count · play · explore

Vertical Wind Tube Interactive Exhibit

DESIGN, BUILD, AND PLAY GUIDE

Wind tubes provide playful and exploratory opportunities for learners of all ages to experiment with floating a variety of common everyday objects in a vertically moving air column. By exploring how objects interact with the wind, children develop ideas about flight, cause and effect, wind resistance, and aerodynamics. Wind tubes also invite learners to explore, change, and experiment with different variables as they craft and fly their creations. The power of the vertical wind tube is that it often provides unexpected results that engage learners in the hallmarks of the scientific method: creative design, prediction, embodied experimentation, and analysis.

We would like to acknowledge and credit the Tinkering Studio at the Exploratorium for the development of "Wind Tubes" (bit.ly/exploratorium-wind-tubes). Their work has deeply inspired and informed this activity. We strive to respect the values and goals of the original activity while making adaptations so that this activity can be implemented in a variety of contexts and learning environments.

Set Up

The wind tube should be set up in an open space. It can be placed on the ground or on a low table that is easy for children and families to access. Cords should be taped down or covered to prevent tripping. Materials for exploration should be located nearby.

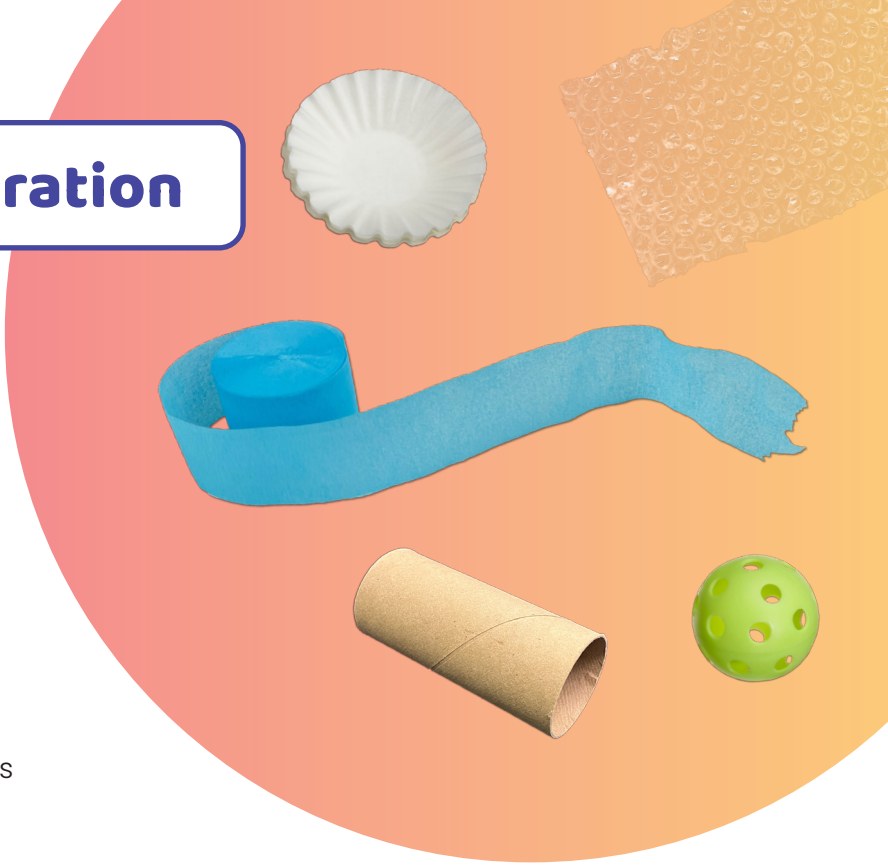
Space

A single wind tube takes up very little floor space along with the accompanying materials. You may also want to create a display area for participants to place their creations for public sharing.

Material Storage

Having materials in clear bins helps keep things organized. It is helpful to have one bin for exploration materials and another bin for tools such as tape, scissors, and hole punchers.

Materials for Exploration



A wide variety of materials can be used in exploring with the wind tubes. Many found objects and items common to schools or homes can be used. When choosing materials for exploration, it is not necessary that all materials will fly on their own.

Here is a list of materials that could be considered a starting point:

- **Crafting items**
  Cotton balls, fabric scarves, pipe cleaners
- **Balls of various sizes**
  Ping pong balls, styrofoam balls, wiffle balls, inflatable balls
- **Household items**
  Coffee filters, packing materials, paper portion cups, toilet paper tubes
- **Paper**
  Index cards, origami paper, crepe paper streamers, tissue paper

Be creative!
Gather other items and materials to explore in the wind tube.

Tools for Creating

- **Crayons and/or markers**
- **Painter's tape**
  We recommend using painter's tape to allow for easy removal and limited residue.
- **Scissors**
- **Single-hole punchers**

Building the Wind Tube

The vertical wind tube design is a vertical, clear plastic tube on top of a small household fan. This provides a consistent, constrained airflow which allows a degree of predictability to how objects in the tube will float or fly.

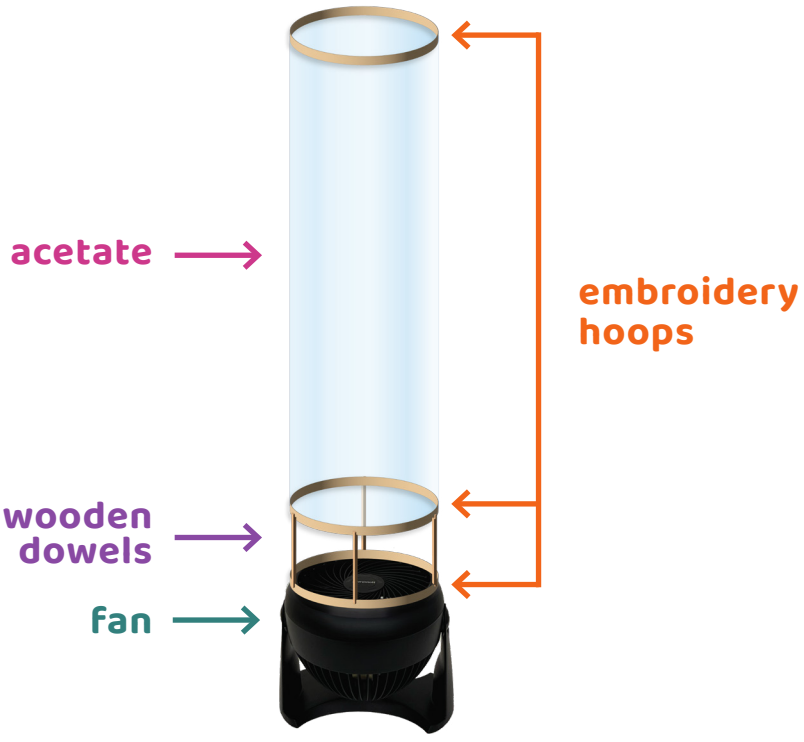
More details on these items are listed on page 16.

Materials

Item	Qty.
Turbo force fan with a head that rotates 90-degrees	1
9" wooden embroidery hoops	3
12" wide cake collar clear acetate roll	1 roll at least 90" in length
3/8" diameter x 4.5" length wooden dowels	4

Tools

- Cutting mat
- Fine-blade coping saw
- Heavy-duty clear packing tape, 2" wide
- Hot glue gun
- Painter's tape
- Utility blade or sharp scissors
- Yard stick



Instructions

Before You Begin

Follow these tips before managing the acetate sheet in order to keep the plastic optically clear.

- Remove any items from the table and wipe down the surface on which you will be constructing the wind tube.
- Make sure your hands are clean.
- Try to touch the sheets mostly from the edges to avoid fingerprints.

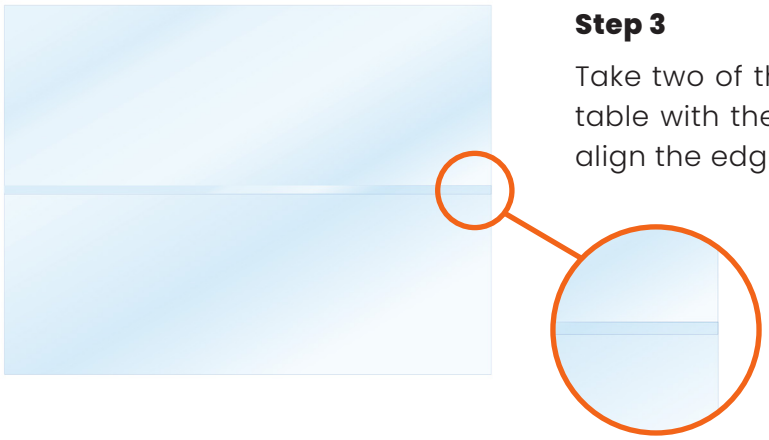
Prepping the Acetate Wall

Step 1

On a large table, roll then cut the acetate cake collar sheet 30" in length using a sharp utility blade or scissors.

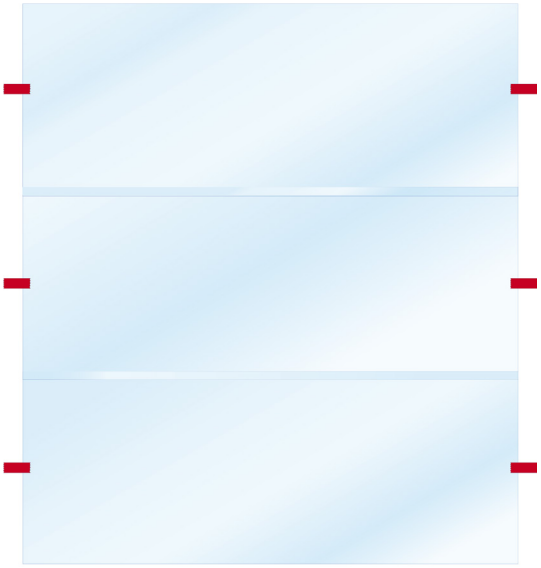
Step 2

Repeat Step 1 two more times for a total of three 12" x 30" sheets.



Step 3

Take two of the 12" x 30" sheets and lay them on the table with the long sides parallel to each other then align the edges. Overlap the long edges about 1/4".



Step 4

Repeat the same process in Step 3 with the third sheet creating an overlap of about 1/4". Make sure all areas are even and parallel. Use small pieces of painter's tape to secure the sheets in this alignment. All three sheets should now be secured together to make one large rectangular sheet approximately 30" x 36" in size.

Step 5

Using clear packing tape, slowly start at one end and carefully tape the two sheets with a single, uninterrupted strip. Try to avoid bubbles or creases.
You may want to practice this step several times on a smaller scale before attempting this maneuver.

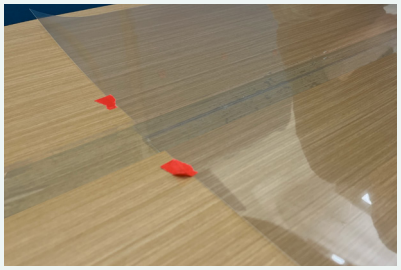
Step 6

Trim the excess tape from around the outer edge of the acetate sheet.

Helpful Tips

Make sure both sheets are precisely lined up and perfectly parallel with each other before taping.

DO NOT touch the sticky surface side of the clear packing tape. The oils from your hand will cloud the surface.



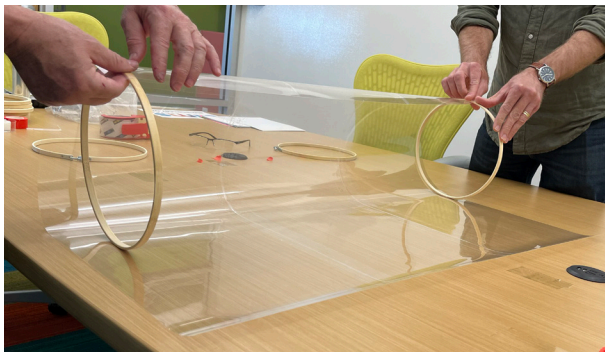
Create a leading edge of the tape a few inches away from the sheets so that you can cut off the fingerprints left from the initial start point.

It is okay to have a few small bubbles or creases in the tape. Do not try to peel the tape off. An ID or credit card can be a helpful tool to smooth the tape as you attach it to the sheets.

Securing the Wall

Step 7

Separate the interior rings from two of the 9” embroidery hoops. Loosen the screws on the outer rings to its widest setting.

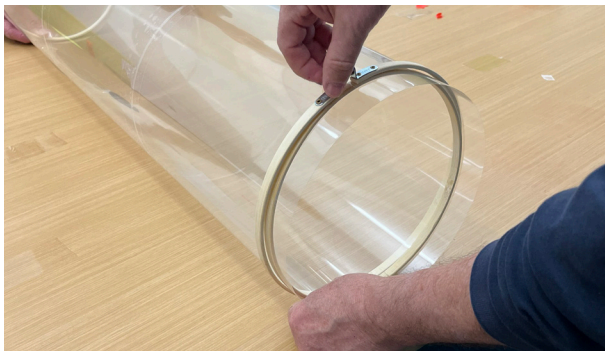


Step 8

With a partner on either end of the 30” side, each person holds an interior ring in front of them about 1/2” from the edge the acetate sheet. At the same speed, each person begins to evenly roll the sheet along the outer rim to form three-foot tall cylinder. When the ends meet, there should be about 3/4” overlap.

Step 9

On each end, place the outer rings of the embroidery hoops over the acetate cylinder then align them over the inner rings.



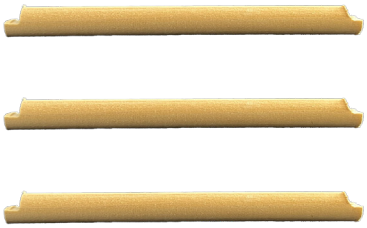
Step 10

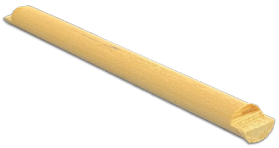
Partially tighten the screw on the outer embroidery hoops then pull the sheet tight to make adjustments needed to align the edges of the acetate sheet.

Step 11

Carefully move the overlapping inner and outer wooden hoops to the edges of the cylinder. The inner and outer embroidery wooden hoops should be aligned over the top of each other at this point at top and bottom edges of the acetate cylinder. Tighten the screw so that acetate sheet is trapped smoothly between the inner and outer wooden hoops on each end of the cylinder.

Creating the Base



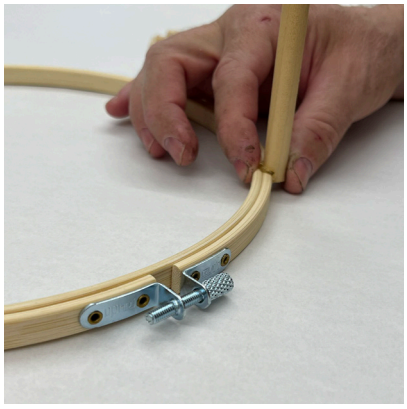


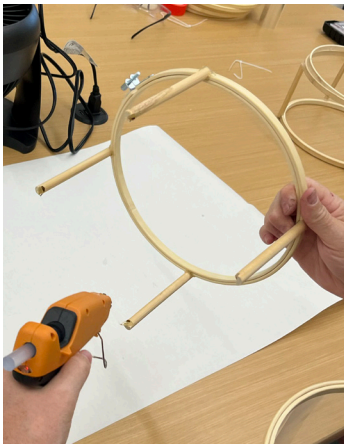
Step 12

Using a fine-blade coping saw, cut a notch on both ends of all four wooden dowels in the same orientation. This notch should be 1/4" deep and a half a semicircle of the cross-section.

Step 13

Lay one 9" wooden hoop on a table. Add hot glue to one end of a notched dowel then press the notch to the outside of the embroidery hoop. Hold the dowel a few seconds until the glue has sufficiently dried. Add more hot glue around the base of the dowel to secure it in place. Repeat for the remaining three dowels gluing each dowel equally spaced around the circumference and perpendicular to the hoop.





Step 14

Stand the acetate tube vertically on the floor. On the other end of each of the four dowels, add an ample drop of hot glue. Then, quickly flip over and attach each of the four ends to the hoop attached to the acetate tube. Make sure that the hoops are aligned and parallel to each other. Press all four dowels against the tube's hoop until the glue has sufficiently dried.

Putting It All Together

Step 15

Rotate the fan upwards and place the base of the cylinder on the fan. Cut four pieces of clear packing tape approximately 3" long. Secure the cylinder to the fan by evenly placing the strips around the bottom embroidery hoop. This will secure the cylinder to the fan while remaining easy to remove for storage or travel.

Before You Launch Your Exhibit

It's important to take some time to play with materials and to experience this activity as a learner. This can provide valuable information about how you might need to adapt materials or change the setup of the exhibit.

For example, as you set up your wind tube and explore materials as a learner, you might notice that certain objects float or fly really well while others don't float or fly at all. You might discover that adding a streamer to a heavier object actually makes it float. You might decide to add a few streamers alongside the heavier objects in the materials area, along with adding your own creation to the public display area to encourage others to learn from your play. This results in a better experience for learners!

Safety considerations
Before launching your exhibit, test your exploration materials to make sure materials are not too heavy. Attend to any other safety concerns that may arise.

Facilitation

Getting started

Here are some prompts to try with the exhibit. Prompts can be delivered through printed posters and signage. Also, if there is a staff member, educator, or volunteer present in the space, they can engage learners and offer these prompts in their conversations. We suggest leaving each series of prompts in the exhibit space for at least a week. After a couple of weeks, you can introduce new prompts. Feel free to adjust the prompts and timing according to your preferences and observations of how community members interacting. If you use printed materials, consider having the prompts translated into the languages that your community speaks.

Exploring the Wind Tube

Children and family members can begin their explorations with the wind tube by simply selecting materials and placing them in the tube to see how they interact with the wind. We recommend seeding the materials area with a few interesting objects or materials at the outset. Shortly after these initial explorations, you might add a few more materials and post a few questions nearby the wind tube that can spark further explorations:

Prompts:

- What things will fly?
- What things will not fly?
- Can you make something that floats in the tube?

The prompt to make something that floats encourages creative exploration with craft materials. Adults may assist young children by cutting out interesting shapes from paper or helping to attach pipe cleaners to creations.

Tip

When a wind tube is installed and running, sometimes all that's needed to invite learners to play is to put a few items inside and watch them dance!

Create a Flying Creature

You might also want to pose an interesting challenge. For example, you could invite children and family members to make a flying creature as shared below.

Prompt:

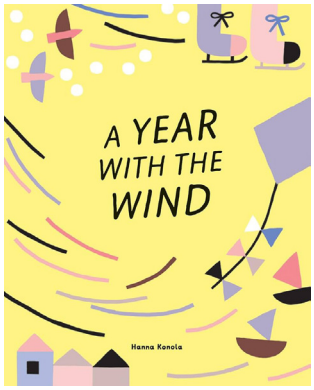
Make a flying creature!

- **Start with a body**
  For example: a paper tube or paper portion cup
- **Use materials to add to your creature**
  For example: pre-cut paper shapes, googly eyes, or pipe cleaners
- **Watch your creature fly**
- **Share your creature**
  Create a public sharing area for children to display their creations.

For further exploration, continue to add various materials that can be explored in the wind tube. Invite participants to try different combinations of materials, share their creations with others, and extend their own ideas as they play and explore.

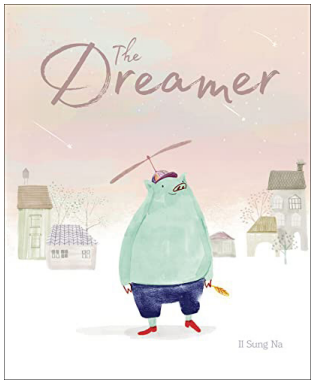
Literature

There are many wonderful books about wind and flight to incorporate into your exhibit. You can display the books near the exhibit and make them available for families to engage with alongside the activity. You might also consider a special read-aloud time during a family event, followed by wind tube explorations!



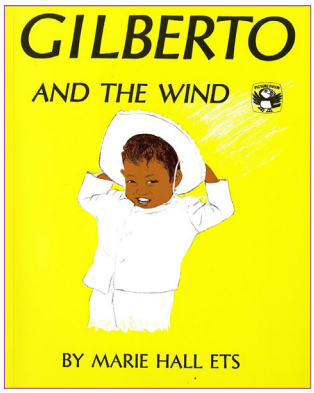
A Year with the Wind
by Hanna Konola

Baby Loves Aerospace Engineering
by Ruth Spiro
(English & Spanish)

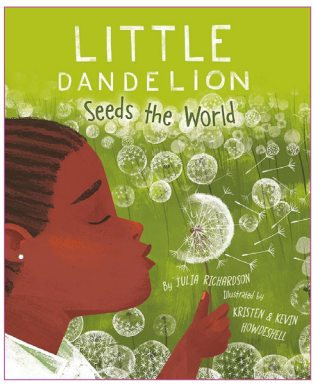


The Dreamer
by Il Sung Na

Flight School
by Lita Judge



Gilberto and the Wind
by Marie Hall Ets
(English & Spanish)



Little Dandelion Seeds the World
by Julia Richardson

Outdoor Connections

Further explorations of wind and how different objects move through air can be done anywhere! Consider taking your investigations outdoors.

Scavenger Hunt

Go on a scavenger hunt for wind and flying objects outside. Search for items that move through the air, such as flying seeds, falling leaves, flying animals, and flying machines.

Dandelion Seeds

Have fun blowing dandelion seeds and watch how they move through the air.

Observation & Feedback

Take some time to observe families as they interact and play with the wind tube. Using these observations to guide your adaptations of the exhibit ensures that the activity is responsive to ways your community is engaging.

As you observe, you might reflect on the following questions:

- How are people engaging with the exhibit? What do they seem to especially enjoy about it? What aspects might be frustrating?
- How are adults and caregivers engaging alongside children? How could the exhibit encourage more co-play between children and family members?
- What materials seem to be working well? What are some other materials you might consider using?
- Are there any other adaptations needed based on your observations?

Resources

All resource links can be found at
bit.ly/vertical-wind-tube-exhibit

Materials

This list provides details about the items and materials needed for your wind tube exhibit. The sample links point to possible locations where you may purchase these items. Search terms are also included that can help you find similar items sold from other online retailers. You may also find similar items in local stores.

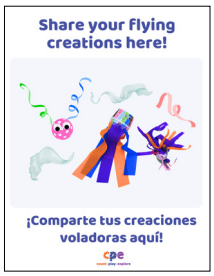
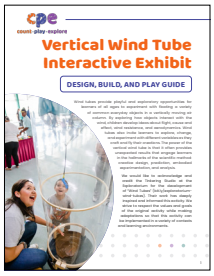
Wind Tube Construction Materials

See page 4.

Item	Specifications	Sample Links
Honeywell TurboForce Fan HT-900 Qty. 1	Fan head must rotate 90-degrees to vertical	Link: bit.ly/turbo-table-fan 
9" Wooden Embroidery Hoops Qty. 3	The embroidery hoops must fit the circumference of the head of the fan.	Link: bit.ly/9-embroidery-hoop 
Clear Acetate Cake Collar Roll, 12" width Qty. 90" in length (minimum)		Link: amzn.to/3v8nVpH 

Item	Specifications	Sample Links
Wooden Dowel Rods, 3/8" diameter Qty. 4 dowels 4.5" in length	You can purchase a long dowel at least 18" in length then cut 4 rods each 4.5" length.	Link: bit.ly/3-8-in-dowel 
Clear Heavy-duty Packing Tape, 2" diameter Qty. 1 roll	A roll with simple dispenser is easiest to use.	Link: bit.ly/heavy-duty-tape 

Prints

Print	Recommended Print Details
Wind Tube Poster 	**Standard Letter Size (8.5" x 11")** • You can print this size on any printer • Print in color on cardstock then laminate or display the print in a tabletop acrylic sign holder Link: bit.ly/vertical-wind-tube-poster-01 **Large Poster Size (24" x 36")** • You may need to order a poster this size from a print store such as Office Depot • Use removable mounting tape to hang up the poster Link: bit.ly/vertical-wind-tube-poster-02
Display Area Sign  See page 12	**Standard Letter Size (8.5" x 11")** • You can print this size on any printer • Print in color on cardstock then laminate or display the print in a tabletop acrylic sign holder Link: bit.ly/wind-tube-display-sign
Vertical Wind Tube Interactive Exhibit Design, Build, and Play Guide 	This guide is made available online to print and share. Link: bit.ly/vertical-wind-tube-exhibit-guide