Friends of the Island Fox

a Program of the Channel Islands Park Foundation, a 501 (c) (3) public benefit org.
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Grade Level: 4 - 7

Time: 30 min. class period

Objective: Students will 1) understand basic olfactory anatomy, 2) calculate and measure surface area, 3) experiment to solve an engineering problem.

Method: Students will use math skills to experiment and problem solve.

Materials: Two colors of paper (i.e. white and a color), rulers, scissors, pencils, paper clips, clear tape, an aerosol scent.

CA Standards:

Science: 4.6b,c; 5.2; 7.5b,; Math: 4 Number Sense 3.0, Measurement & Geometry 1.1, 1.2 , 3.6, Reasoning 1.1, 2.3; 5 Number Sense 2.1, Measurement & Geometry 1.4, 2.1, Reasoning 1.1, 2.3; 6 Number Sense 2.1, Reasoning 1.1; 7 Number Sense 1.2, Measurement & Geometry 1.1, 2.1, 3.5, Reasoning 1.1, 2.2, 2.5

EEI: Not Applicable

The Nose Knows

As a canine, like the domestic dog, the Channel Island fox has a greater sense of smell than humans. One of the factors that influences this sensitive olfactory ability is surface area.

Background: Finding food on the Channel Islands can be difficult. The island fox uses its eyes, ears and its sensitive nose to locate fruit and animal prey. It can smell insects under the ground and track deer mice to their burrows.

For a mammal to smell an odor, molecules must be shed off of an item into the air or onto a surface. These molecules must then come in contact with special receptor cells (olfactory sensing cells) in the nose. The olfactory sensing cells then send information to the brain and the smell is detected.

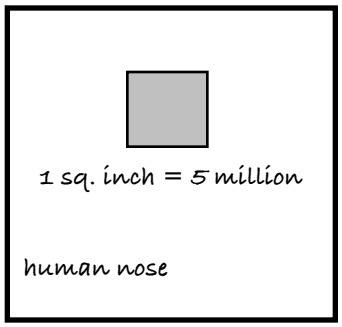
All members of the dog family, canines, have an excellent sense of smell. An animal's ability to smell is related to the surface area in its nose that is covered with olfactory sensing cells. The more sensing cells which can come in contact with the molecules of scent, the better your ability to locate and identify a smell.

The structure of a human nose is like a tube. Inside that tube, the surface area of olfactory sensing cells is equal to approximately 1 square inch, about the size of a postage stamp. That 1 square inch is covered with 5 million odor receptors.

An island fox has a sense of smell 50 times greater than a human. Inside the fox's nasal passage 50 square inches are covered with approximately 200 to 250 million olfactory sensing cells. To create the surface area for this large amount of sensing cells, canine noses have evolved a honeycomb structure that increases surface area without increasing size. This allows an island fox's nasal passage to be smaller than a person's, and still have 50 times the interior surface area. With more surface area, the island fox's nose is more likely to detect even the faintest smell represented by just a few molecules.

Procedure:

1. Assign students to small groups. Each group should have a piece of white paper and a piece of colored paper, a ruler, a pencil, a pair of scissors, 2 paper clips, and clear tape or a stick glue. (To shorten time, the pieces of paper for the nasal passages and the human sensing cells can be pre-cut. For each group: Two 5”x5” squares of white paper and one 1”x1” square piece of colored paper.)
2. Explain to students how the olfactory sensing cells in their nose detect scent molecules in the air and send information to their brain. Demonstrate by spraying some kind of scent into the air. There are 5 million sensing cells on one square inch of area in the human nasal passage. Have students measure out two 5”x5” squares of white paper and one 1”x1” square of the colored paper.
3. Have students label one of the 5” squares “human nose” and the other “island fox nose.”
4. Have them attach the 1” colored square somewhere in the middle of the “human nose” square. Label the colored square - “1 square inch = 5 million sensing cells.” Have them roll the paper into a tube with the side edges of the paper just meeting and the colored square on the inside. Secure the edges together with a paper clip at each end. This is a model of the human nose. Air comes in through the nose. Molecules of scent are in the air as it passes through the nose. If the molecules of scent come in contact with the square of sensing cells, information is sent to the brain to tell us we smell something. How could molecules of scent get past the sensing cells in the human nose? What would happen if you had a cold with a runny nose? How might it affect your ability to smell?



5. The island fox is a small canine. It stands only 12 inches tall. It has a small nose for a member of the dog family, but that nose is only a little bit smaller than a person’s. Explain that the island fox has a sense of smell that is 50 times better than a person’s. Ask the students to think along the idea of surface area. How might the fox’s nose might be different and therefore better at detecting smells?
6. Surface area is the measurement of how much exposed area an object has. On a flat surface, like a piece of paper, surface area can be calculated by multiplying the length of the two sides together to determine a square unit measurement. Open up the “human nose” and lay it flat. Have the students measure the whole “human nose” (5”x5”) and calculate the amount of surface area in square inches. 5” x 5” = 25 square inches.
7. If the island fox’s sense of smell is 50 times greater than a person’s, and a person has 1 square inch of sensing cells, how many square inches of sensing cells might the island fox have in its nose? 50 square inches of surface area. Have the students measure out a piece of colored paper that will give them 50 square inches. Can pieces with the same surface area have different perimeter measurements?

8. Here is nature's challenge: The 50 square inches of surface area must fit on the inside of the island fox's nose tube. Encourage students to be creative as they try to solve this problem. They can cut and tape or glue, but they must use all of the surface area. After a few minutes, give them the clue that a flat surface can have surface area on two sides, if it is exposed to air on both sides.

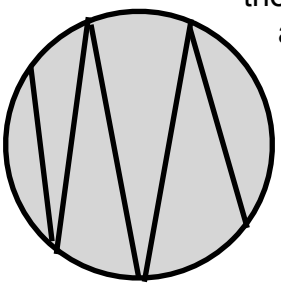
Assessment:

9. Have groups share their solutions and explain why their nose design will be successful for picking up smells.

10. How does a good sense of smell help a wild animal like the island fox?

Conclusion:

11. Demonstrate how an island fox's nose has been designed by evolution. A layer of sensing cells covers the whole inside of the nasal tube (the whole inside of the 5"x5" square). Role the paper, with the colored interior layer, into a tube. Then a 5"x 2.5" piece of the colored paper is folded like a fan or accordion and inserted into the nasal tube so that air contacts both sides. This accommodates the full 50 square inches of surface area. The island fox like most canines has thin layers of bone, called ethmo-turbinate bones, that create a honeycomb-type structure and increase the surface area for olfactory sensing cells in the nose.



Additions: Combine with *Sniff This!* and *Your Parents' Nose* for an Olfactory Lab.

1/26/12