Pinnae Possibilities
Investigation #3

Description
Big ears, small ears, ears that flap, and ears that rotate: Which ears would you prefer?

Materials
• Heavy paper
• Tape
• Paper plates
• Pencil
• Ruler
• Scissors
• Ear plugs
• Funnels of different sizes

Procedure 1: Prepare animal ears
1. Prepare two ear-trumpet pinnae, which are the outer part of an animal’s ear. Roll heavy paper into cone shapes with a narrow opening, or substitute funnels of different sizes.
2. Tape each cone in place and set aside.
3. Then make a pair of flat pinnae by cutting two large pieces of paper in the shape of an elephant’s ear.
4. Cut a small opening in the elephant ears to place against your own pinna.
5. Make a third pair of pinnae out of paper plates.
6. Divide the paper plate into fourths. Here’s how: Lightly fold the paper plate in half so you can barely see a mark. Open the plate and rotate it so the first fold is horizontal. Fold the plate lightly in half again. With a ruler, using the faint fold marks as a guide, draw two straight lines, perpendicular to each other, from edge to edge and running through the center of the plate.

7. Cut out one quarter of the plate and throw that piece away.

8. Bring the cut edges together so they are touching. Tape in place. This should leave a very small hole at the center that can be placed near your own pinna.

Procedure 2: Test the ears.
1. Use an ear plug to plug one ear.
2. Place the ear trumpet just inside your ear canal.
3. Be careful not to push anything forcefully or deep into the ear.
4. Direct the cone different ways and listen. What do you notice?
5. Remove the cone. Try cupping one hand above your listening ear.
6. Does cupping your hand capture more sound?
7. What animals can rotate their ears to capture sounds?
8. Try the other types of pinnae you made. What do you notice?
9. Remove the ear plug and try each set of pinnae in both ears.
10. What if you combined different kinds of pinnae in each ear? How would that effect the sounds you hear?

My Results
Explanation
Our outer ears, or pinnae, are designed to catch sound waves and direct them into our ear canals. The shapes of our ears are especially effective at catching the frequencies of the human voice. Not only do our outer ears catch different sounds, but they also amplify the sound up to 100 times while filtering out background sounds. Using the cone-shaped or paper-cupped pinnae captures and amplifies even more sounds, but the opening has to be directed toward the source. Turning the cone away from the sound makes the sound seem further away. This is why you will see animals like horses or dogs moving their ears to better capture sounds around them. The larger ears do little to improve our hearing, but for elephants, larger ears do help to keep them cooler. When combining different ears or moving the ears around, you may have felt confused. This is because our brains are not accustomed to moving our ears to process the directions from which sounds come.

Think about this: Find a diagram of the human ear on the internet or in a book. The outer part of the ear is called the pinna. Its purpose is to catch and direct sound waves through the ear canal to strike the ear drum. The 10-millimeter drum membrane vibrates and causes a tiny bone called the malleus to wiggle. The malleus acts like a lever and transfers the energy to two more bones, the incus and stapes. The amplified pressure waves travel through the cochlea and causes fluid and fibers to resonate. The resonance is identified by tiny hair cells, which begin to move, sending an electrical signal to the cochlear nerve and then to the brain. What a sweet sound!

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