

Patterns in Crystal Structures

STEM: The Math, Science, and Art of Water Molecules Using Magnetic Models

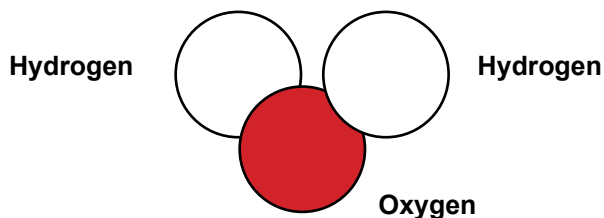
Teacher Key

Pre-activity questions

1. Think of a snowflake. How many sides does it have? 6
2. Imagine you bring a snowball in the house and put it in a bowl. An hour later, you come back. What will be in the bowl? Water.

Observations

1. What is a hexagon?
A shape with six sides.
2. How many hexagons do you see in the ice you were given?
5
3. How many water molecules are in this ice structure?
12
4. Look at one water molecule. Draw a picture of what you observe. Color or label your water molecule to match the model.





The Math, Science, and Art of Water

Water is sometimes called H_2O . (We say “H - 2 - O”.) This means there are 2 H, or hydrogen atoms, and 1 O, or oxygen atom.

5. In the model, what color is the H, or hydrogen? White.

6. In the model, what color is the O, or oxygen? Red.

Models are similar to the real objects, but not *exactly* the same. These water models use magnets to show how water molecules interact. But in real water, there are no magnets.

Look at two water molecules. Explore how the two molecules act when you bring them close together. Consider what happens when you:

Bring 2 red oxygen atoms together.

Bring 2 white hydrogen atoms together.

Bring a red oxygen and a white hydrogen together.

7. Write a rule that describes your observations.

Red bonds (sticks) to white but not red. White bonds (sticks) to red but not white.

States of Matter

8. Take 3 water molecules and slowly roll them between your hands. What do you feel and hear? Write your observations.

Water molecules stick together and break apart. When they stick it makes a clicking sound.

9. With the water molecules in your hands, rub them together a little faster. What changes do you observe? There is less sticking and clicking.

10. Now, slow down and stop rubbing your hands. Are the water molecules separated or stuck together? Stuck together.

You have just modeled what happens when you heat or cool down water. When you aren't rubbing your hands, there is little heat, and the water forms ice. When you heat it up (by rubbing your hands), you “melt” the ice and form water. If you heat it up a lot (rub your hands fast), you form water vapor or steam.





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11. Write a description of the behavior of water when it is ice, water or steam in terms of how the molecules stick to each other.

The water in ice sticks together. The water in liquid form sticks together and comes apart. The water molecules in steam do not stick together.

Reassembling the Ice

Follow the directions for building cubic ice.

12. How many hexagons do you see in this ice structure? 4

13. How many water molecules did you use to build this structure? 10

14. Is this the same ice structure you were given at the start of the activity? Explain your answer.

No. There is a different number of water molecules and a different number of hexagons.

Modeling as a Practice of Science

15. How are the water molecule models like real water?

They stick together and come apart. There are 2 'hydrogens' and 1 'oxygen'.

16. How are the water molecules models different from real water?

Answers might include: Water doesn't have magnets. Water isn't red and white. Water isn't hard.

Extension

17. Compare the model of a sodium chloride crystal with the model of a hexagonal water crystal and write your observations. How are they similar? How are they different?

See page 4 of Teacher Notes.