Science in Your Airplane Seat

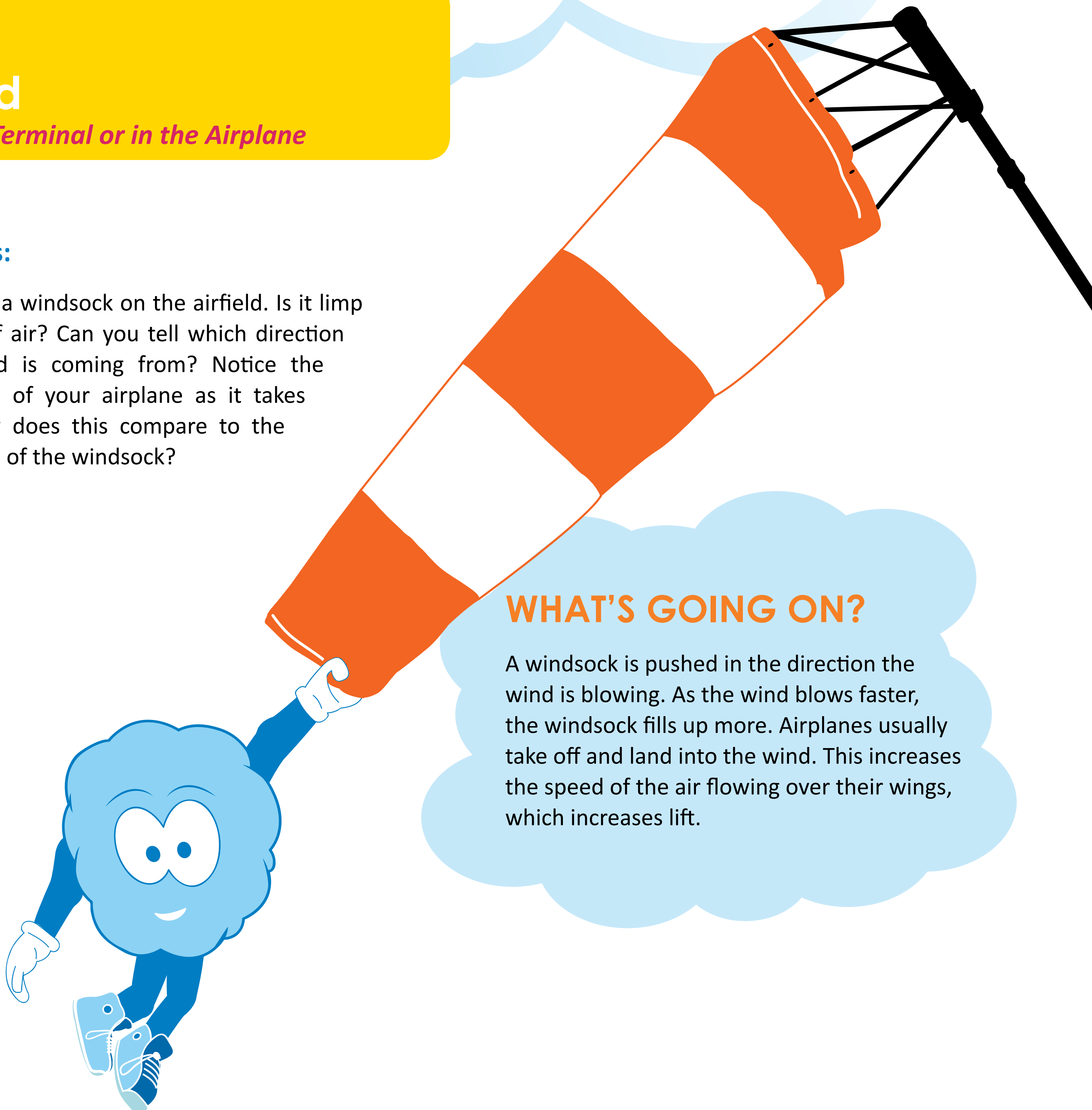
Why are airplane wings shaped the way they are? What can pretzels tell you about flying? Instead of catching a nap or flipping through the in-flight magazine, do some experiments next time you fly.

Wind

In the Terminal or in the Airplane

Try This:

Look for a windsock on the airfield. Is it limp or full of air? Can you tell which direction the wind is coming from? Notice the direction of your airplane as it takes off. How does this compare to the direction of the windsock?



WHAT'S GOING ON?

A windsock is pushed in the direction the wind is blowing. As the wind blows faster, the windsock fills up more. Airplanes usually take off and land into the wind. This increases the speed of the air flowing over their wings, which increases lift.

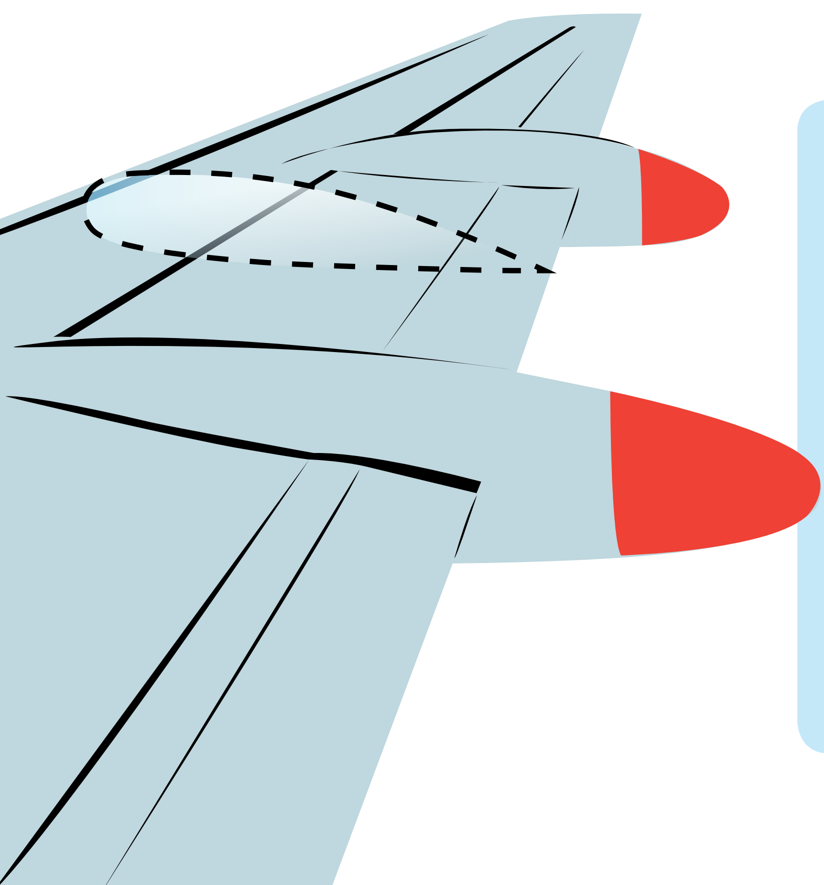
Wing Shape

In the Terminal or in the Airplane

Try This:

Look at the wings of an airplane from the side and notice their shape. How would you describe it? Which edge of the wing is pointy? Which is rounded? Why do you think they are shaped this way?

During takeoff and landing, watch the wing. Notice the flaps that move. How do they change the shape of the wing? Why do you think these changes are made?

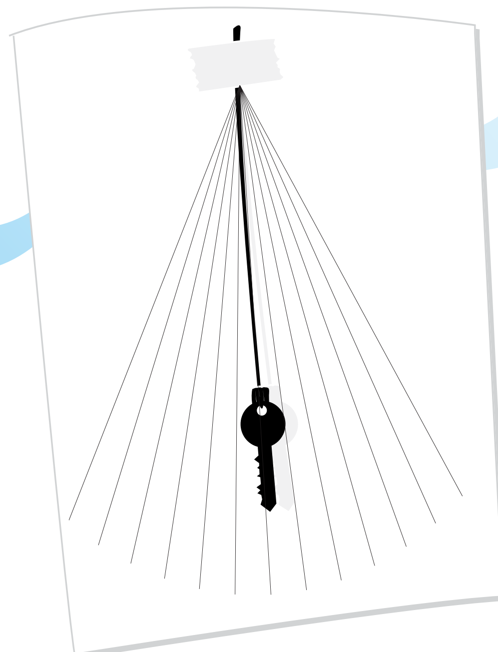


WHAT'S GOING ON?

The cross section of most airplane wings is shaped something like a teardrop on its side—the front edge is thick and rounded, the back edge is thin and pointed. The thicker front edge forces air to speed up as it moves up and over the wing. As the air speeds up, it pushes on the wing less than the air below the wing. The "pushier" air below the wing helps lift the airplane into the air. During takeoff and landing, the pilot extends flaps on the back edge of the wing. The flaps increase the curve of the wing, which helps create more lift at slower speeds. After takeoff, the pilot retracts the flaps.

In-Flight Physics

In the Airplane



Try This:

Before the airplane begins moving, tie one end of a string to a small weight (such as a paper clip or key) and tape the other to the worksheet at the back of this handout. Tape the worksheet to your window. Watch the string as the airplane begins to speed up and move down the runway. Try to mark where the string swings. As the airplane lifts off, look straight at the paper and notice where the string is hanging. Mark this point on the worksheet. Mark the string's position a few minutes later, while the airplane is still climbing. Mark it again after the pilot announces that the airplane is at its cruising altitude. As the airplane is landing, but before it touches the runway, mark the string's position one last time.

Materials

- Tape
- String
- Paper clip or key
- Pencil or pen
- Worksheet

Now Try This:

Mark the string's angle as the airplane turns on the runway, then again as it turns in flight. On the ground, airplanes can't tilt as they turn on runways. In the air though, airplanes tilt into the turn just as you do when you make a tight turn on your bicycle.

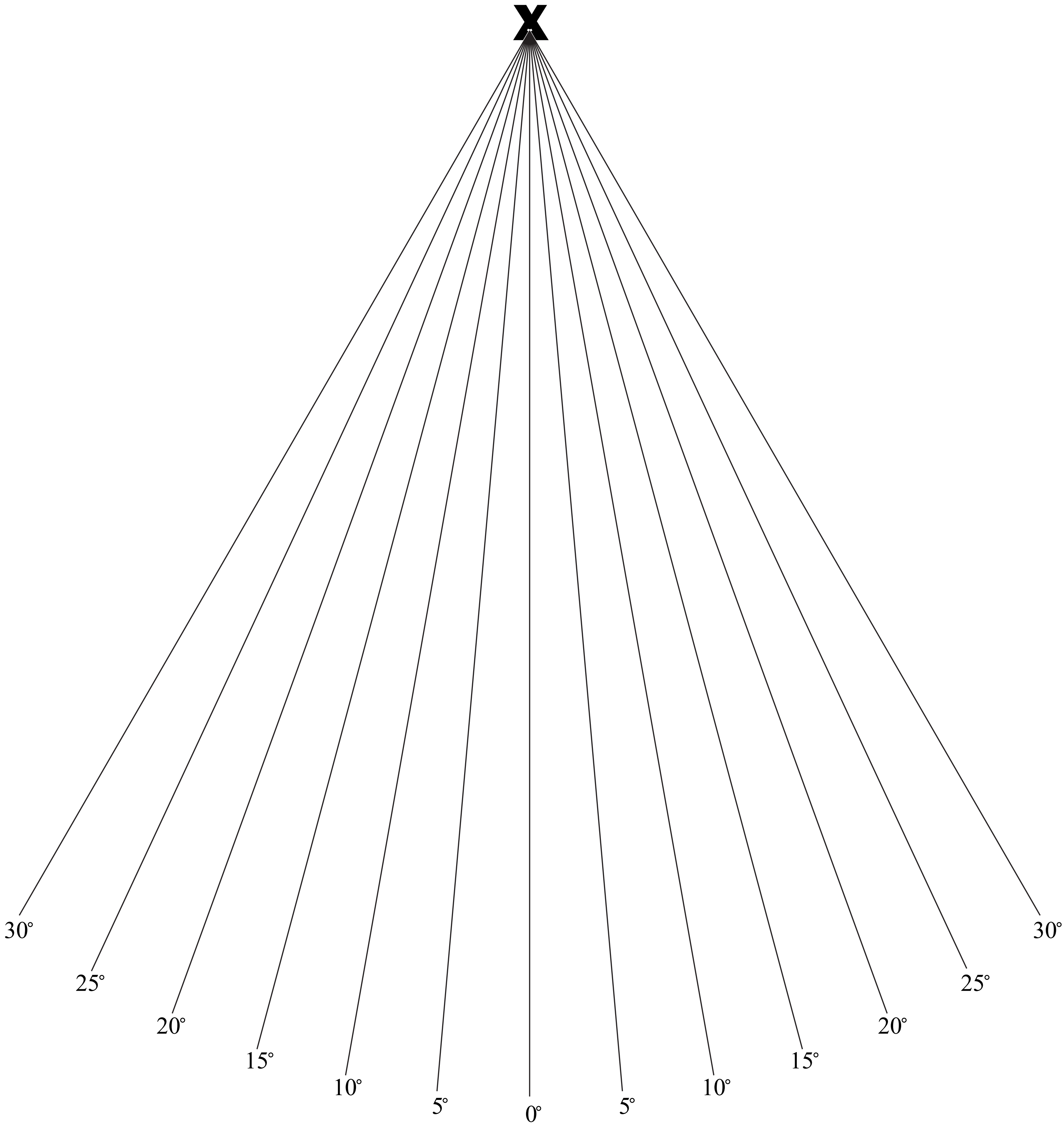
WHAT'S GOING ON?

The string is measuring the airplane's tilt and/or its change in speed (also called acceleration). During a test flight of this activity, the string swung between 15 and 20 degrees toward the back of the airplane as it took off. During most of the climb, the string held steady at 10 degrees, and for the rest of the flight it stayed right around zero degrees. And as the airplane was landing, the string swung about 10 degrees toward the front of the airplane.

Worksheet for In-Flight Physics Activity

Before the airplane begins moving, tie one end of a string to a small weight (such as a paper clip or a key) and tape the other end of the string on the “X.” Tape this sheet to your window so that the string hangs exactly along the zero degree line.

Tape String Here



Puffy Pretzels and Popping Ears

In the Airplane

Try This:

Ask for a bag of pretzels before the airplane takes off. Study the bag carefully—notice its size, its shape, whether you can squish it—but don't open it! Put the bag away in a safe place during takeoff. When the pilot announces that the airplane has reached its cruising altitude, look at the snack bag again. Has its size or shape changed? Can you squish it now? Why? Put the bag away again until the airplane begins to land. Take out the snack bag again and look for any changes.

Notice how your ears feel throughout the flight. Do they feel different once the airplane begins to fly level? What do you think is happening inside your ears?

Materials

- **Unopened bag of pretzels or chips**

WHAT'S GOING ON?

Air pressure decreases as you go higher in altitude. If you were outside the airplane when it is flying at 30,000 feet, you'd hardly be able to breathe because the air pressure is low. You can breathe easily in the airplane because the cabin is pressurized—the air pressure is only slightly lower than normal.

The snack bag probably looked a lot puffier once the airplane was in the air. The snacks were packed with normal air pressure, so air presses on the inside and outside of the bag equally. During flight, as the cabin pressure drops, the pressure inside the bag pushes the bag outward. As the airplane lands, the air pressure outside the bag increases and pushes on the bag, so it seems to deflate. Remember, the amount of air inside the bag doesn't change during any part of this activity—only the pressure of the air outside it. If your snack bag seemed to stay the same throughout your flight, the snack might have been packed in a high-altitude city, such as Denver or Salt Lake City. Why would this make a difference?

Your ears behave like the snack bag. On the ground, they are filled with normal air pressure, so air presses on your eardrums equally. As the pressure inside the airplane drops, the pressure inside your ears pushes on your eardrums. This can make them hurt. You can relieve the pressure by helping some of the air in your ears escape though an opening into your throat. The best way to equalize the pressure in your ears is by chewing gum or swallowing.

Sit Back and Relax

In the Airplane

Try This:

Settle back into your seat and close your eyes. Do you feel like you're moving? What clues do you feel? Can you tell how fast you're moving? Repeat this activity if the airplane turns to approach the airport. Do you feel differently now? Why? Compare how you feel to when you are in a turning car or on a bicycle pedaling around a curve. What is different or similar? While the airplane is descending, repeat the activity. Compare how you feel to when the airplane was cruising and turning. What feels different?

WHAT'S GOING ON?

The observations you make during this activity show one of the laws of motion: A force is needed to change the speed or direction of an object. For example, if you're moving in a straight line at a constant speed—such as when the airplane is cruising—you won't be able to feel the motion because nothing is forcing you to change your speed or direction. However, you should feel a change in motion if you are in an airplane that is speeding up or slowing down. You may also notice when the airplane is turning. Airplanes make turns that are perfectly banked or coordinated—they tilt at an angle, into the turn. You do this on a bicycle too. But if you are in a car that is turning on a flat surface (such as a parking lot), you'll feel "pushed" to the outside of the turn.