What's in That Tube?

Solving the Structure of the Atom

Introduction

What was it like to imagine the nature of the atom? How difficult is it to produce a model of something that can't be seen? The Think Tube allows students to appreciate the challenges associated with understanding things we can't see, such as atoms. As the instructor performs a series of simple manipulations with the Think Tube, students record their observations and later develop a hypotheses to explain the construction and inner workings fo the tube.

Concepts

- Models
- Hypothesis

Materials

White tube, 18 inches long, 1.5″ in diameter, with 4 holes
Cord, nylon, neon, 36 inches, 2
Wood bead, 3/4-inch diameter, red
Wood bead, 3/4-inch diameter, green
Wood bead, 3/4-inch diameter, blue
Wood bead, 3/4-inch diameter, yellow
Washer, 3/4-inch diameter
Tube caps, 2
Think Tube Worksheet

Safety Precautions

The Think Tube is considered nonhazardous. Follow all normal laboratory guidelines.

Preparation

1. Loop the cords through a washer as shown in Figure 1. Place the washer in the middle of the tube.
2. Pull the ends of the cords through the holes of the tube (see Figure 1).
3. Pull the ends of the cords through the holes of the wooden beads and tie a knot at the end of the cords to hold the beads in place. Use the red bead in the upper left position, the yellow bead in the lower left position, the blue bead in the upper right position and the green bead in the lower right position (see Figure 1).
4. Cover the ends of the tube with the tube caps that have been provided.

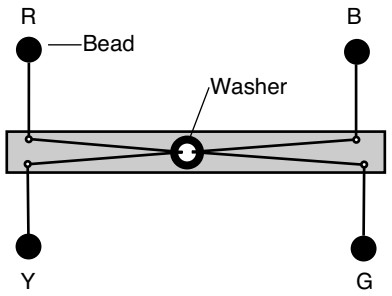


Figure 1.

Procedure

1. Pass out the Think Tube Worksheet.
2. Have students draw the original positions of the beads for each experiment in the left column of the Think Tube Worksheet.
3. The basic sketch for each manipulation should look similar the Figure 2. (R = Red bead; B = Blue bead; Y = Yellow bead; and G = Green bead)
4. In the middle column of the Think Tube Worksheet, students should draw or write what happened in each demonstration.
5. In the right column of the Think Tube Worksheet, students should draw or write their hypothetical explanation for each demonstration.
6. Perform the following four demonstrations. Be sure to pull the cord until it stops.

Publication No. 91235
061616

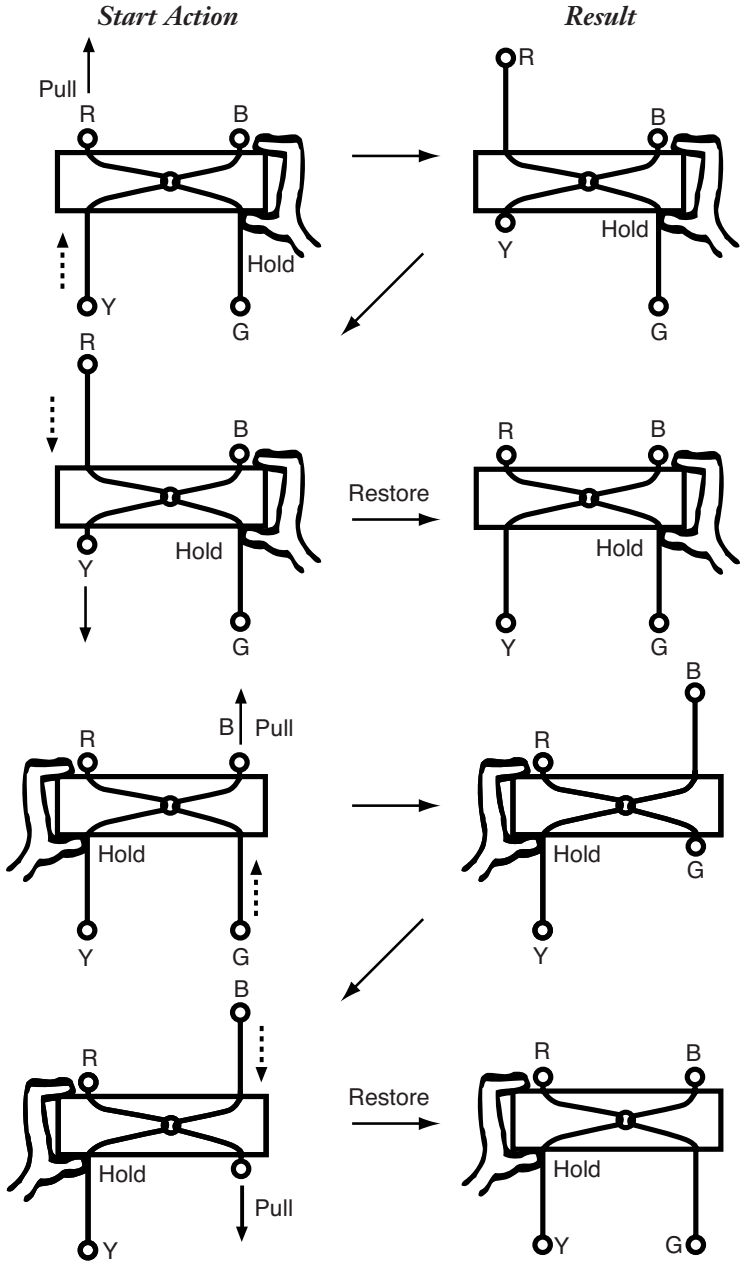
Demonstration 1

Red and yellow beads on left end appear to be connected by a single string.

1. Hold the cord attached to the green bead.
2. Pull the red bead.
3. Pull the yellow bead.

Blue and green beads on right end appear to be connected by a single string.

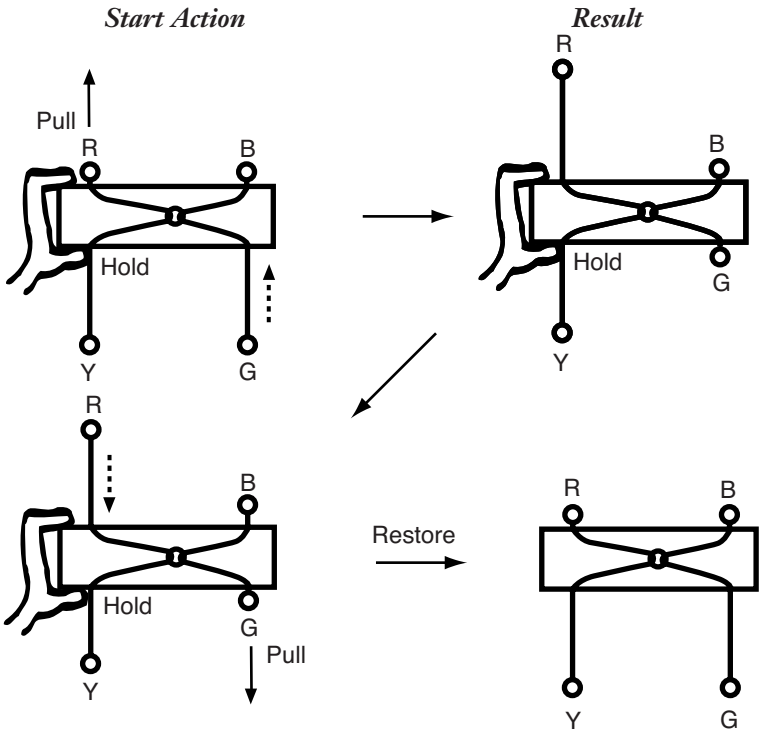
1. Hold the cord attached to the yellow bead.
2. Pull the blue bead.
3. Pull the green bead.



Demonstration 2

Red and green beads appear to be connected by a single string.

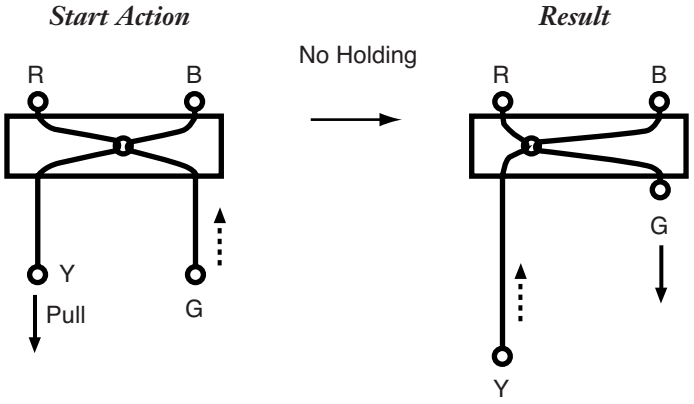
1. Hold the cord attached to the yellow bead.
2. Pull the red bead.
3. Pull the green bead.



Demonstration 3

Yellow and green beads appear to be connected.

1. Hold no cords.
2. Pull the yellow bead.
3. Pull the green bead.



Review:

Repeat any and all demonstrations and review what was observed.

Review should show that:

Demo 1: The red and yellow beads appear connected and the blue and green beads also appear connected.

Demo 2: The red and green beads appear connected.

Demo 3: The yellow and green beads appear connected.

So, it is pretty clear by now that the top and bottom strings on each end are not one single string.

Disposal

The think tube may be reused from class to class and year to year.

Tips

- This demonstration may be done as many times as desired.
- Practice each step of all four demonstrations before presenting the entire activity to the students. Some practice will be required to master all of the steps, especially holding the string at the holes without being obvious to students.
- The ends of the cords may be melted with the flame from a match to prevent fraying.

Discussion

The demonstrations presented in this activity are designed to create discrepancies in the minds of the viewers. In the first demonstration, it appears that the red and the yellow beads are directly connected together and that the blue and green beads are connected. In the second demonstration, the red and green beads seem to be attached to each other. The third demonstration seemingly illustrates that the yellow and green beads are also attached. Repeat the three demonstrations as many time as necessary for your students to develop a model. Some students may be able to describe in words better than draw what is occuring. Encourage both words and drawings to record observations and the model.

The goal of this demonstration is to have students hypothesize and develop a possible model of exactly what is happening. The demonstration may be presented as many times as you would like until students fully understand the mechanics behind the Think Tube. You may want to reveal the design at the end of the demonstration, or you may decide to keep the secret to yourself. Use your discretion!

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
Content Standards: Grades 5–8
Content Standard A: Science as Inquiry
Content Standards: Grades 9–12
Content Standard A: Science as Inquiry

Acknowledgment

Special thanks to Robert Lewis, Downers Grove North High School, Downers Grove, IL, and Jeff Hepburn, Dowling High School, West Des Moines, IA, for providing the idea and instructions for this activity.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *What's in That Tube?* activity, presented by Bob Lewis, is available in *Solving the Structure of the Atom*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Think Tube* are available from Flinn Scientific, Inc.

Materials required to perform this activity are available in the *Think Tube—Demonstration Kit* available from Flinn Scientifc.

Catalog No.	Description
AP6149	Think Tube—Demonstration Kit

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

Name: _____

What's in That Tube? Worksheet

A model is a representation of an object or process that cannot be directly observed. For example, we cannot see atoms but we can create models of atoms that are consistent with our observations. We cannot see what happens inside the brain as someone learns, but we can create models of how learning takes place.

You will see some demonstrations performed with strings coming out of a tube. You will use observations of how the strings work to create a model of the arrangement of strings inside of the box or tube.

After each demonstration, record what happened by drawing a diagram or explaining in words. After each demonstration, create a model of the string arrangement inside the tube.

	Original Position	**What Happened**	**Model**
Demonstration 1			
Demonstration 2			
Demonstration 3			
Review			