Developing a Community Outreach Program on the Physics of Smell

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Goals:
- Teach people of all ages, especially students, about a relevant yet under-researched everyday process that everyone can relate to

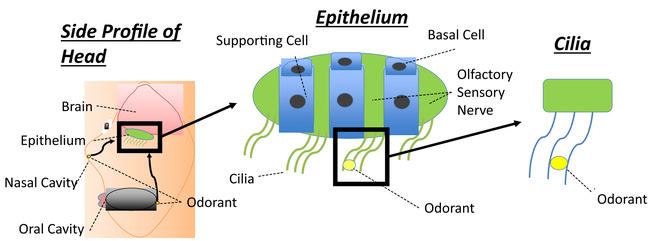
- Relay the importance of learning about the physics of smell; it will allow us to further understand the human body, as well as uncover possibilities for technological applications, such as creating artificial olfactory conduits and pathways

Plan:
- To visit schools and museums and give an interactive presentation that displays how the process of olfaction works and/or write a paper about the project
- Use visually stimulating graphics and videos, a laser demonstration, and 3-D printed materials to capture interest and better represent the physics of olfaction

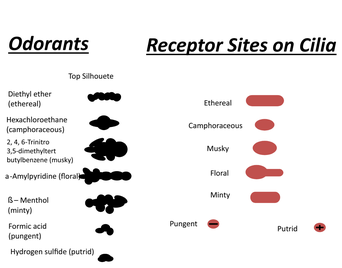
Lock and Key Theory

1963

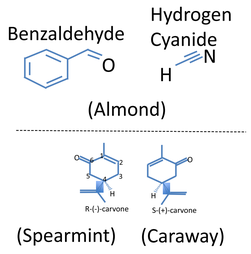
- Odorants fit receptors like puzzle pieces, based on their shape
- Demonstration: 3_D printed receptor landscape and puzzle-piece-like odorants to fit, animations



The entie molecule does not have to fit into the receptor (Shape Theory) - it can be only part of the molecule (Odotope Theory)



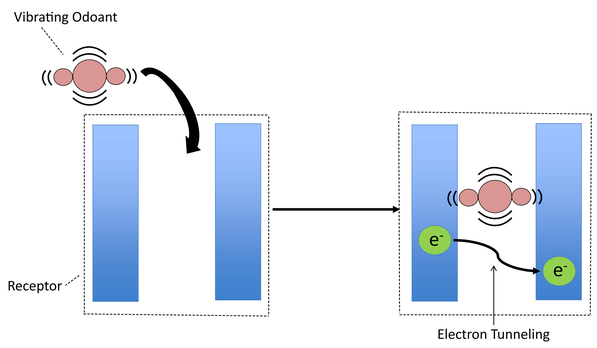
However…



Vibration/Inelastic Elecon Tunneling Theories

1937&1977 / 1996

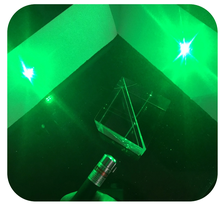
- Odorants are detected through infrared radiation
- Once odorants are detected, a signal is transmited to the brain by quantum processes
- Demonstration: frutrated internal reflection (a form of tunneling), animations



The most widely accepted theory of detection to date combines both Lock and Key Theory and Vibration Theoy; that is, an odorant is detected through both its shape and vibrational patterns. The Inelastic Electron Tunneling Theory is the most widely accepted theory for signal transmitance

Lock and Key Model

Designed a 3-D printed Lock-n-key model that students can engage with during the presentation.

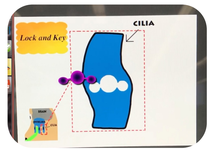


Tunneling

Designed a simple demostration using frustrated total internal reflection to demostrate the concept of tunneling

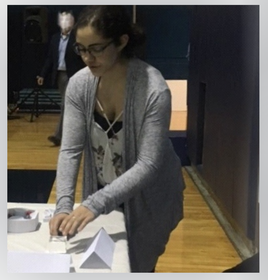
Animations

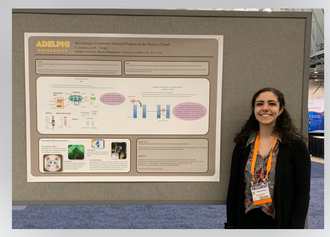
Created a number of animations that demostration the process of smell.



Current Progress

The research has been presented at Rocky Point High School STEM Exposition, the American Physical Society March Meeting, and the Eastern Long Island Mini Maker Faire. Currently we are in the process of making more 3-D prints of the receptors and finalizing the frustrated internal reflection demonstration.





What's Next?

-Putting all the pieces together into one coherent demonstration and presenting it at schools/museums and/or writing a paper about the project

-Reflecting on what worked and what did not, and adjusting the demonstration accordingly. This reflecting process will be done after every demonstration to continually improve it.

References

[1] Bentley R. The Nose as a Stereochemist. Enantiomers and Odor. ChemInform **37,** 2006.
[2] Brookes JC. Olfaction: the physics of how smell works? Contemporary Physics **52**, 385–402, 2011.
[3] Damask, A. C., and Charles E. Swenberg.Medical Physics. Academic Press, 1984.
[4] Sell CS. The Unpredictability of Odor. ChemInform **38**, 2007.

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