Chapter 10. Does Air Contain Water Vapor? A Structured-Inquiry Activity

Think About This!

Have you ever observed water droplets on the outside of a glass when you were drinking a cold drink on a very warm day? Where did these droplets come from? Did the liquid seep through the glass to the outside? How do you know? Could you test a prediction about this phenomenon?

Have you ever been traveling in a warm automobile on a very cold day and observed droplets of water on the inside of the windows or windshield? How might you explain the appearance of these droplets?

How might you explain the droplets on the outside of the cold drink glass and the droplets on the glass on the inside of the warm car? Are these different phenomena? Why? Why not?

Probing Further

The purpose of this investigation is to help the learner determine if air contains water vapor and the importance of this variable to the study of meteorology. This activity should enable the learner to better understand and apply the factors involved in the formation of droplets on the cold drink glass and the automobile window.

Objectives for the Learner (Essentials of Inquiry)

Conceptual Theme: To develop a basic understanding of the change that takes place when water vapor condenses from a gas to a liquid and how a change in temperature affects this transformation.

Content: Developing basic information relating to the condensation process and establishing a basic understanding of dew point. Further, providing the student additional understanding of other factors that constitute the study of meteorology.

Skills: The focus is on using laboratory equipment, making careful observations, recording physical changes, drawing conclusions, and describing and communicating results.

Scientific Habits of Mind: The importance of careful observations, respect for data, and verifying results.

Materials

Safety glasses

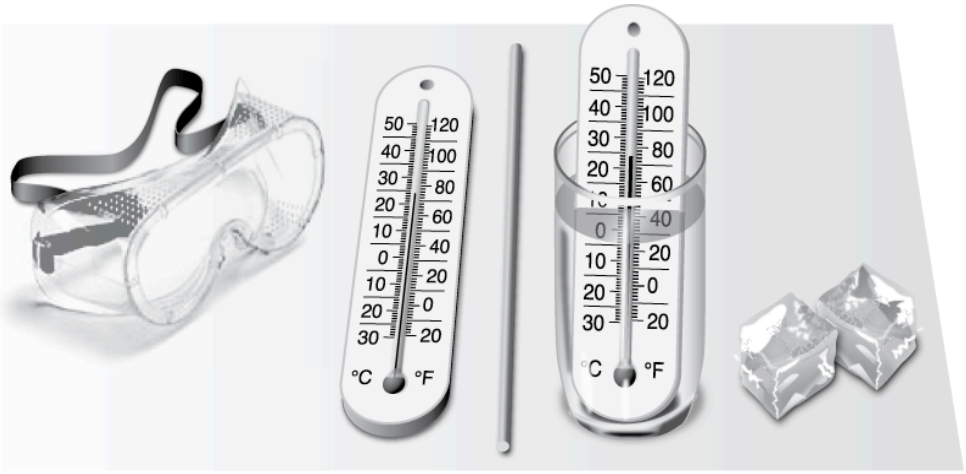
2 non-mercury thermometers

1 clear glass container or smooth shiny can (about 200 ml in size)

Ice cubes

Stirring rod

Tap water



Procedure

Place the clear glass container or smooth shiny can on a firm flat surface. Fill the container about three-fourths full of water. Place one of the thermometers in the container of water and place the other thermometer on the surface beside the container. Immediately observe and record the temperatures of both thermometers.

Add ice to the container of water and use a stirring rod to stir the ice and water. Carefully observe the outside surface of the container and look for any changes in the appearance of the surface.

As soon as you observe changes on the surface of the container, carefully record the temperature of the water and the temperature of the surface thermometer.

Examining Results

The purpose of this activity is to facilitate examining concrete evidence that there is water in air.

What change did you observe that indicates that water vapor condenses from a gas to a liquid and how a change in temperature affects this transformation?

The droplets that formed on the outside of the container had to condense out of the warmer air when it came in contact with the colder container.

How would you describe the process of condensation and does this help you establish a basic understanding of dew point? Can you relate these two concepts to meteorological processes?

It is a process where gaseous water becomes liquid water and is extremely important in cloud formation and the formation of precipitation.

What do you understand to be the most important outcome of this investigation? Why?

Allow the student to state what he or she thinks was the most important outcome. The student should realize that air does contain water in the gaseous form that will condense into a liquid when the temperature is lowered.

After conducting this investigation, what did you conclude about air containing water? What is the most important factor in verifying this conclusion for you?

If the container was watertight, the water had to have condensed out of the air. The droplets on the glass were the most important factor in verifying the results.

Conclusion

What was your major conclusion regarding air containing water vapor after conducting this activity?

Air does contain water in the vapor (gaseous) state even though you cannot see it until it condenses.

Going Further

How could you better validate the temperature at which water droplets appeared on the container?

The learner could reverse the procedure by warming the container and observe when the droplets evaporated.

Challenge

What do you think would happen to the droplets on the outside of the glass if you allowed the glass to sit until all the ice melted and the liquid inside the glass got warmer and warmer? Why? Can you design a simple activity to test your hypothesis? What additional equipment is needed?

As the ice melts and the water in the glass gets warmer, the droplets of water on the outside of the glass will be reabsorbed into the air. Students can reverse the activity to discover what happens.

Pitfalls

This activity shifts more responsibility for learning to the student and more responsibility to the teacher for facilitating activities as opposed to directing the activity.

This activity is designed to challenge both the learner and the teacher after having worked through several of the different levels of inquiry in activities. The learner must come to design the experiment by getting skillful facilitation and arrive at a valid conclusion based upon the results.

The teacher must address the following:

Through a discussion, enable the learner to complete an appropriate design around a student- or teacher-generated testable question.

Through a discussion with the learners, conduct an appropriate and valid look at the outcomes.

Ensure that the learner has made a valid and appropriate conclusion based upon the experimental design and the generated data.

If it is so desired, suggest possible procedures for answering the questions posed in the "Going Further" and "Challenge" sections above.

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