricks side by side to form a 4 peg x 4 peg platform and add another white 2 peg x 2 peg brick to the top of this platform.
3. Repeat Steps 1-2 two more times with white bricks and three times with red bricks. At this point there should be three white tops, three white bottoms, three red tops, and three red bottoms.
4. Arrange the cluster bottoms in a hexagon in an alternating white and red pattern. A straight edge of each of the cluster bottoms should be facing the center of the hexagon.

5. Choose one of the four corners of a white cluster bottom closest to the middle of the hexagon and attach one end of a blue 1 peg x 6 peg brick on top of that corner. Attach the other end of the brick to a corner of a red cluster bottom.
6. Repeat Step 5 for an additional five times until all of the cluster bottoms are connected in a hexagon shape.
7. Place the cluster tops on the cluster bottoms, making sure to match colors.
8. Punch three small holes in the top of a water bottle cap, near the edge of the cap and equidistant from each other. Push a yellow or white rubber band through each small hole and loop it through itself.
9. Repeat Step 8 for a second water bottle cap, using three red rubber bands.
10. Loop the ends of the white or yellow rubber bands around the 2 peg x 2 peg bricks at the top of the white brick clusters. Try to adjust the tightness of the rubber bands so that the bottle cap is equidistant from the white brick clusters.
11. Loop the ends of the red rubber bands around the 2 peg x 2 peg bricks at the bottom of the red brick clusters. Try to adjust the tightness of the rubber bands so that the bottle cap is equidistant from the red brick clusters.
12. Use permanent markers to color one of the bottle caps differently than the other (e.g., red). Draw a “-” sign on the white atom clusters and the corresponding bottle cap. Draw a “+” sign on the red atom clusters and the corresponding bottle cap.

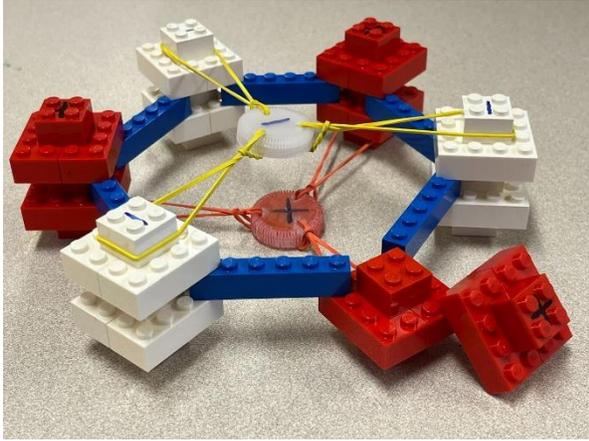


Figure A. Hexagonal LEGO brick model of piezoelectric structure. One of the red atom brick cluster tops is removed from its corresponding cluster bottom to reveal how the bricks are connected together.

### **Instructions for building four-atom LEGO non-piezoelectric structure model**

#### **Supplies needed**

- 4 blue 1 peg x 6 peg bricks
- 6 red 2 peg x 2 peg bricks
- 8 red 2 peg x 2 peg bricks
- 6 white 2 peg x 2 peg bricks
- 8 white 2 peg x 2 peg bricks
- 2 small red rubber bands (all same size)
- 2 small yellow or white rubber bands (all same size)
- 2 water bottle caps
- permanent markers

#### **Assembly**

1. Assemble the bottom part of a LEGO brick cluster representing an atom. Place two white 2 peg x 4 peg bricks side by side to form a 4 peg x 4 peg platform and place this over a white 2 peg x 2 peg brick. Add another white 2 peg x 2 peg brick to the center top of this platform.
2. Assemble the top part of a LEGO brick cluster representing an atom. Place two white 2 peg x 4 peg bricks side by side to form a 4 peg x 4 peg platform and add another white 2 peg x 2 peg brick to the top of this platform.

3. Repeat Steps 1-2 one more time with white bricks and two times with red bricks. At this point there should be two white tops, two white bottoms, two red tops, and two red bottoms.
4. Arrange the cluster bottoms in a square in an alternating white and red pattern. A straight edge of each of the cluster bottoms should be facing the center of the square.
5. Choose one of the four corners of a white cluster bottom closest to the middle of the square and attach one end of a blue 1 peg x 6 peg brick on top of that corner. Attach the other end of the brick to a corner of a red cluster bottom.
6. Repeat Step 5 for an additional three times until all of the cluster bottoms are connected in a square shape.
7. Place the cluster tops on the cluster bottoms, making sure to match colors.
8. Punch two small holes in the top of a water bottle cap, near the edge of the cap and equidistant from each other. Push a yellow or white rubber band through each small hole and loop it through itself.
9. Repeat Step 8 for a second water bottle cap, using two red rubber bands.
10. Loop the ends of the white or yellow rubber bands around the 2 peg x 2 peg bricks at the top of the white brick clusters. Try to adjust the tightness of the rubber bands so that the bottle cap is equidistant from the white brick clusters.
11. Loop the ends of the red rubber bands around the 2 peg x 2 peg bricks at the bottom of the red brick clusters. Try to adjust the tightness of the rubber bands so that the bottle cap is equidistant from the red brick clusters.
12. Use permanent markers to color one of the bottle caps differently than the other (e.g., red). Draw a “-” sign on the white atom clusters and the corresponding bottle cap. Draw a “+” sign on the red atom clusters and the corresponding bottle cap.