# Bio 112 Handout for Physiology 6

This handout contains:
- Today's iClicker Questions
- Handouts for today's lecture

# iClicker Question #26A - <u>before</u> lecture

Which of the following are true?

    A. Scented molecules are detected by cells on the tongue.
    B. Scented molecules bind to channels in the membrane of receptor cells and open them, leading to an action potential.
    C. Scented molecules bind to receptors in the membrane of certain sensory cells.
    D. All of the above
    E. None of the above

# iClicker Question #26B - <u>after</u> lecture

Suppose there were a drug Q that binds to the cAMP-gated $Na^+$ channels found on OSN's and <u>prevents</u> these channels from opening. What effect would this drug have on your sense of smell?

    (A) No effect on your sense of smell.
    (B) It would make your sense of smell <u>more</u> sensitive.
    (C) It would make your sense of smell <u>less</u> sensitive.
    (D) I don't know.

**Beaming in your answers**
1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iCliker by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer as follows:
    a. Press the button corresponding to the answer you've selected (A thru E).
    b. The "STATUS" light will flash green to indicate that your answer has been received. If the "STATUS" light flashed red, your answer was not received; you should re-send it until you get a green "STATUS" light.

# Bio 112 Smells

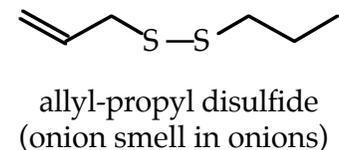**Key players**:
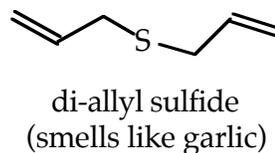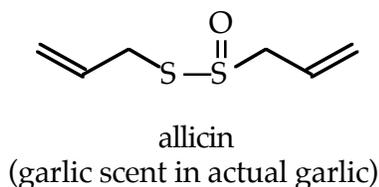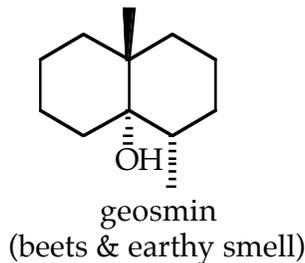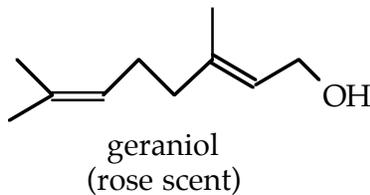These are all described in Campbell pages 206-217.

1. <u>Scent Molecule</u> a small molecule (see below) that has a scent (a.k.a. an "odorant"). Roughly equivalent to the "growth factor" in the Cancer section of Bio 111.
2. <u>Odorant Receptor Protein (ORP)</u> a protein that is embedded in the membrane. The outside-the -cell part of the receptor binds the scent molecule - receptors bind only one kind of scent molecule (or a closely-related family of molecules). Once the scent molecule is bound, the inside-the-cell portion of the receptor becomes active and activates G-proteins. Roughly equivalent to the "receptor" in the Cancer section of Bio 111.
3. <u>G-protein</u> a protein that is activated by an active receptor; it has a time-delayed deactivation mechanism. Active G-protein activates ATCase. Roughly equivalent to the "ras protein" in the Cancer section of Bio 111. See Campbell fig. 11.7
4. <u>Adenylyl cyclase (ATCase)</u> a protein which, when activated by active G-protein converts the small molecule ATP to the small signaling molecule cAMP. See Campbell fig. 11.9 and 11.10
5. <u>ATP</u> the same ATP from glycolysis, etc. See figure 11.9.
6. <u>cAMP</u> (cyclic AMP) a modified form of ATP that is used as a signal inside some cells (see below). See figure 11.9



ATP
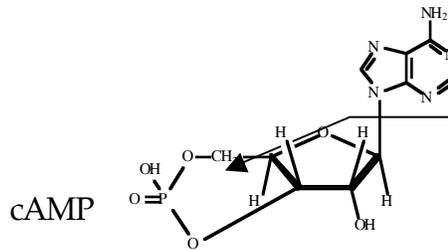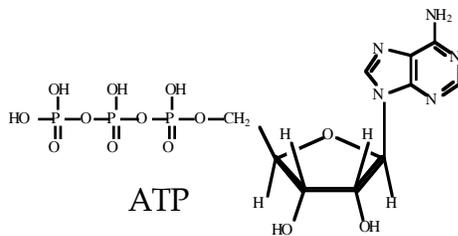
cAMP

Notice the ring - that's why it's "cyclic".

7. <u>cAMP-gated $Na^+$ channels</u> sodium channels that open when cAMP is present.

## Some scented molecules:



geraniol
(rose scent)

geosmin
(beets & earthy smell)

allicin
(garlic scent in actual garlic)

di-allyl sulfide
(smells like garlic)

allyl-propyl disulfide
(onion smell in onions)
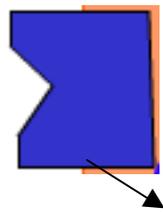
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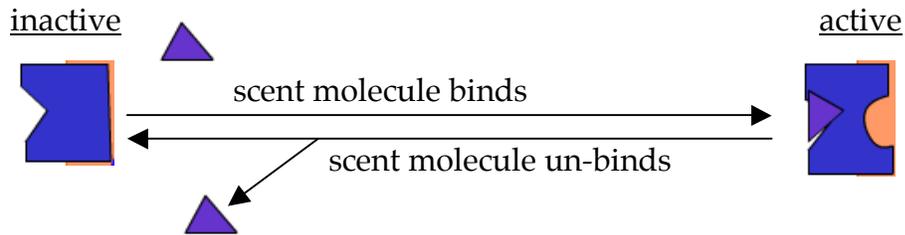# Bio 112 Scent Transduction

**Cast of Characters** Note that each has a turn-on and a turn-off mechanism.

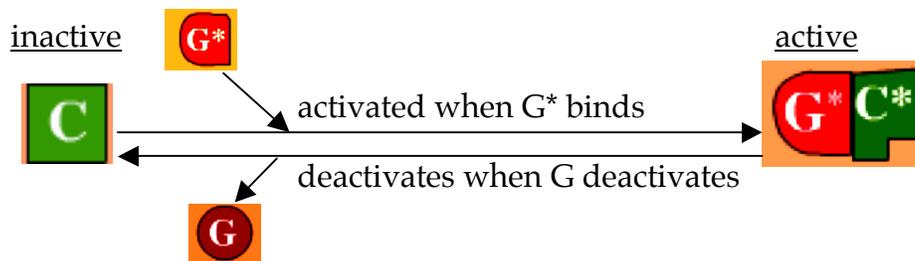1) **Scent Molecule**: one of millions of molecules that we can smell.

2) **ORP** (odorant receptor protein). Specialized to bind one scent molecule or a set of related scent molecules. It has two forms:

inactive     active

scent molecule binds

scent molecule un-binds

3) **G-protein**. A signal transduction protein used in many systems. **Catalytically** activated by active ORP; deactivates spontaneously after a short time.

inactive     active

G     activated by active ORP     G*

deactivates on its own after delay
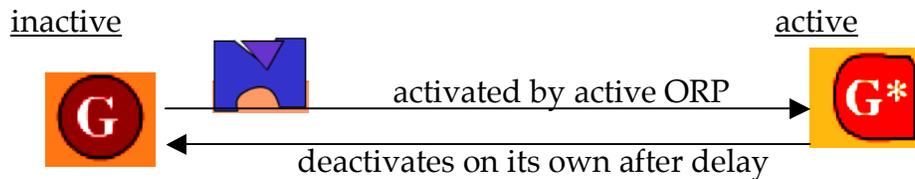
4) **ATCase** (adenylate cyclase). Another signal transduction protein used in many systems. **Individually** and reversibly activated by active G-proteins. When active, it converts ATP to cAMP (cyclic AMP).

inactive     active

C     G*     activated when G* binds     G* C*

deactivates when G deactivates

G

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**cAMP**

5) **cAMP** (cyclic AMP). A signaling molecule used in many systems. **Catalytically** synthesized from ATP by ATCase; broken down by PDE (phosphodiesterase) to AMP.
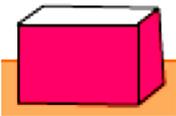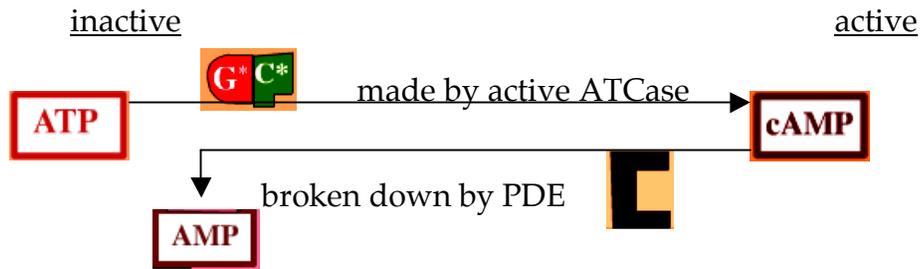


6) **cAMP-gated Na$^+$ channel**. A Na$^+$ channel that is **individually** gated by cAMP. When cAMP binds, it opens; when cAMP is absent, it closes.



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