After taking a mixture of mind-altering drugs one night, Stephen D., a 22-year-old medical student, dreamed that he had become a dog and was surrounded by extraordinarily rich, meaningful smells. The dream seemed to continue after he woke up—his world was suddenly filled with pungent odors.

Walking into the hospital clinic that morning, "I sniffed like a dog. And in that sniff I recognized, before seeing them, the twenty patients who were there," he later told neurologist Oliver Sacks.

"Each had his own smell-face," he said, "far more vivid and evocative than any sight-face." He also recognized local streets and shops by their smell. Some smells gave him pleasure and others disgusted him, but all were so compelling that he could hardly think about anything else.

The strange symptoms disappeared after a few weeks. Stephen D. was greatly relieved to be normal again, but he felt "a tremendous loss, too," Sacks reported in his book *The Man Who Mistook His Wife for a Hat and Other Clinical Tales*. Years later, as a successful physician, Stephen D. still remembered "that smell-world—so vivid, so real! It was like a visit to another world, a world of pure perception, rich, alive, self-sufficient, and full...I see now what we give up in being civilized and human."

Being civilized and human, for one thing, that our lives are not ruled by smells. The social behavior of most animals is controlled by smells and other chemical signals. Dogs and mice rely on odors to locate food, recognize trails and territory, identify kin, find a receptive mate. Social insects such as ants send and receive intricate chemical signals that tell them precisely where to go and how to behave at all times of day.

But humans "see" the world largely through eyes and ears. We neglect the sense of smell—and often suppress our awareness of what our nose tells us. Many of us have been taught that there is something shameful about odors.

Yet mothers can recognize their babies by smell, and newborns recognize their mothers in the same way. The smells that surround us affect our well-being throughout our lives.

Smells also retain an uncanny power to move us. A whiff of pipe tobacco, a particular perfume, or a long-forgotten scent can instantly conjure up scenes and emotions from the past. Many writers and artists have marveled at the haunting quality of such memories.

In *The Remembrance of Things Past*, French novelist Marcel Proust described what happened to him after drinking a spoonful of tea in which he had soaked a piece of madeleine, a type of cake: "No sooner had the warm liquid mixed with the crumbs touched my palate than a shudder ran through my whole body, and I stopped, intent upon the extraordinary thing that was happening to me," he wrote. "An exquisite pleasure had invaded my senses...with no suggestion of its origin...

"Suddenly the memory revealed itself. The taste was of a little piece of madeleine which on Sunday mornings...my Aunt Leonie used to give me, dipping it first in her own cup of tea....Immediately the old gray house on the street, where her room was, rose up like a stage set...and the entire town, with its people and houses, gardens, church, and surroundings, taking shape and solidity, sprang into being from my cup of tea."

Just seeing the madeleine had not brought back these memories, Proust noted. He needed to taste and smell it. "When nothing else subsists from the past," he wrote, "after the people are dead, after the things are broken and scattered...the smell and taste of things remain poised a long time, like souls...bearing resiliently, on tiny and almost impalpable drops of their essence, the immense edifice of memory."

Proust referred to both taste and smell—and rightly so, because most of the flavor of food comes from its aroma, which wafts up the nostrils to cells in the nose and also reaches these cells through a passageway in the back of the mouth.

Our taste buds provide only four distinct sensations: sweet, salty, sour, and bitter. Other flavors come from smell, and when the nose is blocked by a cold, most foods seem bland or tasteless.
Both smell and taste require us to incorporate—to breathe in or swallow—chemical substances that actually attach themselves to receptors on our sensory cells. Early in evolution, the two senses had the same precursor, a common chemical sense that enabled bacteria and other single-celled organisms to locate food or be aware of harmful substances.

How we perceive such chemical substances as odors is a mystery that, until recently, defeated most attempts to solve it. Anatomical studies showed that signals from the olfactory cells in the nose reach the olfactory area of the cerebral cortex after only a single relay in the olfactory bulb of the limbic system. The olfactory area of the cerebral cortex, in turn, connects directly with a key structure called the hypothalamus, which controls sexual and maternal behavior.

When scientists tried to explore the details of this system, however, they hit a blank wall. None of the methods that had proved fruitful in the study of vision seemed to work when studying how we smell.

To make matters worse, very little was known about the substances to which the olfactory system responds. The average human being, it is said, can recognize up to 10,000 separate odors. We are surrounded by odorant molecules that emanate from trees, flowers, earth, animals, food, industrial activity, bacterial decomposition, other humans. Yet when we want to describe these myriad odors, we often resort to crude analogies: something smells like a rose, like sweat, or like ammonia.

Our culture places such low value on olfaction that we have never developed a proper vocabulary for it. In *A Natural History of the Senses*, poet Diane Ackerman notes that it is almost impossible to explain how something smells to someone who hasn't smelled it. There are names for all the pastels in a hue, she writes—but none for the tones and tints of a smell.

Nor can odors be measured on the kind of linear scale that scientists use to measure the wavelength of light or the frequency of sounds. "It would be nice if one smell corresponded to a short wavelength and another to a long wavelength, such as rose versus skunk, and you could place every smell on this linear scale," says Randall Reed, from the Johns Hopkins University School of Medicine who has long been interested in olfaction. "But there is no smell scale," since odorant molecules vary widely in chemical composition and three-dimensional shape.

To find out how these diverse odorant molecules trigger our perception of smell, researchers needed to examine the olfactory cells and identify the receptor proteins that actually bind with the odorants.

**Questions**

*Comprehensively answer the following on a separate sheet of paper.*

1. Explain what the Stephen D. means by "smell face", in your own words.

2. Lower forms of animals seem to rely on smell more than humans. Read between the lines -- why does the author think so? Do you agree? Why or why not? (Hint: It's the same reason human moms and babies recognize each other's smells.)

3. The author talks about how just a whiff of a familiar smell brings back a flood of memories. Explain a situation in your life when this happened.

4. How do our sense of smell and sense of taste work together? Why?

5. Why is the sense of smell so much harder to quantify (to determine the number or extent of something) than the senses of sight and hearing? (Hint: When you quantify something you have to use math to describe it.)