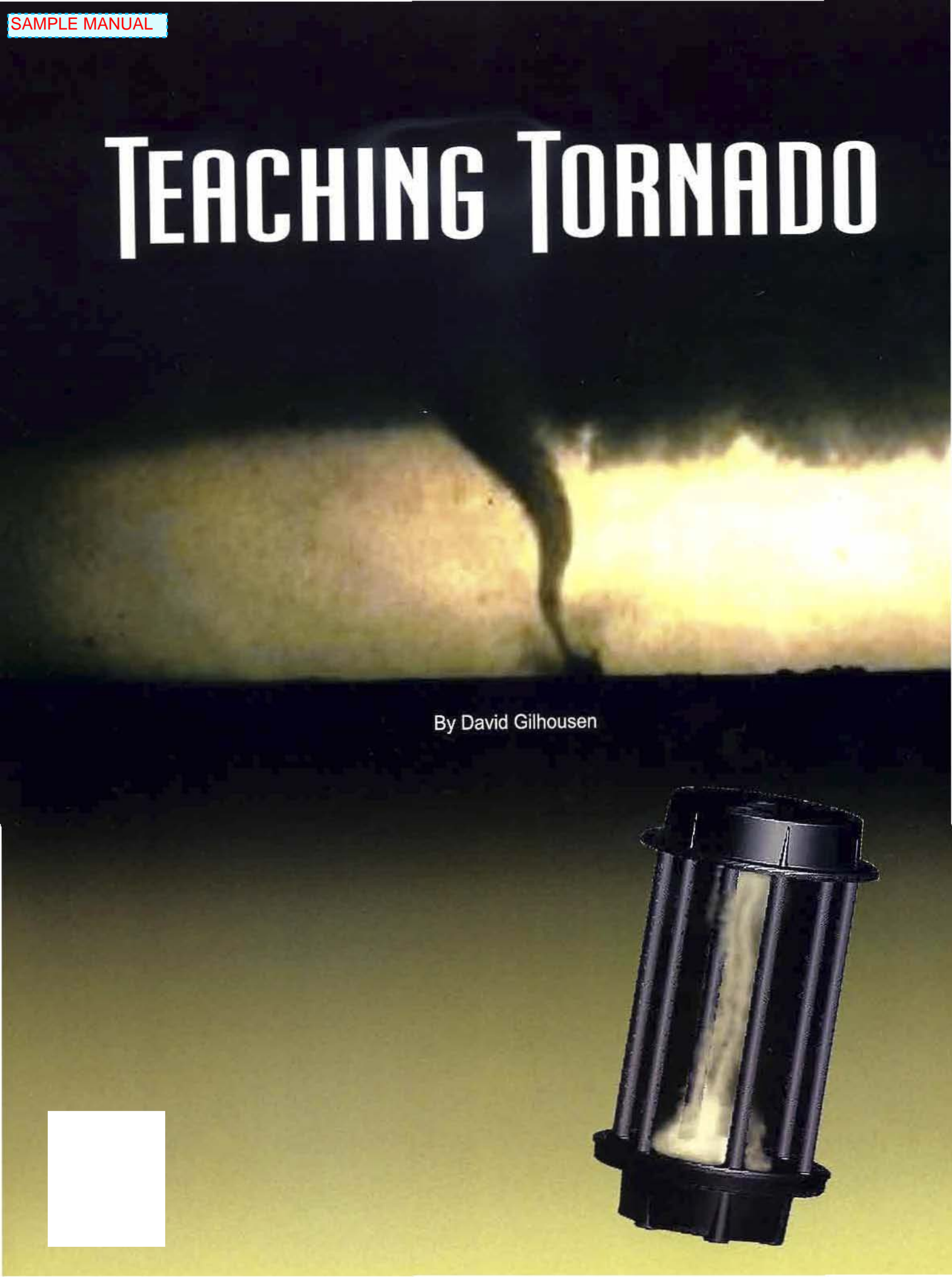
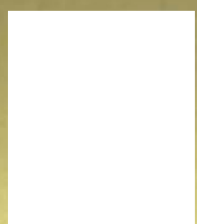


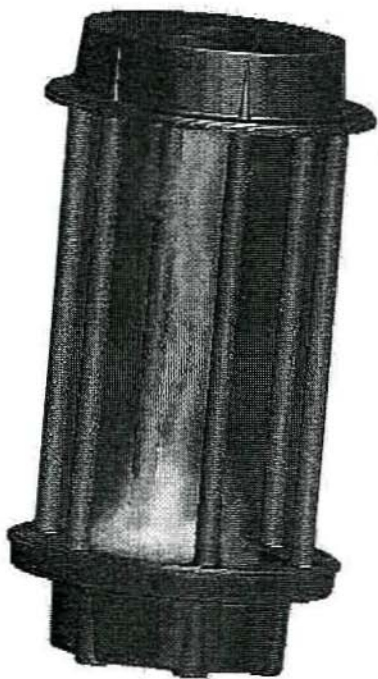
TEACHING TORNADO



By David Gilhousen



TEACHING TORNADO



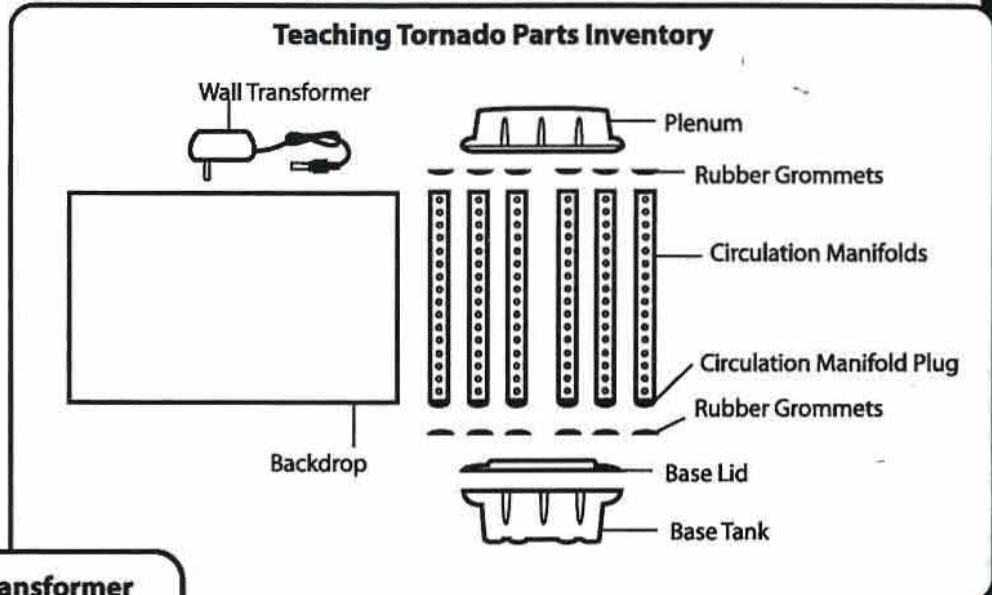
Assembly Instructions for the Hubbard Scientific 648 Teaching Tornado

Assembly Time: approximately 10 minutes

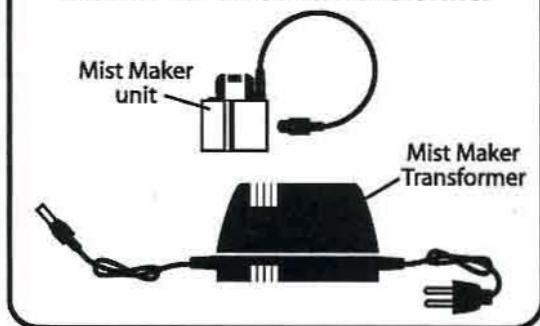
Carefully unpack the contents of the box.
Be sure that all of the following components are present:

- 1 Base Tank
- 1 Mist Maker*
- 1 Wall Transformer
- 1 Base Lid
- 1 Plenum
- 6 Circulation Manifolds
- 1 Back Drop
- 1 Teacher's Guide

(Rubber Grommets are already inserted into the Plenum and the Base Tank Lid. Circulation Manifold Plugs are already fit into the Circulation Manifolds.)



Mist Maker Unit and Transformer



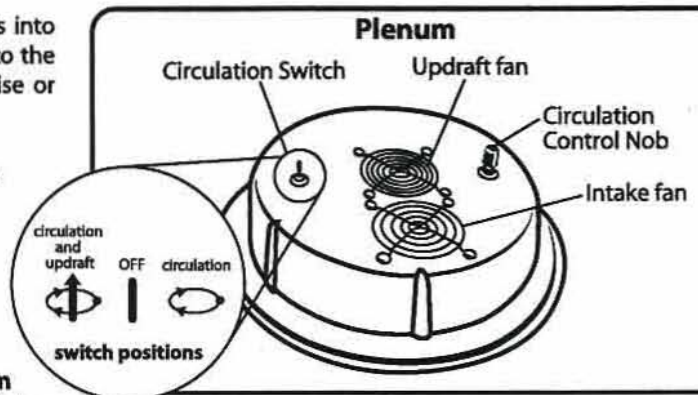
2. Fill the Base Tank with water about 2/3 the depth of the tank. Place the Mist Unit in the center of the tank. The water must cover the mist unit, so top off if necessary. Be sure the cord rests in the indentation on the lip of the tank.
3. Insert the Circulation Manifolds by twisting them into the rubber grommets in the Base Lid so that the plugged end rests on the inner ledge of the Base Tank. Position the Circulation holes at 45° from the center of the unit.

NOTE: It may be easier to insert the Manifolds by rubbing a small bead of dish soap around the inside of the rubber grommet with your finger.

4. Insert the unplugged ends of the Circulation Manifolds into the rubber grommets on the Plenum. Insert the first into the grommet of your choice, then move on either clockwise or counter-clockwise to the next Circulation Manifold.
5. Insert the Backdrop, if desired, into the groove around the edge of the Base Tank and the Plenum.
6. Plug in the Wall Transformer to the Plenum. Plug the Wall Transformer and Mist Maker Transformer into a standard 120V wall outlet.

IMPORTANT SAFETY NOTE: The Mist Maker will turn on as soon as it is plugged in. Do not operate the Mist Maker when the Mist Unit is not fully submerged.

DO NOT TOUCH THE MIST UNIT WHILE IT IS OPERATING. INJURY MAY RESULT!



*Please read Mist Maker unit instructions thoroughly before operating.

TEACHING TORNADO

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TEACHING TORNADO

Introduction to the "Teaching Tornado"

Your students will have a great deal of fun simply gazing at this tornado, but you can use it to guide many student-assisted demonstrations that teach principles of how tornadoes form. These demonstrations can fill an entire class period for junior high or high school students, or can be scaled down for elementary students. Most teachers find that this demonstration is best presented after a unit on weather to reinforce what has been taught.

Your students will make exciting discoveries concerning:

-  Why a strong updraft is important in a tornado.
-  Why both convergence and rotation are needed to create a tornado.
-  How funnel speed is related to funnel width.
-  Why you can produce a "reverse" tornado.
-  What can cause tornadoes to dissipate.

Technically speaking, the explanations involve the Coriolis Effect, the conservation of angular momentum, mass convergence, and centrifugal force as they relate to atmospheric fronts, thunderstorms, and tornadoes.

The basic order of each demonstration begins with the teacher posing a problem through a series of questions. Then, one or two student assistants can be selected to perform an action. These actions may involve twisting the pipes to change the inflow angle, taping over selected holes, or changing fan speeds. After students observe the change to the funnel, you can provide the scientific explanation or ask students additional questions to guide them towards the answer. After all the demonstrations are completed, you can hand out the student observation sheet, which is contained in the manual, to assess student learning. If time permits, a follow-up discussion of student answers can be beneficial.

TEACHING TORNADO

This manual will guide you through each step with all of the questions, explanations, and other "fun facts." So, have fun and be an entertainer! Add suspense and humor for a complete learning experience. Finally, keep the demonstration flowing at a reasonably fast pace, especially for elementary students.

The typographic conventions of this guide are as follows:

Questions to ask your students are given in bold italics like this.

Actions your students can take to help the demonstration are shown like this.

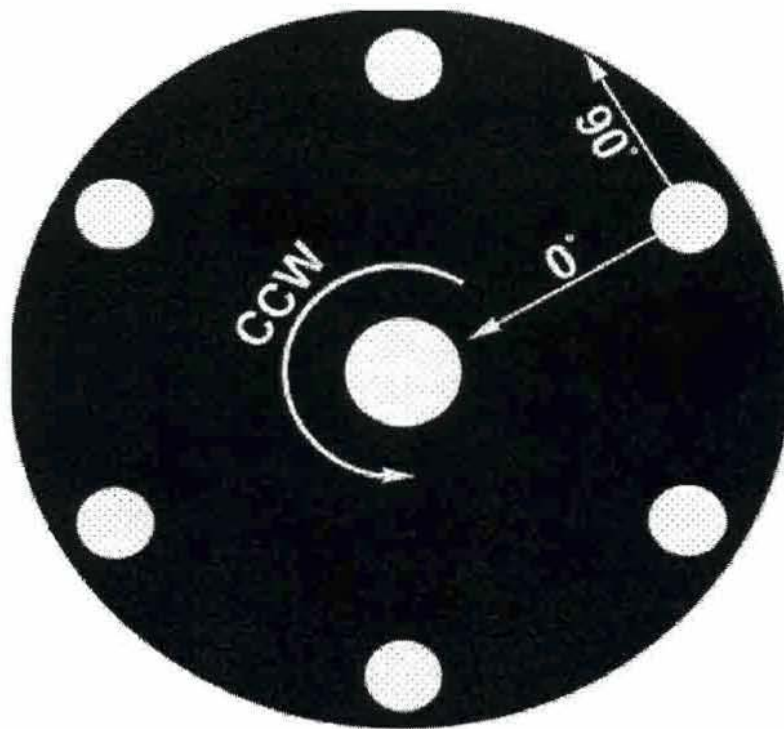
Explanations that you can provide your students are shown like this.

Fast Fact: Supplemental material is provided in text boxes.

TEACHING TORNADO

How to Introduce the Teaching Tornado

Before class, make sure that the holes are lined up in the proper direction before you turn on the tornado. The rows of holes on each pipe should be pointed in the same direction, about 45 degrees from the center, so that the air will spiral counterclockwise.



To improve funnel visibility, install the black backdrop. You might also want to improve the lighting in front of the tornado. Also, tape over the "Teaching Tornado" logo on the top to hide the purpose of this device.

Introduce the "Teaching Tornado" by.... not saying anything. Have the students guess what this machine will produce. You can explain that the machine contains two fans (show their location by lifting the tornado model off its base and tilting it towards the students being careful to hold one hand on the top and one on the bottom.), and an atomizer that provides mist like a humidifier. After a few guesses, rip off the tape and share that a tornado will form. However, explain this is not an ordinary tornado, but a "Teaching Tornado" that will help them understand how tornadoes form and dissipate.

TEACHING TORNADO

Basic Tornado Observations....Or, You Can Learn a Lot Just by Looking

What role does the fan facing upward play?

This fan creates the updraft. You might want to show how you can adjust the updraft speed and what effect this has on the tornado.

What role does the fan facing downward play?

This fan creates the inflow by drawing outside air into the upper chamber and forcing the air out the pipe holes. This inflow feeds the suction created by the updraft. Similarly, you can show how you can adjust this fan which governs the circulation speed.

What role does the atomizer (or humidifier) play?

It provides the condensate, which is a tracer so that you can see the tornado. The atomizer works by creating high frequency vibrations which break up the water into an extremely fine mist.



Fast Facts: In a real tornado, tons of rising, warm air causes lower pressure because warmer air weighs less than the surrounding air. The lower pressure causes the humid air to condense into cloud droplets creating the visible funnel.

Does the tornado consist of water vapor?

Pick a student who believes it is water vapor, and have them place their hand in the tornado. They will discover that it is made of tiny, liquid water droplets, just like a cloud.

Would you have a tornado without the humidifier?

Yes. There would still be a funnel, but you wouldn't be able to see it.

TEACHING TORNADO



Fast Fact: A tornado is any rapidly rotating column of air that extends from the cloud to the ground, regardless of whether it is visible. Sometimes the air is too dry for the funnel cloud to form. In those cases, all you would see is rotating dust or debris.

Does the tornado look like a solid vertical column?

No. You will see strands of slightly thicker cloud swirling up the tornado. These strands are areas of concentrated energy called suction swaths. The upward motion of these swaths is easier to see when the updraft fan speed is low. Higher winds in these swaths explain why one house is destroyed while one next to it is left standing.

What happens when somebody blows his breath lightly towards the base of the tornado?

Have someone perform this near the base of the funnel and the tornado will briefly dissipate. This effect works best at lower fan speeds. Have the student stay until the tornado reforms, ask the next series of questions, and have the student disrupt it again. This will give students time to observe how it dissipates.

How does the tornado dissipate? What causes the tornado to break apart?

The bottom part of the tornado blew away and got disconnected from the top part of the funnel. Similarly, real tornadoes can dissipate when the surface circulation moves away from the circulation at the cloud base. Strong surface winds that are weaker aloft help create this shearing action. For example, a downdraft from another, nearby thunderstorm can cause these strong surface winds which can blow the tornado apart.

TEACHING TORNADO

What does this show about tornadoes?

Though tornados can cause serious damage, many are often very fragile and don't last a long time. Also, tornadoes often break down for a minute or two and reform later. This also helps to explain why one house is destroyed and the other is left standing.

Fast Facts: Most tornadoes only last about 5 minutes, have a width of 50 - 100 yards and have a path length of a few miles. Only a few "killer" tornadoes each year have greater longevity, path lengths and widths.

