

K'Nex Hydrogen Bonding

Summary

In this activity, students build models of polarized water molecules using K'Nex toy components and adhesive Velcro. Students investigate hydrogen bonding by shaking the models in various ways. They observe the resulting interactions and relate their observations to physical states of water and the difference between strong bonds and weak attractions.

Time Frame

1 class periods of 45 minutes each

Group Size

Pairs

Materials

- [student page](#)

(attached)

K'Nex pieces: 14 3/4-in. rods, 7 spoked green connectors, 14 dark gray horseshoe-shaped connectors

14 adhesive patches of black circular Velcro loop

14 adhesive patches of white Velcro hook

large plastic container with lid

protractor

Background for Teachers

K'Nex does not make kits for the models described in this Activity. The needed K'Nex components could be ordered individually from K'Nex; part numbers for the needed components are below. Kits of K'Nex to build 100 models (enough for ~15 groups of students) are available from the Bloomsburg University Mathematics and Science Learning Center for a nominal cost plus shipping; contact:

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Velcro with adhesive backing is available in fabric or craft stores. Whole black loop circles (~1.5 cm diameter) can be used for electron pairs on oxygen. Strips of white hook Velcro can be cut up for the partial positive charge on the hydrogens. The hook Velcro should be trimmed to just cover the ends of the hydrogen K'Nex connector to minimize non hydrogen-bonding connections. The most common unwanted event is the connection of two hydrogens to one oxygen electron pair. Over time, there may be degradation of the Velcro and adhesive backing, resulting in the Velcro not connecting correctly or the Velcro falling off the models. "Super glue" can be used in these cases.

Instructional Procedures

All instructional procedures are detailed on the student sheet attached.

Assessment Plan

Scoring Rubric or answer key:

The bond angle in the model is 135° ; the bond angle in water is 105° .

A rod represents the two electrons in a covalent bond between hydrogen and oxygen. A black loop Velcro patch represents an electron pair (and a lot of negative charge). A white hook Velcro patch represents a slight excess of positive charge due to the polarization of the electrons in the covalent O--H bonds toward the central oxygen.

Hydrogen bonds are represented by the spots where the hook and loop Velcro patches connect to each other.

Gentle swirling models condensation of gas phase water molecules. Vigorous shaking represents the application of outside energy. The physical change is vaporization or evaporation of water.

One would need to separate the model's hydrogen and oxygen components by removing the connecting rod.

Breaking a covalent bond requires much more energy than breaking hydrogen bonds.

Bibliography

Adapted from "The Nature of Hydrogen Bonding" by Schultz, Emeric. J. Chem. Educ. 2005 82 400A.
Lesson Design by Jordan School District Teachers and Staff.

Authors

[Utah LessonPlans](#)