# Simple Structures

Molecular Geometry

FLINN SCIENTIFIC CHEM FAX!

## Introduction

Use bubbles as a teaching aid to introduce molecular geometry. Simple demonstration, good clean fun!

## Concepts

- Molecular geometry
- Chemical structures

## Materials

Dishwashing detergent, liquid, Dawn® or Joy®, 100 mL

Glycerin, 50 mL

Water, distilled or deionized, 1 L

Bucket or other large container

Coffee stirrers, plastic, barrel-type, 5 inches in length, ≈ 100

Demonstration tray (optional)

Scissors

Twist ties, plastic-coated, 4 inches in length, ≈ 200

## *Safety Precautions*

*Bubbles break with a fair amount of force; keep them away from your face. The bubble solution will make the floor or pavement slippery; take care to avoid slipping. Glycerin may cause an explosion when contacting strong oxidants. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron.*

## Preparation

1. To make one liter of bubble solution, mix 100 mL of Dawn or Joy dishwashing liquid with 50 mL of glycerin in a bucket. Add to this 850 mL of distilled water. The mixture should be stirred, not shaken, otherwise excessive amounts of suds will be produced. *Note:* For larger structures up to four liters of solution may be needed in order to completely submerge the structures—it may be best to prepare the solution in a larger bucket or other large container.
2. Cut twist ties and stirrers in half.

## Procedure

**Creating a three-way junction:**

1. Place two twist ties on top of one another, fold them into a V-shape, and insert the twist ties together into one end of a coffee stirrer (see Figure 1).
2. Bend each twist tie backwards in opposite directions to form a T-shape (see Figure 2).
3. Place a third twist tie across the top of the other two twist ties, and insert the ends into two coffee stirrers (see Figures 3 and 4).

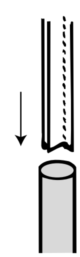

**Figure 1.**

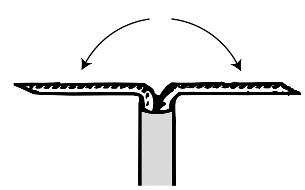

**Figure 2.**

**Creating a four-way junction:**

5. Repeat steps 1 and 2 twice to create two additional T-shaped assemblies.
6. Arrange the two T shapes on top of one another to form a cross shape

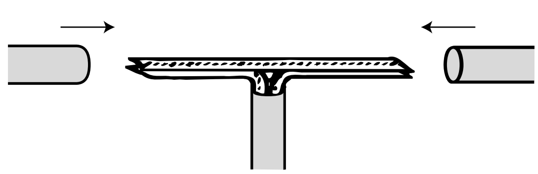

**Figure 3.**

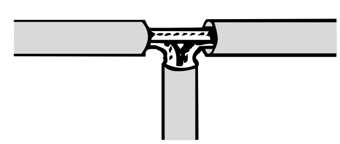

**Figure 4.**



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(see Figure 5).

7. Slide a coffee stirrer over each of the exposed twist ties to create the cross shape (see Figure 6).

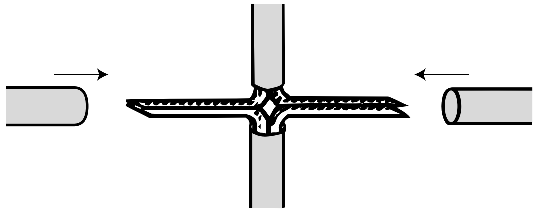


**Figure 5.**

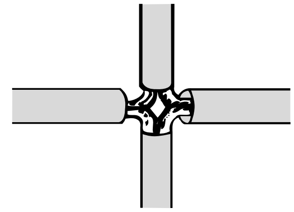


**Figure 6.**

**Creating a five-way junction:**

8. Repeat steps 1–3.
9. With a new stirrer, repeat steps 1–2.
10. Insert one twist tie into a new coffee stirrer.
11. Insert one of the twist ties from step 9 into the stirrer from step 10 to obtain the assembly shown in Figure 7.
12. Place the two exposed twist tie ends into the assembly created in step 8, creating a five-way juncture (see Figure 8).
13. Combine three-, four-, and five-way junctions as needed to build one of the model structures shown on page 3.

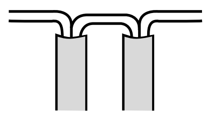


**Figure 7.**

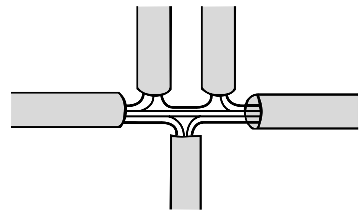


**Figure 8.**

14. Wrap an extra twist tie around one edge of the structure and then back up around itself in order to create a handle for dipping the model.
15. Submerge a model in the bucket containing the soap solution.
16. Pull the model out in one smooth motion. *Note:* It may take several "dips" in order to achieve the internal geometric soap patterns arranged as desired.

## Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. The soap solutions may be disposed of according to Flinn Suggested Disposal Method #26b.

## Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

***Unifying Concepts and Processes: Grades K–12***
Evidence, models, and explanation
Form and function
***Content Standards: Grades 5–8***
Content Standard B: Physical Science, properties and changes of properties in matter
***Content Standards: Grades 9–12***
Content Standard B: Physical Science, structure of atoms, structure and properties of matter

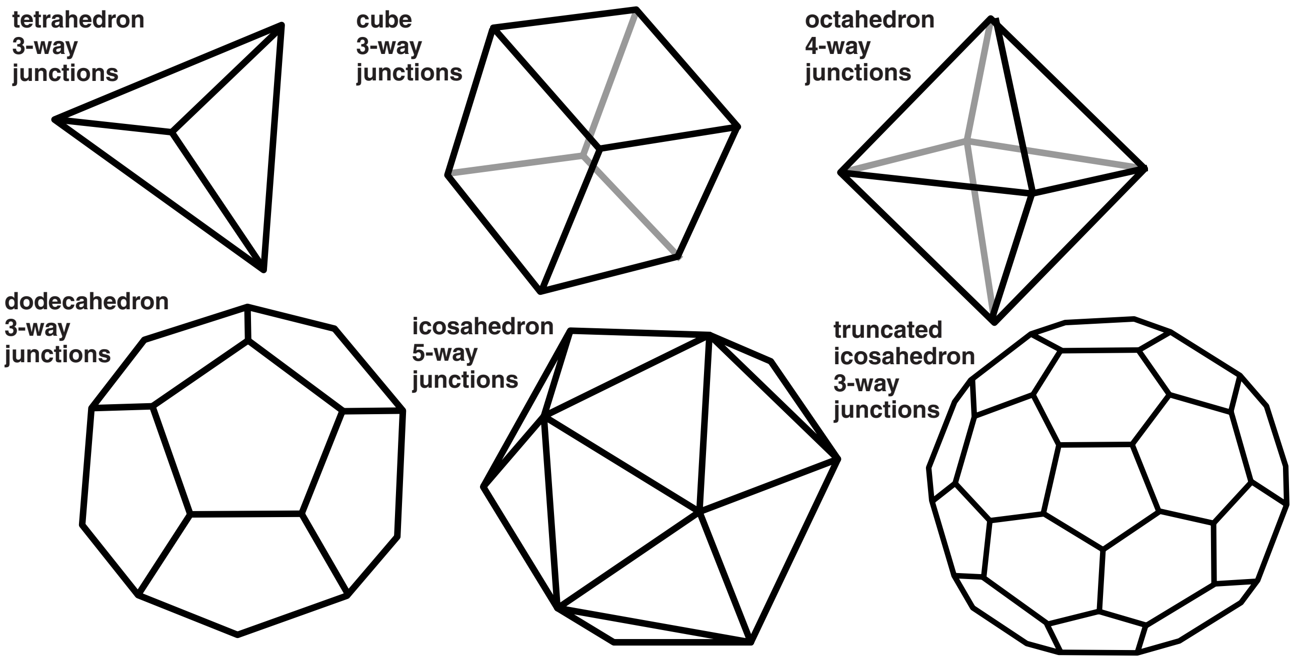
## Tips

- The models may be used without the soap solution to show chemical structures. However, the soap patterns greatly increase the dramatics of the demonstration, adding a "wow" factor.
- Hold the model over the bucket or a demonstration tray—it will drip. A wet surface from broken bubbles will be very slippery. Always cover the tabletop and floor with towels when working with bubbles. It may also be a good idea to work with bubble solutions outdoors.
- The bubble solutions commonly available in toy stores are dilute soap or detergent solutions that are good for making small bubbles, but not particularly effective for large bubbles. For large bubbles, use the recipe given on page 1.
- Use distilled or deionized water only when preparing a soap bubble solution to prevent interference from dissolved metal ions present in tap water. If the solution does not seem to work well, let it sit for a few days to a week. Aging seems to improve the characteristics of soap solutions.
- We have found that Dawn® or Joy® dish detergents seem to work best for preparing bubble solution.
- For larger models the twist ties and stirrers may be cut into thirds.

- Models may double as mobiles to hang in the classroom.

## Discussion

Molecular geometry is often difficult for students to visualize and tricky for teachers to demonstrate. This activity is a great way to illustrate fascinating three-dimensional molecular models. Possible geometric frames that may be constructed are shown below (rear views are not shown for the more complex structures).




A common reason for a bubble breaking is the water in the walls of the bubble draining to the bottom of the bubble. This produces a small droplet at the bottom of a bubble. When the top of the bubble becomes too thin to support the total mass of the bubble, it breaks. Adding glycerin to the soap solution tends to make the bubble stronger by preventing the water from readily draining out of the soap film.

The colors observed on a soap bubble are the result of thin film interference and changing thickness of the film due to the draining liquid. As the thickness of the soap film changes, the distance the light travels changes, and the differential interference reflects different colors in the soap film. The swirling colors observed are a result of uneven thickness in the soap film.

## Acknowledgment

Special thanks to Penney Sconzo, Westminster Schools, Atlanta, GA for sharing this activity with Flinn Scientific.

## Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Simple Structures* activity, presented by Bob Becker, is available in *Molecular Geometry*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

## Materials for *Simple Structures* are available from Flinn Scientific, Inc.

| Catalog No. | Description |
|---|---|
| G0007 | Glycerin, 500 mL |
| C0241 | Cleaner, Dishwashing |

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.