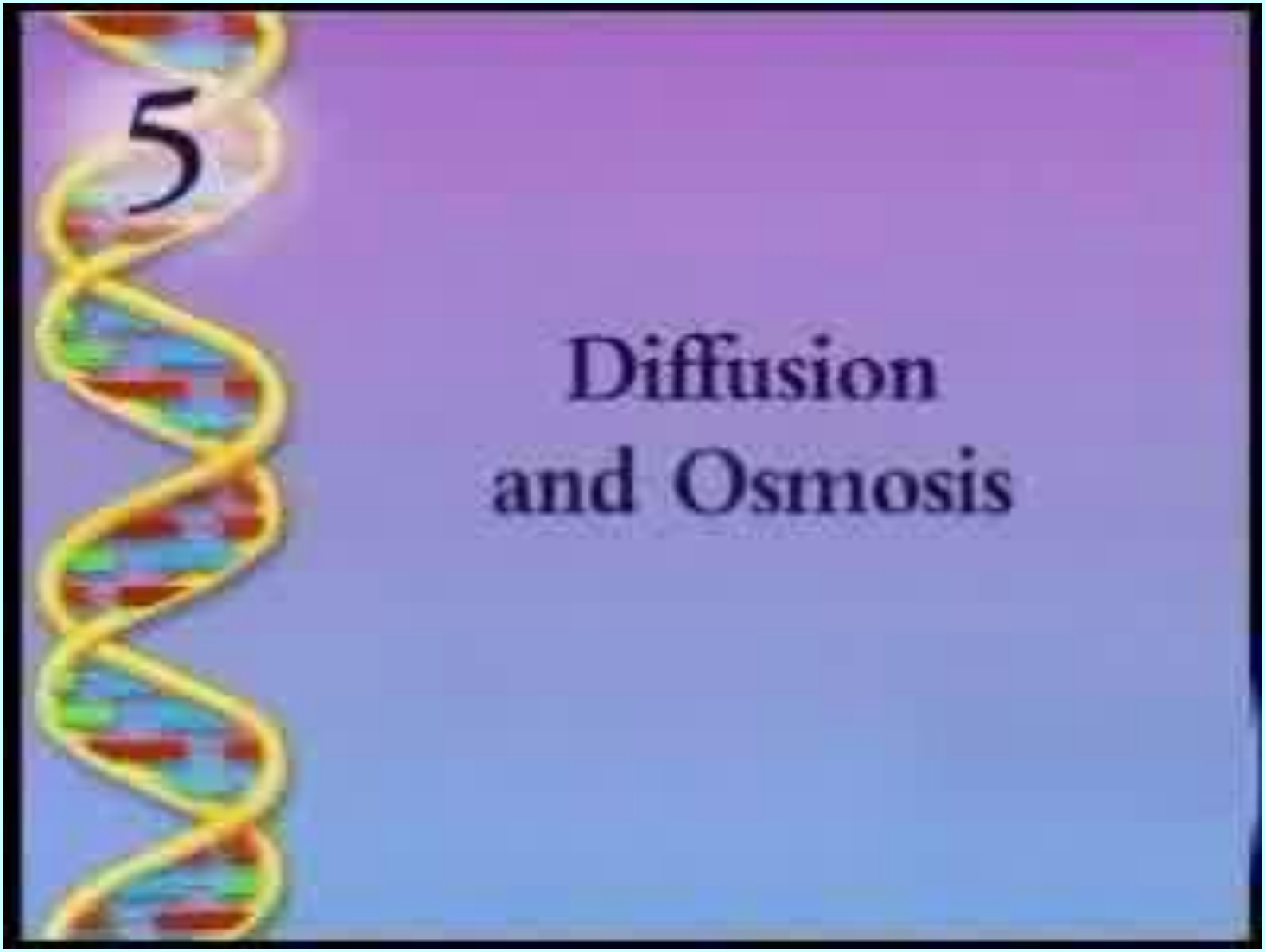
WAYS MOLECULES MOVE

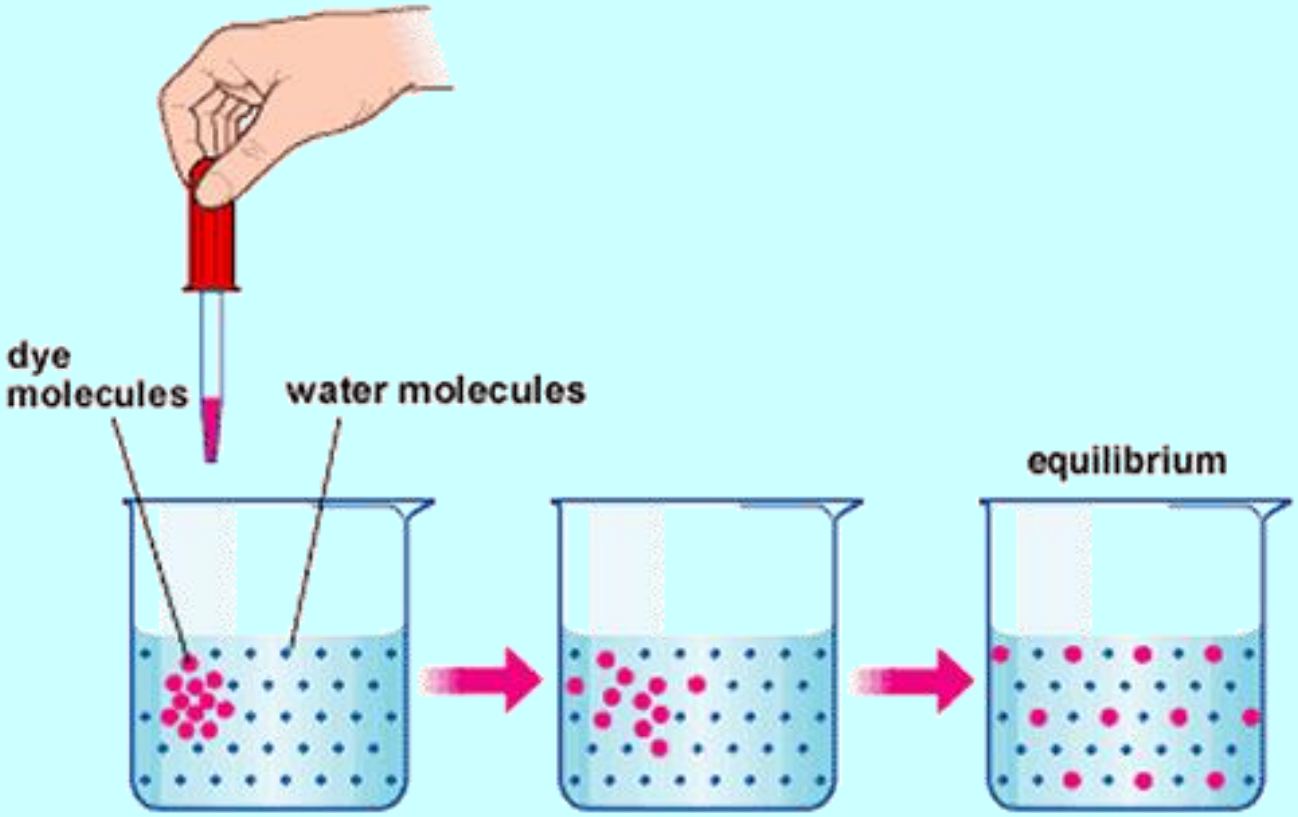
Chapter 7-3

http://www.biology4kids.com/files/cell_main.html



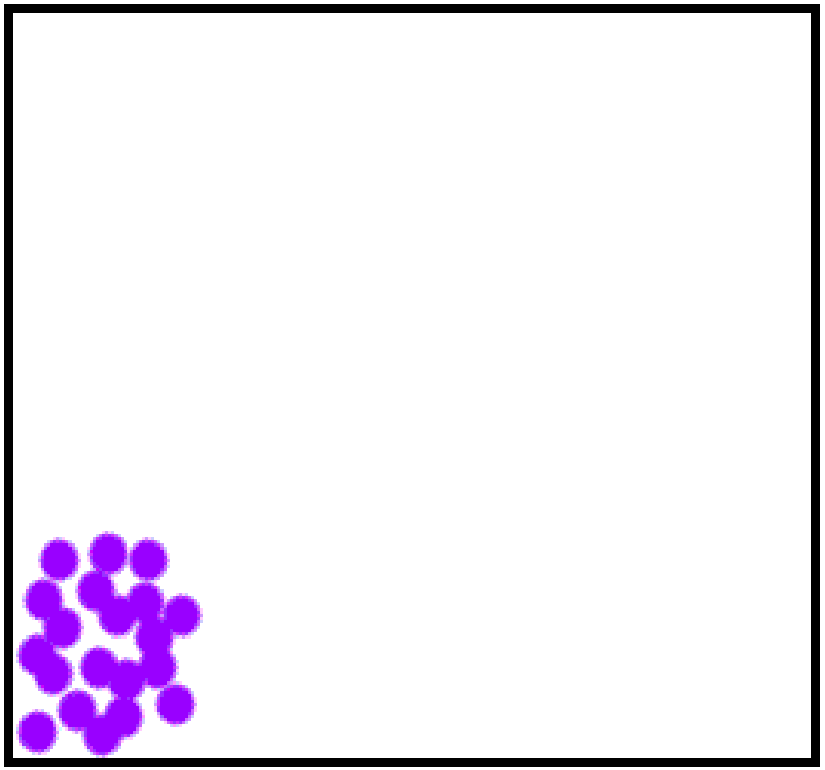
See a video clip about DIFFUSION-7A

Diffusion



http://lhs.lps.org/staff/sputnam/Biology/U3Cell/diffusion_1.png

Animatioin from: http://www.biologycorner.com/resources/diffusion-animated.gif



Molecules move

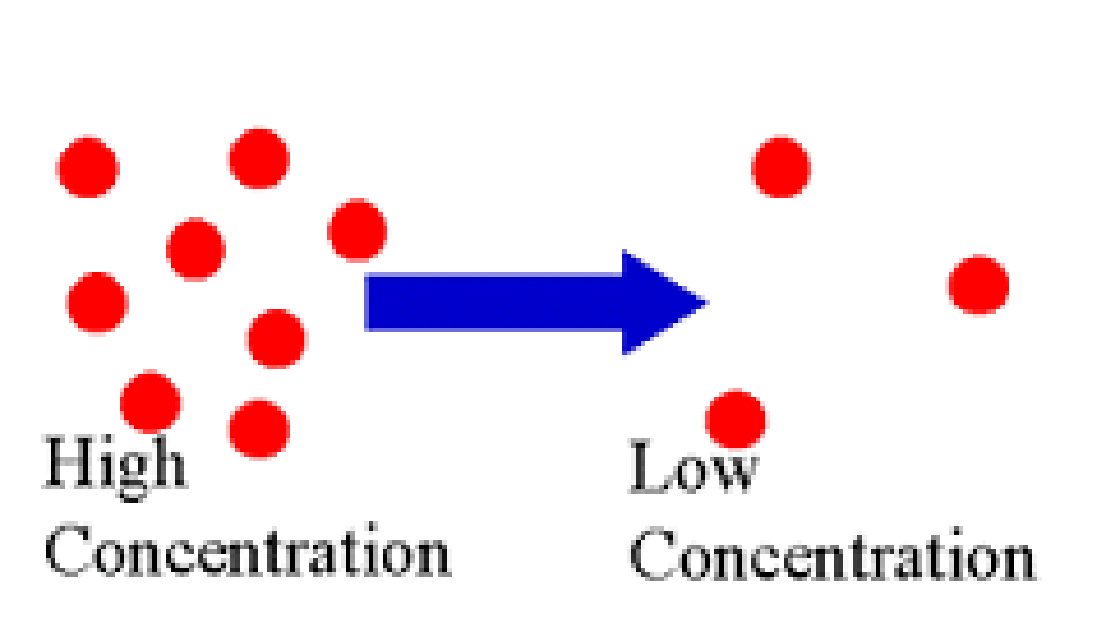
FROM "where there's A LOT"

to "where there's NOT"

DIFFUSION across a space

Happens anytime there is a DIFFERENCE in concentration in one place compared to another

= Concentration gradient



DIFFUSION across a SPACE

Molecules move automatically DOWN the concentration gradient from an area of Higher concentration to an area of Lower concentration

- EXAMPLES

Blue dye in beaker demo,
Someone making popcorn/grilling out
Strong perfume,
Bad smell in room

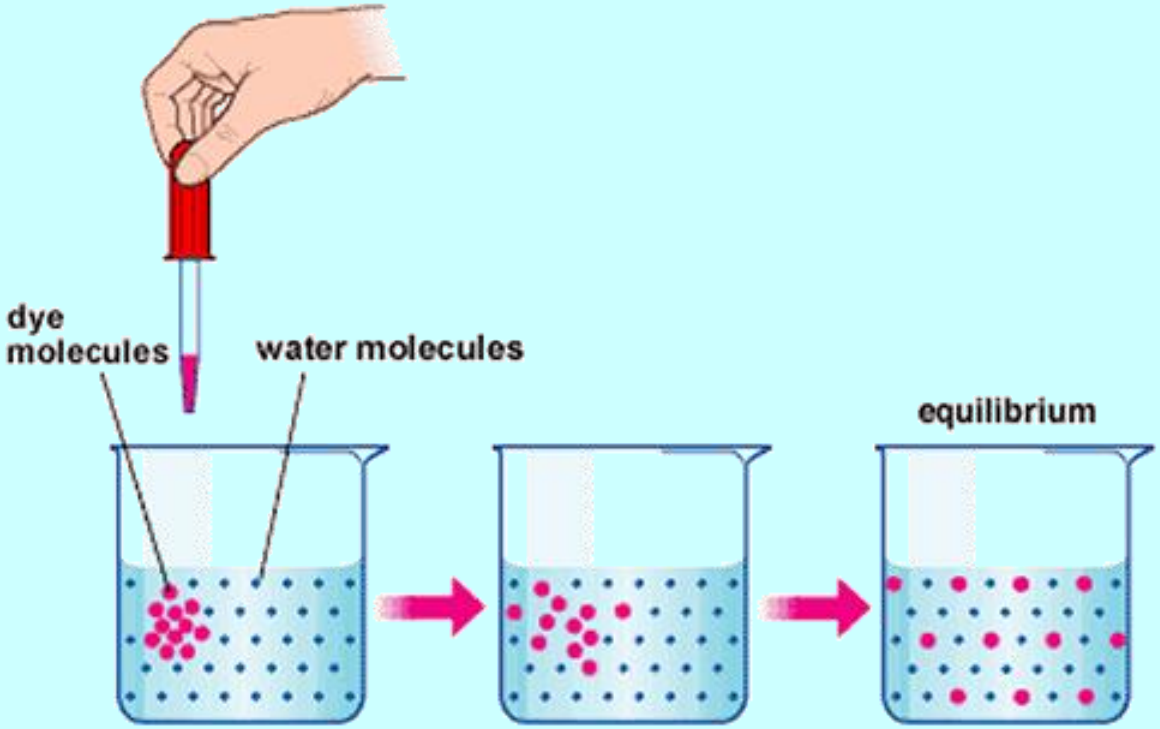
http://leighhouse.typepad.com/blog/images/kool_aid.jpg

http://www.swapmeetdave.com/Humor/Farts.htm

DIFFUSION across a space

Diffusion continues until the concentration is equal everywhere in space

= Equilibrium



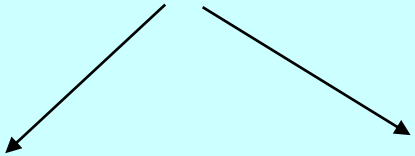
http://lhs.lps.org/staff/sputnam/Biology/U3Cell/diffusion_1.png

Movement of molecules across the cell membrane
"Transport"

High to Low

Passive transport

No energy



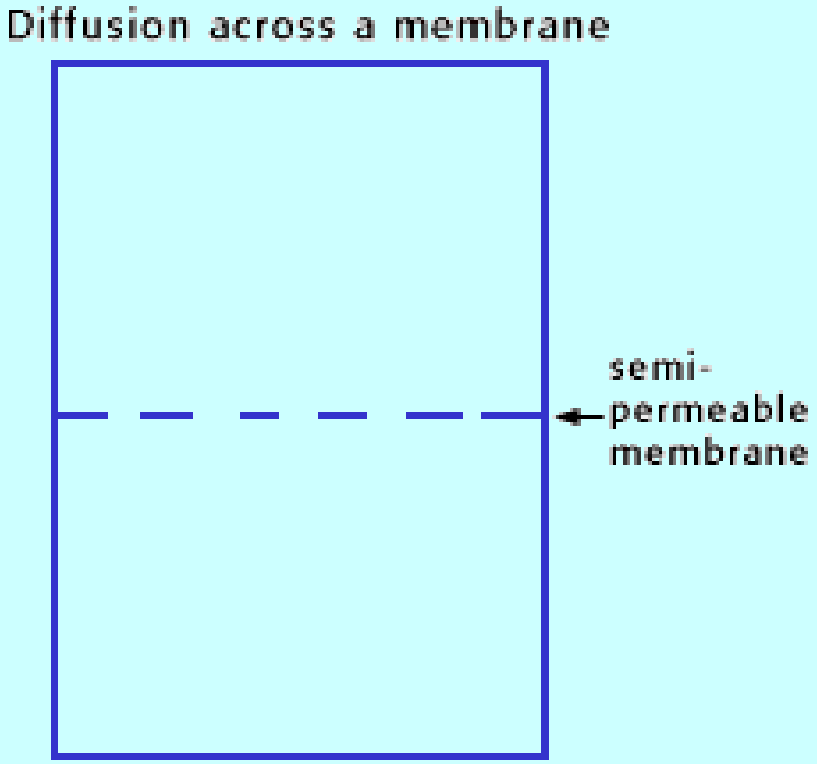
Simple diffusion **Facilitated diffusion**

Low to high

Active transport

Requires energy

Diffusion can happen ___across___ a ___membrane___ in a cell, too

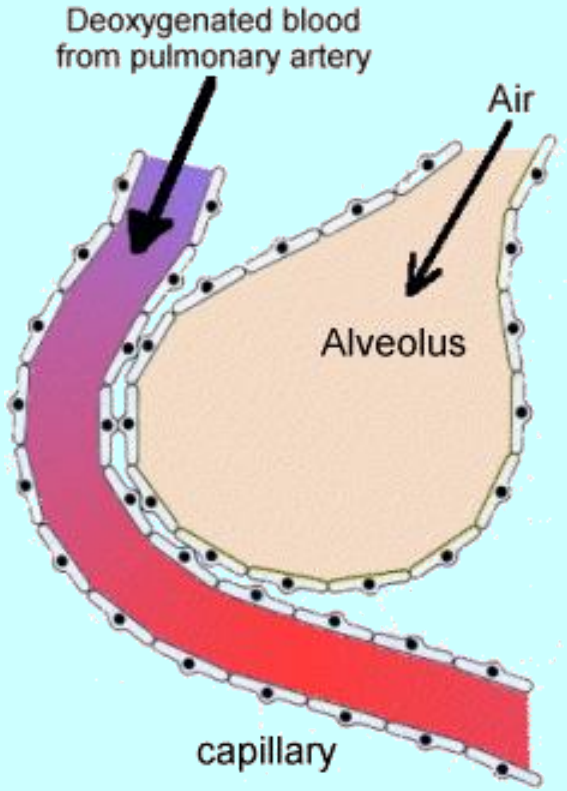


…as long as membrane will let the molecule ___pass through___

CELL EXAMPLE:

DIFFUSION automatically moves oxygen from HIGHER concentration (in lungs) to a LOWER concentration (in blood)

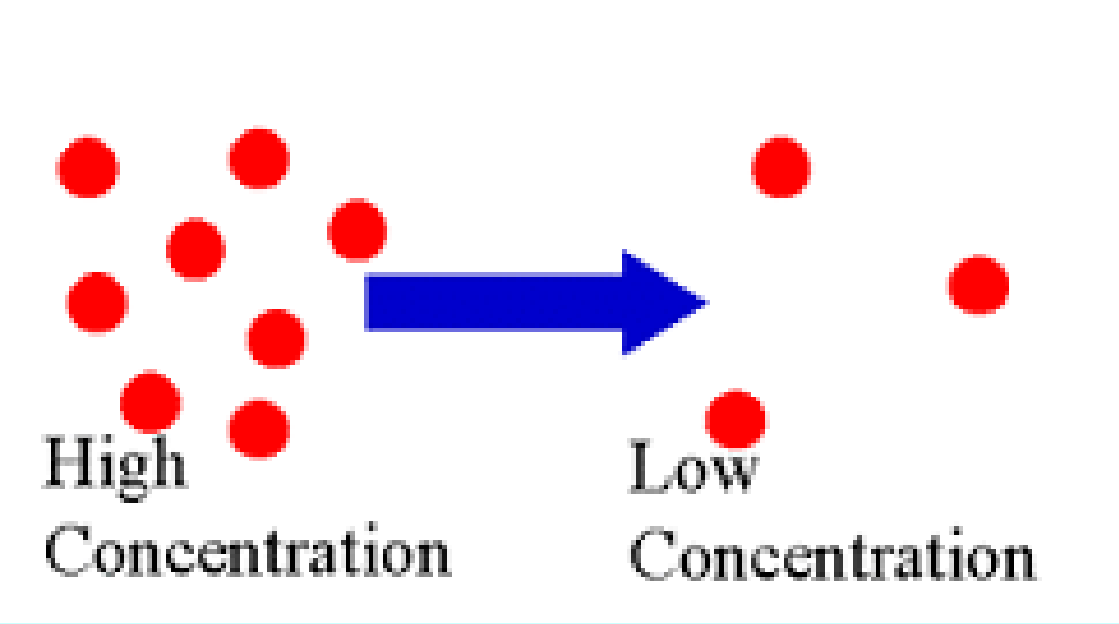
CO_2 automatically moves from where there is a HIGHER concentration (in blood) to where there is a lower concentration (in lungs)



http://www.le.ac.uk/pa/teach/va/anatomy/case2/2_2.html

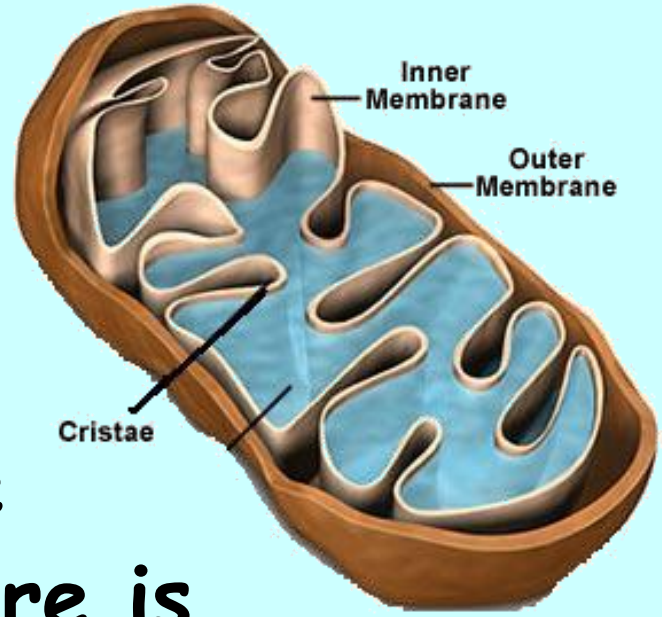
PROBLEM for CELLS?

Diffusion only moves molecules from high concentration to low concentration.



What if cell needs to move a molecule AGAINST the CONCENTRATION GRADIENT?

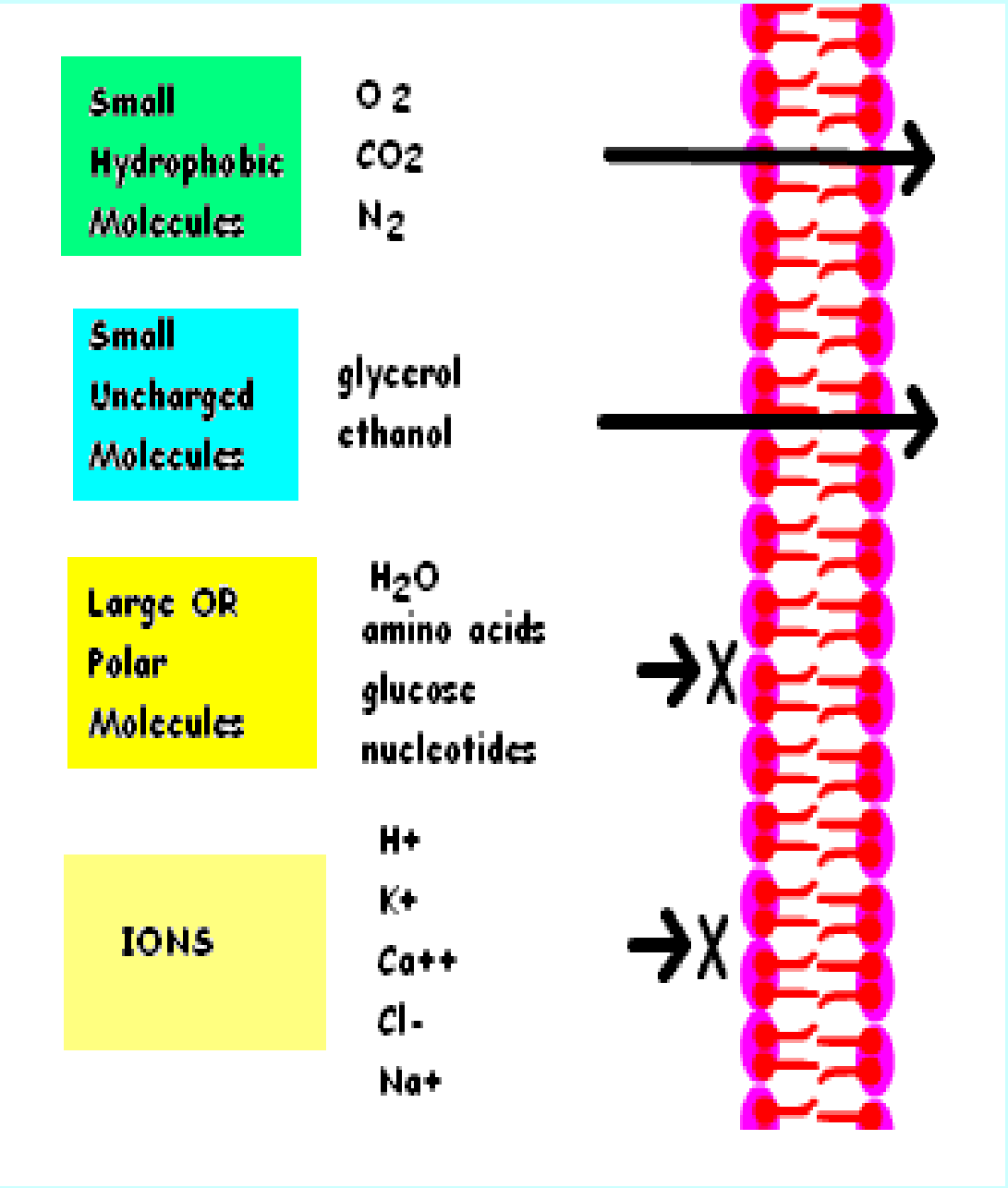
(LOWER → HIGHER)



Cell example:
Want to put MORE glucose into mitochondria when there is already glucose in there

Image from: http://www.biologyclass.net/mitochondria.jpg

Video from: http://www.southtexascollege.edu/tdehne/BC_ShockwaveAnimations/08SWF-MembraneStructureAndFunct/08-02-MembraneStructure.swf

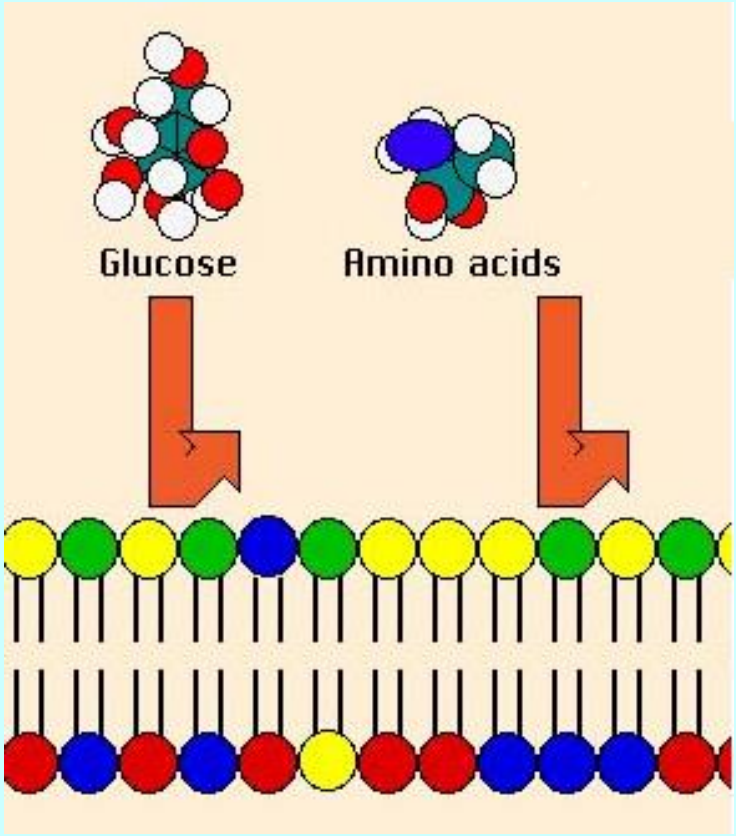


PROBLEM for Cells?

Cell membranes are SELECTIVELY PERMEABLE

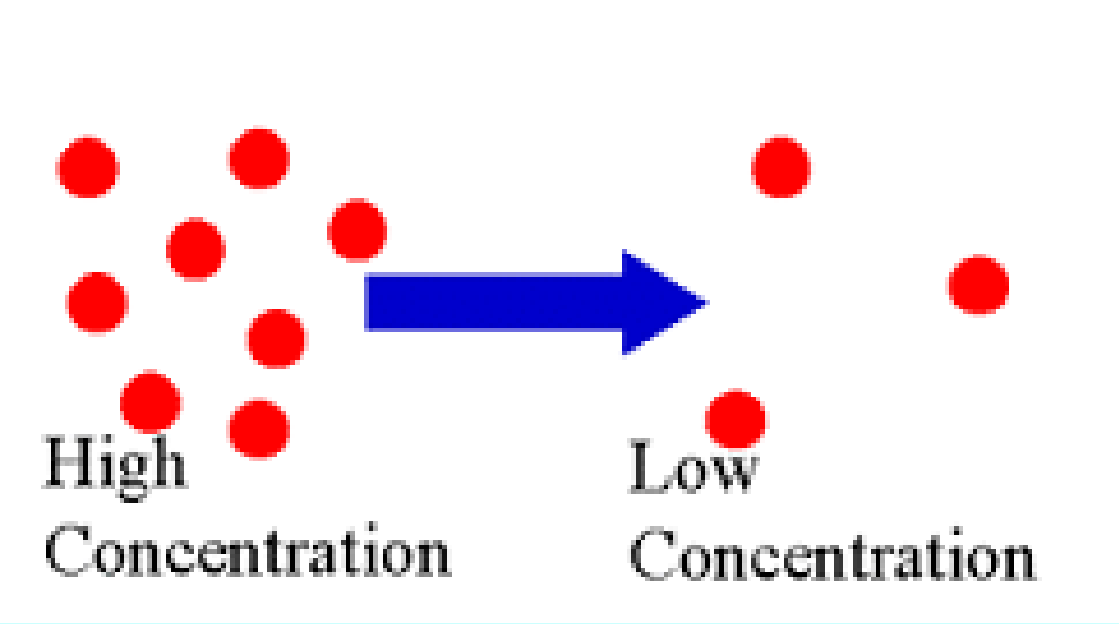
See a movie

What if a cell needs to move LARGE or POLAR molecules that can't get through the membrane?



http://www.d.umn.edu/~sdowning/Membranes/membraneImages/jpegimages/diffusionmedium.jpg

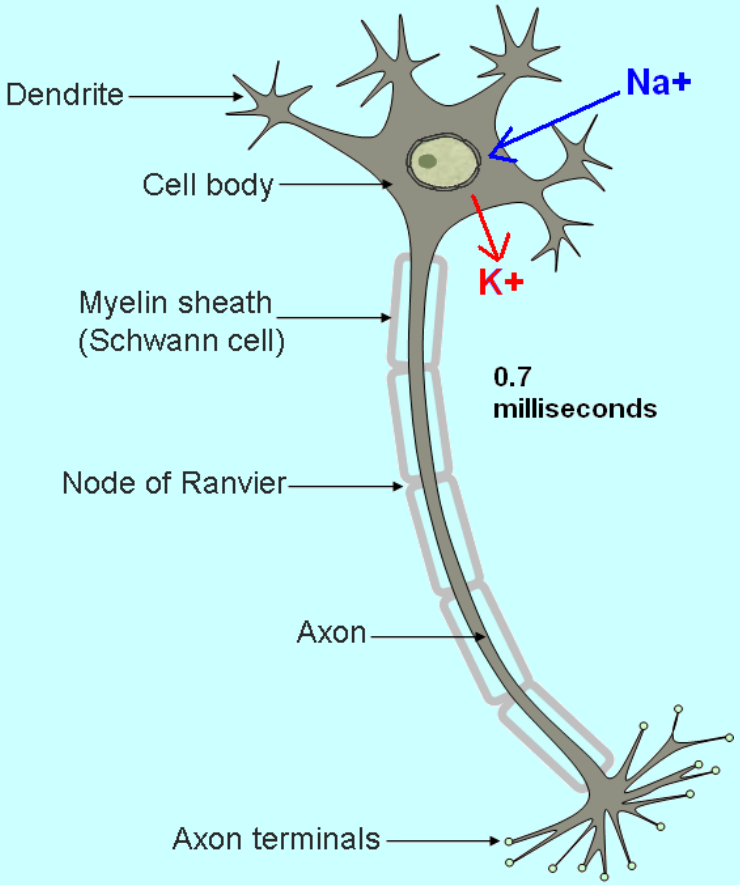
PROBLEM for CELLS?
Diffusion happens very slowly



What if cell needs to move molecules really FAST ?
(can't wait for it to diffuse)

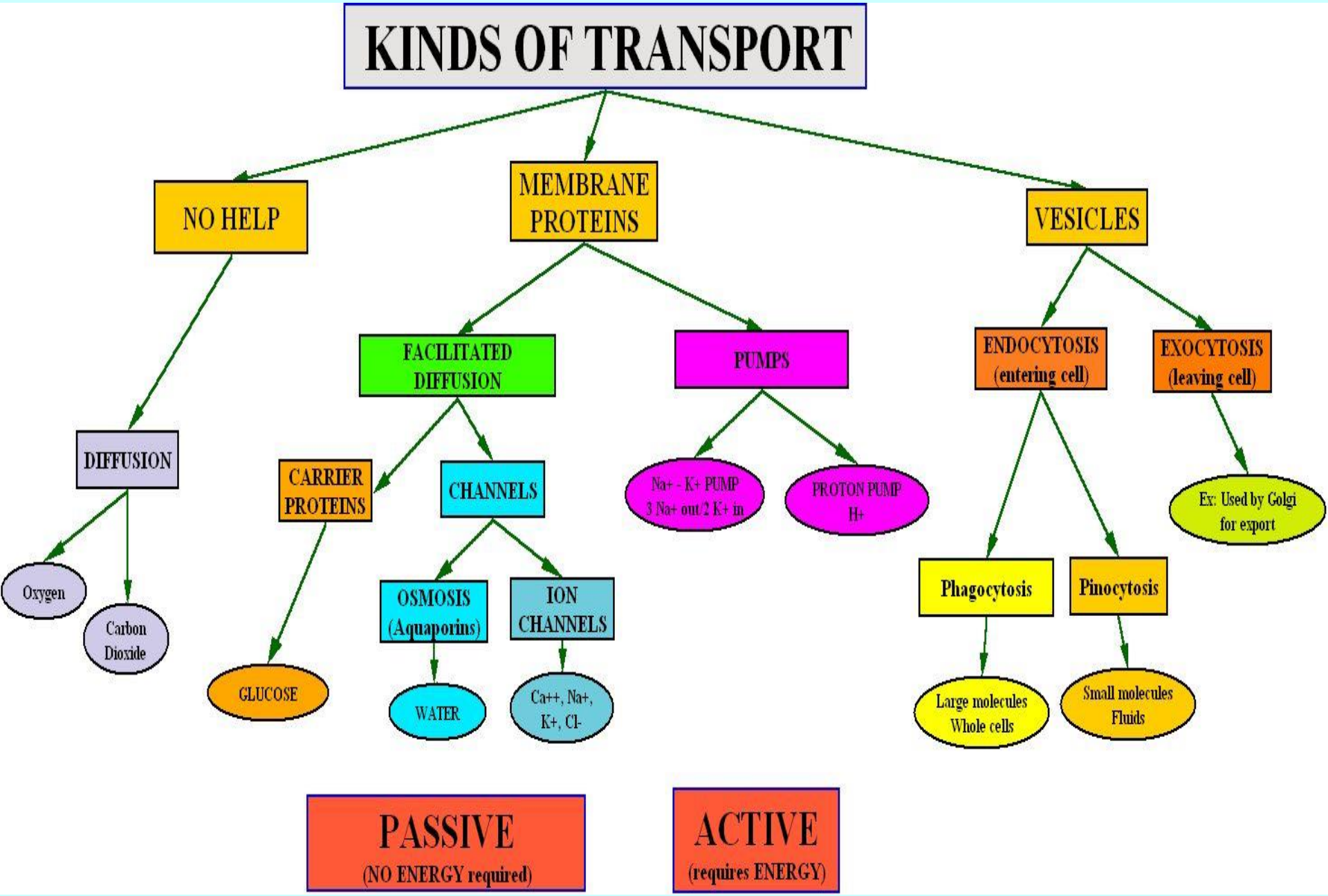
Cell example:

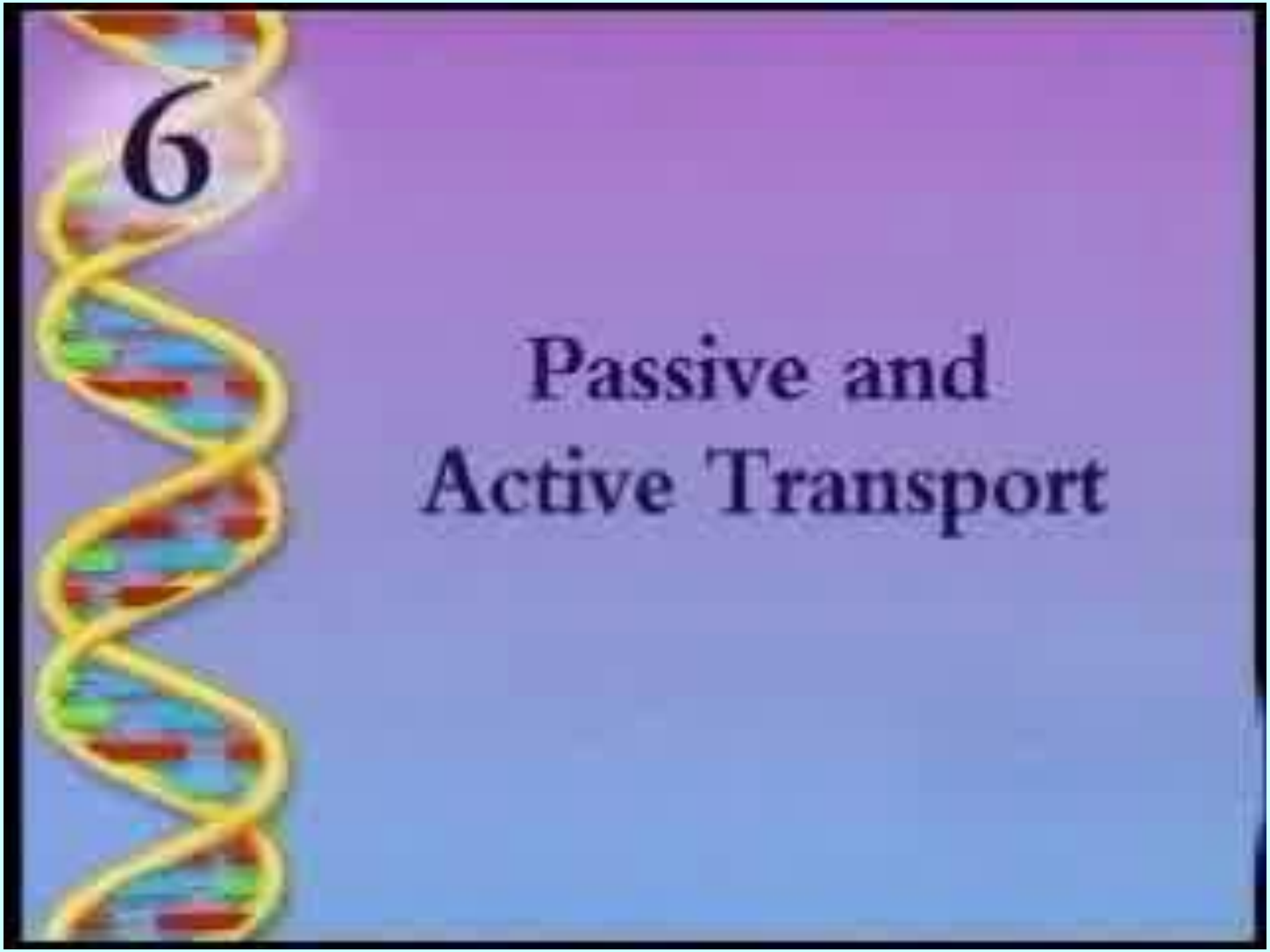
Movement of Na^+ & K^+ ions required to send nerve signals



http://www.steve.gb.com/images/science/neuron.png

Cells need a WAY to HELP molecules across cell membranes that can't go across by themselves





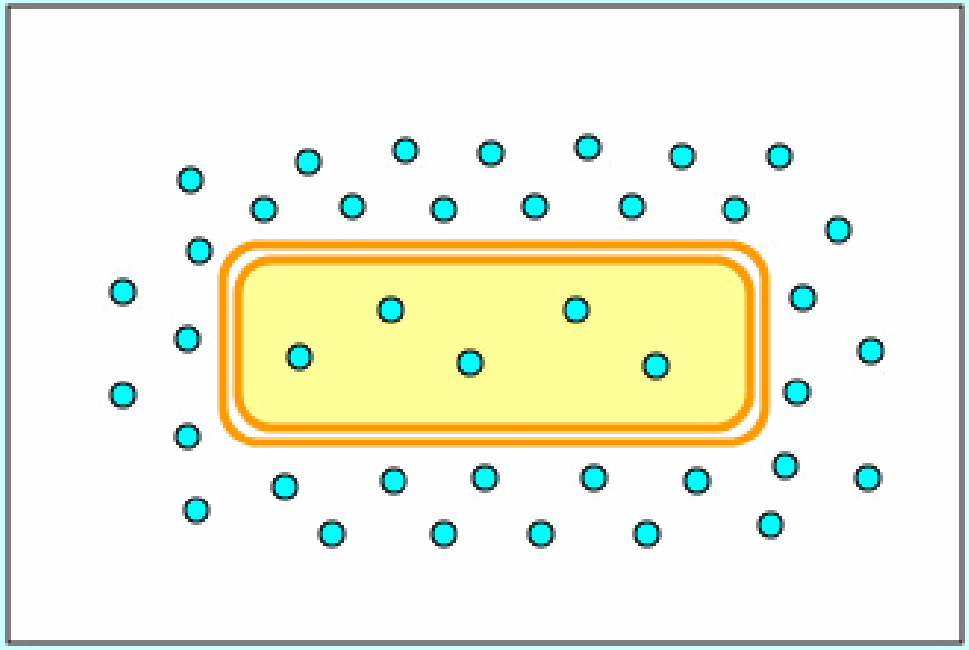
See a video about Passive transport 7-C

Kinds of PASSIVE Transport

- Diffusion
- Facilitated Diffusion
  - Carriers
  - Channels

DIFFUSION across a membrane

Happens anytime there is a DIFFERENCE in concentration on one side of the membrane compared to the other

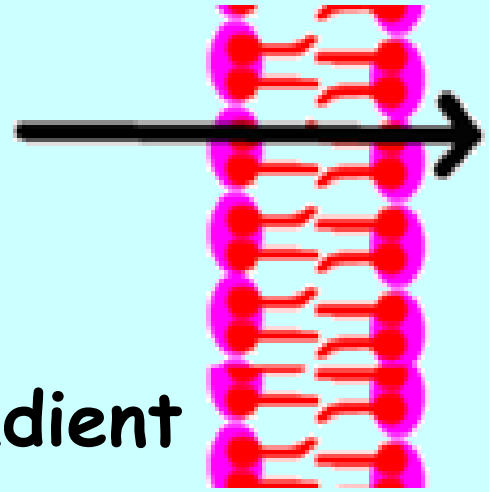


See diffusion animation

http://student.ccbcmd.edu/~gkaiser/biotutorials/eustruct/passiveanim.html

http://bioweb.wku.edu/courses/Biol22000/10Biomembranes/images/membrane.gif

DIFFUSION



- No energy required = PASSIVE
- Moves DOWN concentration gradient from HIGHER to LOWER
- Works for any molecules that can pass through the membrane
- Example of molecules that move this way in cells:

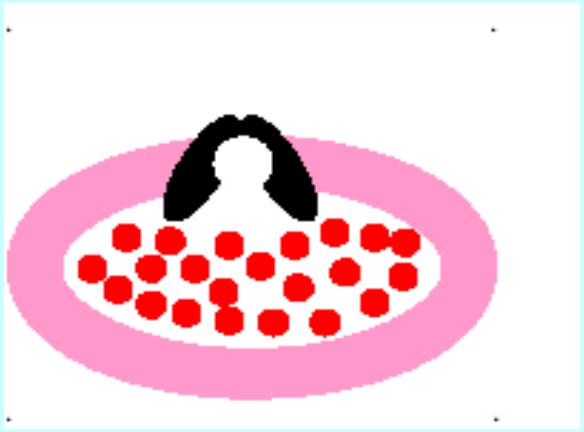
  OXYGEN & Carbon dioxide

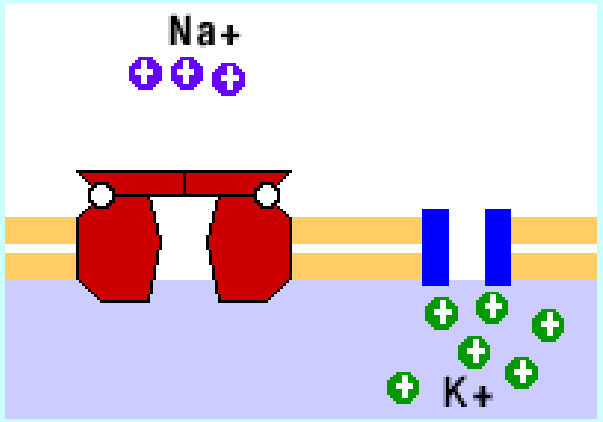
FACILITATED DIFFUSION

uses membrane proteins to help molecules across

2 kinds of proteins help:

Carriers & Channels



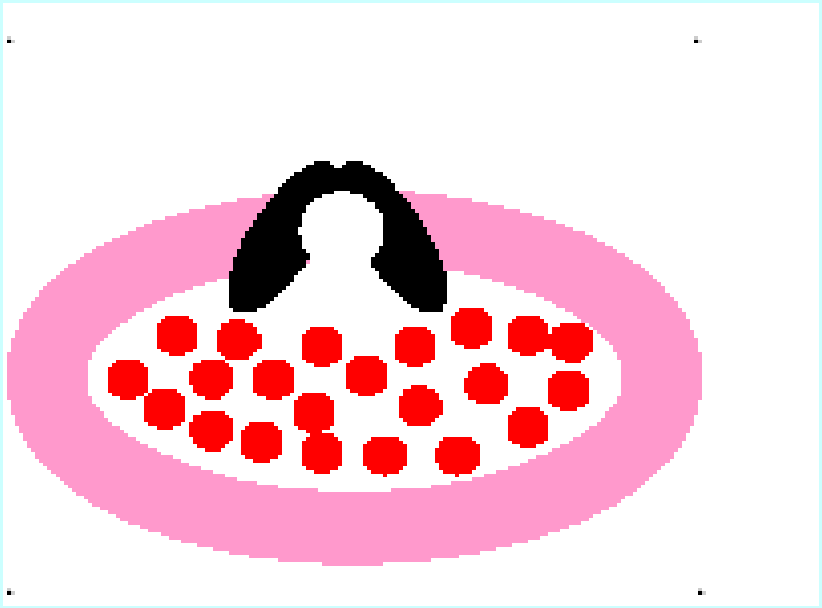


Animations from: http://bio.winona.edu/berg/ANIMTNS/facdifan.gif

http://www2.uic.edu/~myilma1/ionchannel.gif

Facilitated Diffusion with CARRIER PROTEINS

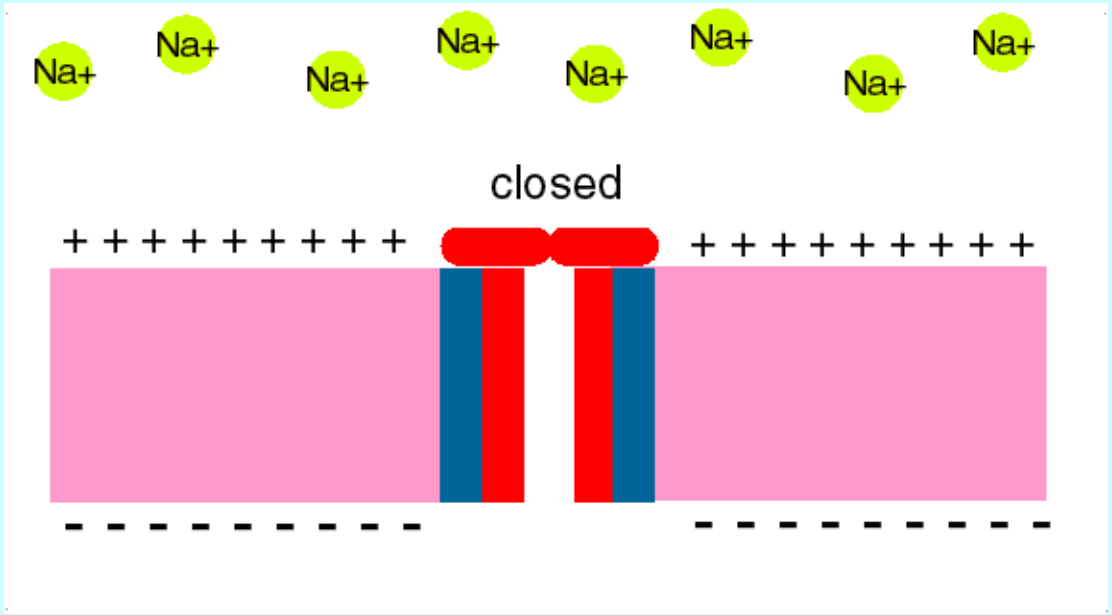
Animation from: http://bio.winona.edu/berg/ANIMTNS/facdifan.gif



Carrier protein grabs molecule, changes shape, and flips across to other side like a revolving door

http://www.gobananas.co.uk/edinburgh-stag-party/enquiry/index.htm

FACILITATED DIFFUSION with CHANNELS



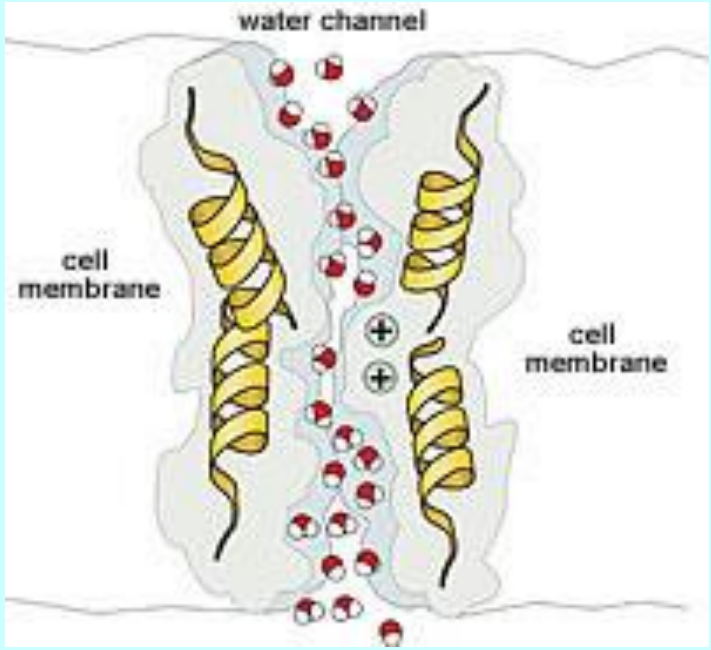
http://bio.winona.edu/berg/ANIMTNS/voltgate.htm

Membrane proteins create a tunnel through which molecules can pass

ION CHANNELS allow charged ions to get past the hydrophobic center

FACILITATED DIFFUSION with CHANNELS

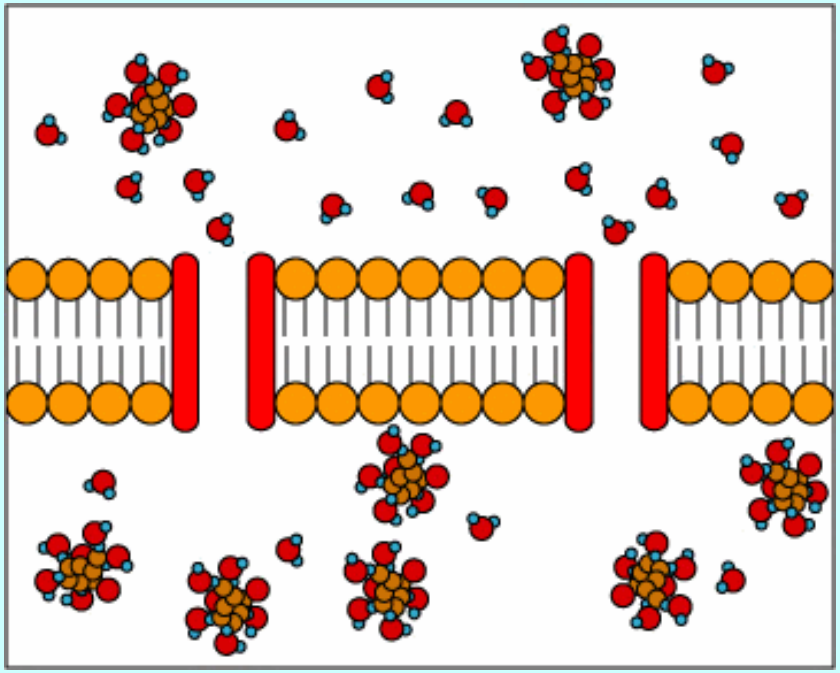
Aquaporin proteins allow polar WATER molecules to get past the hydrophobic middle of cell membrane.



http://www.spps.kvl.dk/news/0507/Lund4.jpg

FACILITATED DIFFUSION with CHANNELS

The movement of water molecules across a cell membrane is called **OSMOSIS**



http://student.ccbcmd.edu/~gkaiser/biotutorials/eustruct/channelanim.html

ALL KINDS OF FACILITATED DIFFUSION

- No energy required = PASSIVE
- Moves DOWN concentration gradient from HIGHER to LOWER
- Membrane proteins help molecules get across membrane

EXAMPLES OF FACILITATED DIFFUSION IN CELLS

- CARRIER PROTEINS

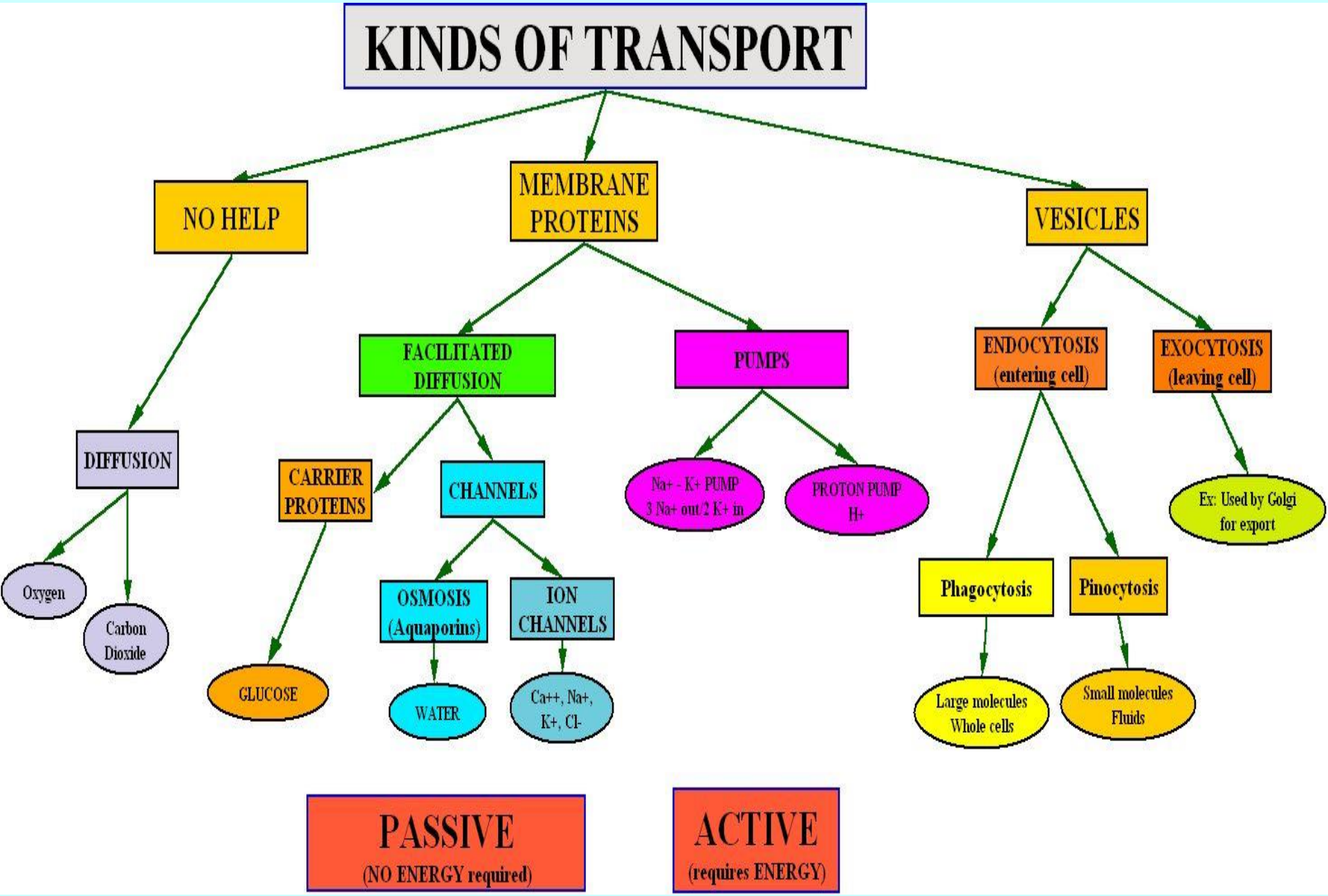
  GLUCOSE

- ION CHANNELS

  Na^+ , Cl^- , Ca^{++} , K^+

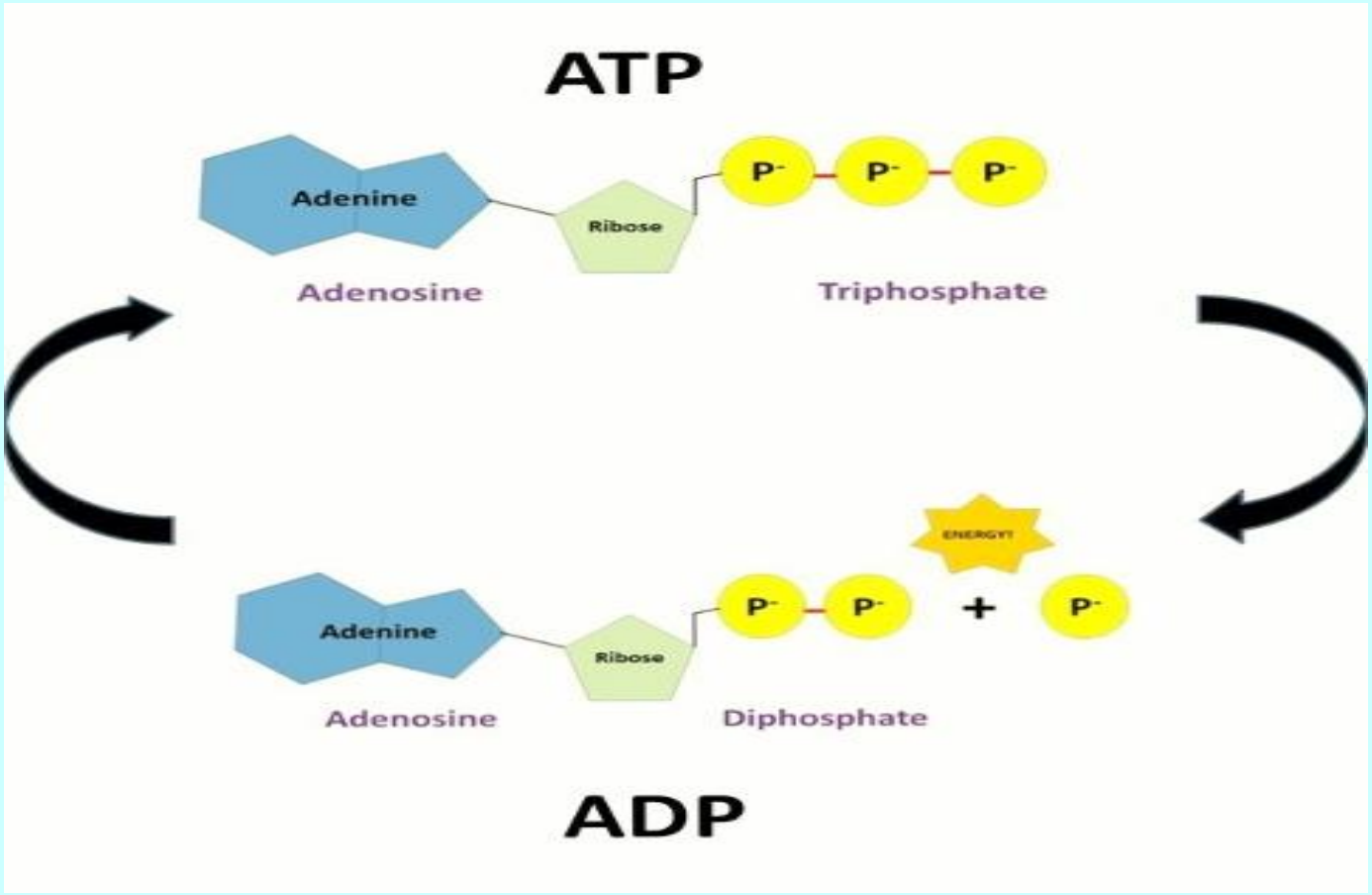
- AQUAPORINS (OSMOSIS)

  WATER



ACTIVE transport (requires energy from ATP)

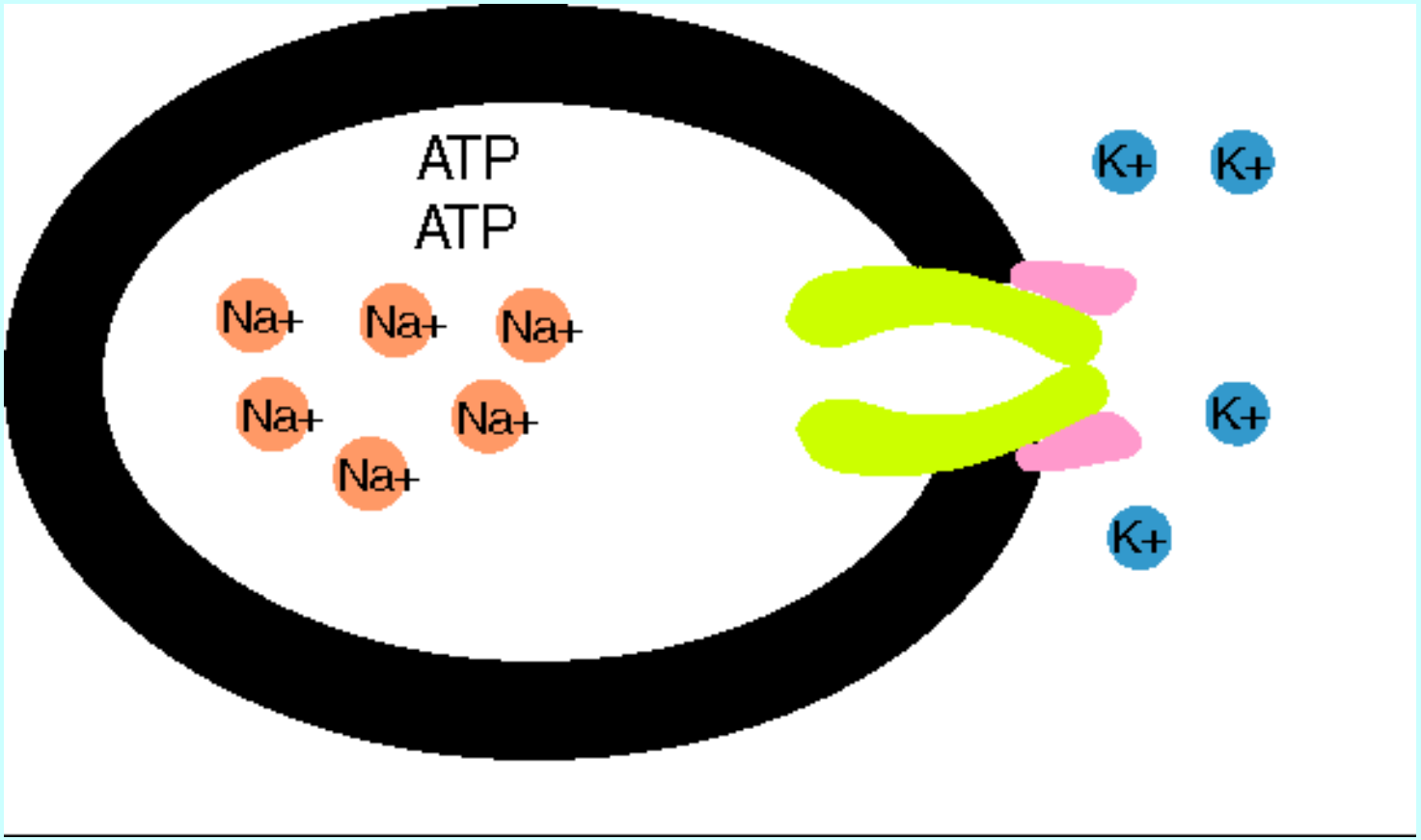
Moves molecules from **low** concentration to **high**



Kinds of ACTIVE Transport

- PUMPS
  - Sodium-Potassium
  - Proton
- Vesicles
  - Endocytosis
  - Exocytosis

Na^+ and K^+ PUMP



Animation from: http://www.lionden.com/cell_animations.htm

See a movie about Na+ - K+ pump

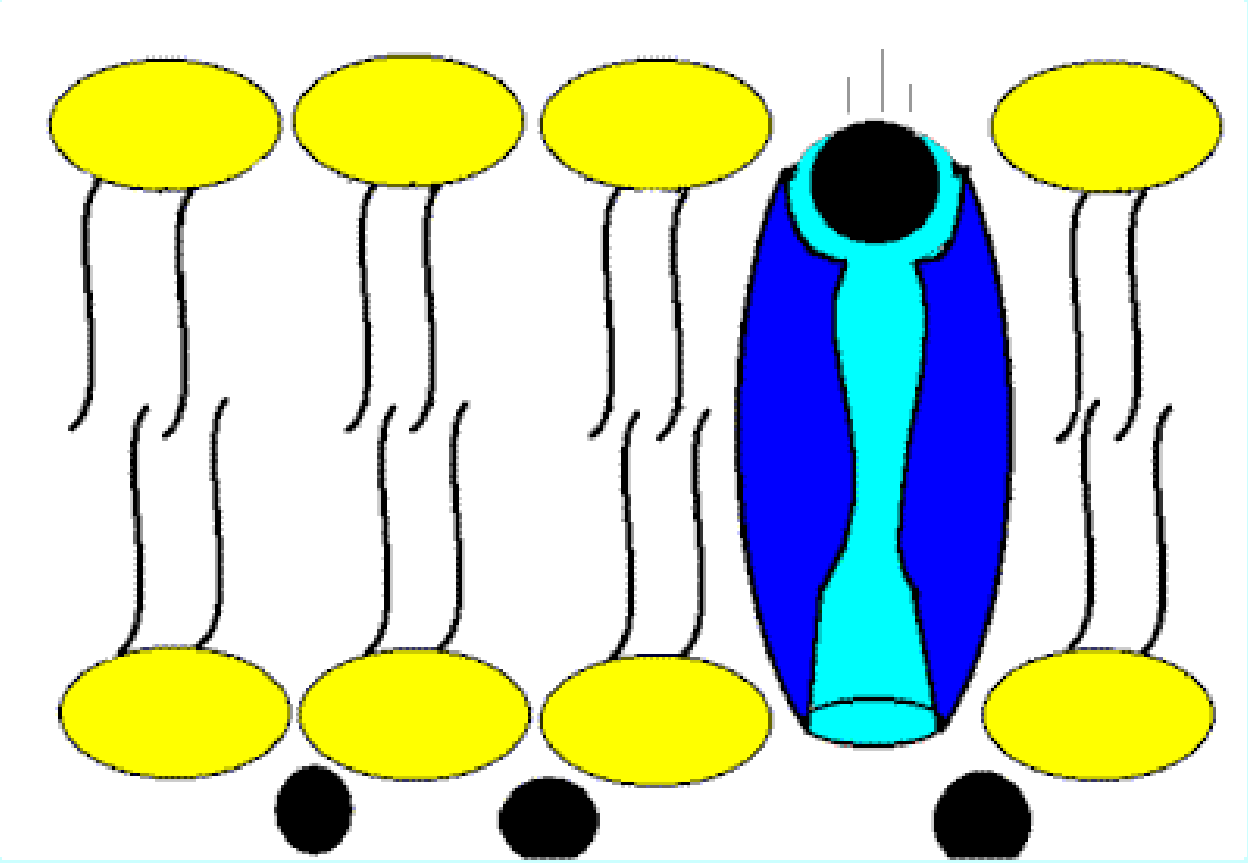
SODIUM-POTASSIUM PUMP

- Special just for Na^+ and K^+ ions
-

- Example: transmission of signals in nerve cells
  Na^+ is pumped out of cells at same time
  K^+ is taken into cells

PROTON PUMP

Moves Protons across membrane = H^+ ions



More on this in Chap 8 & 9

See a movie
proton pump

PROTON PUMP

- Special just for H^+ ions
-

Examples:

- Stomach need acidic conditions for digestion, has proton pumps that secrete H+ ions to create HCL (hydrochloric acid)
- Photosynthesis/Respiration
  (more on this to come in Ch 8 & 9)

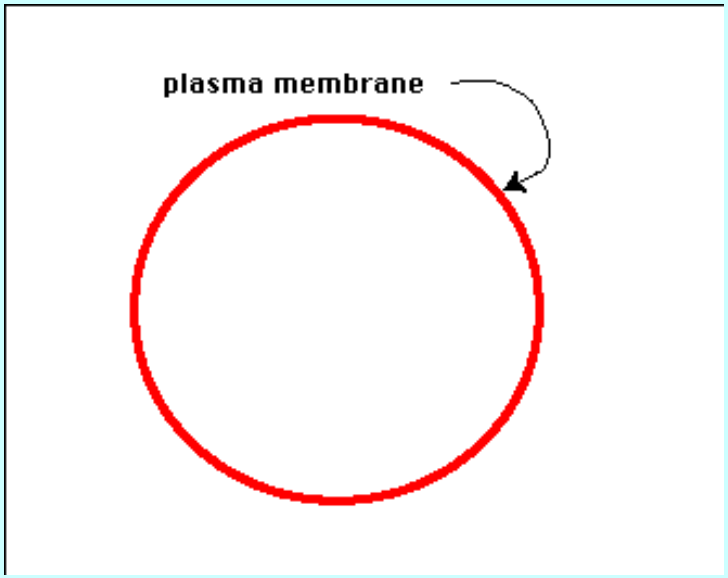
ACTIVE TRANSPORT with VESICLES

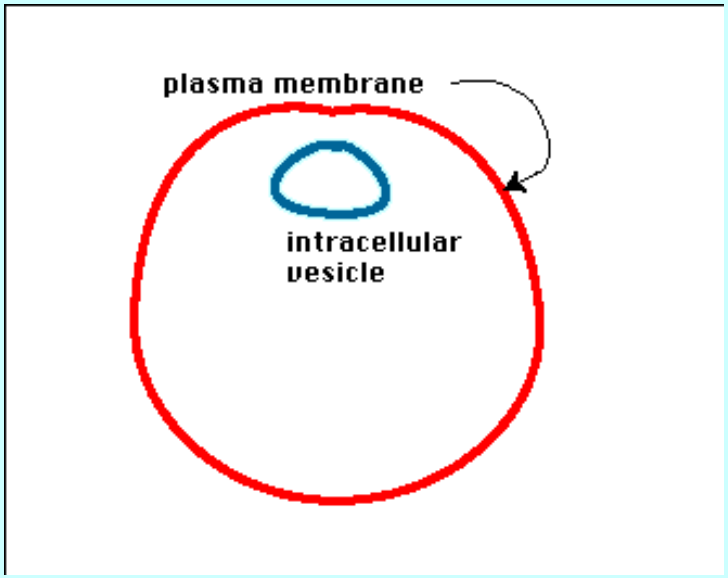
VESICLES are small membrane sacs that pinch off of cell membranes used by cells for transporting molecules

Used for transporting molecules:

If entering the cell = **ENDOCYTOSIS**

If exiting the cell = **EXOCYTOSIS**





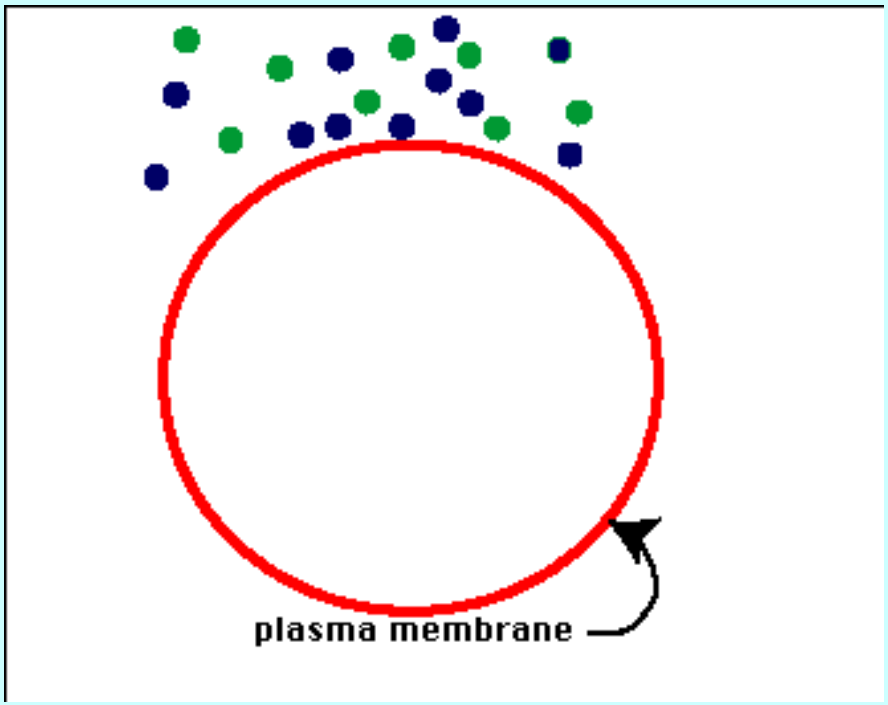
2 KINDS of ENDOCYTOSIS

for taking substances into cell

If taking in:

fluid or small molecules = PINOCYTOSIS

large particles or whole cells = PHAGOCYTOSIS



Animation from: http://academic.brooklyn.cuny.edu/biology/bio4fv/page/endocytb.htm

ENDOCYTOSIS

Substances taken into cell

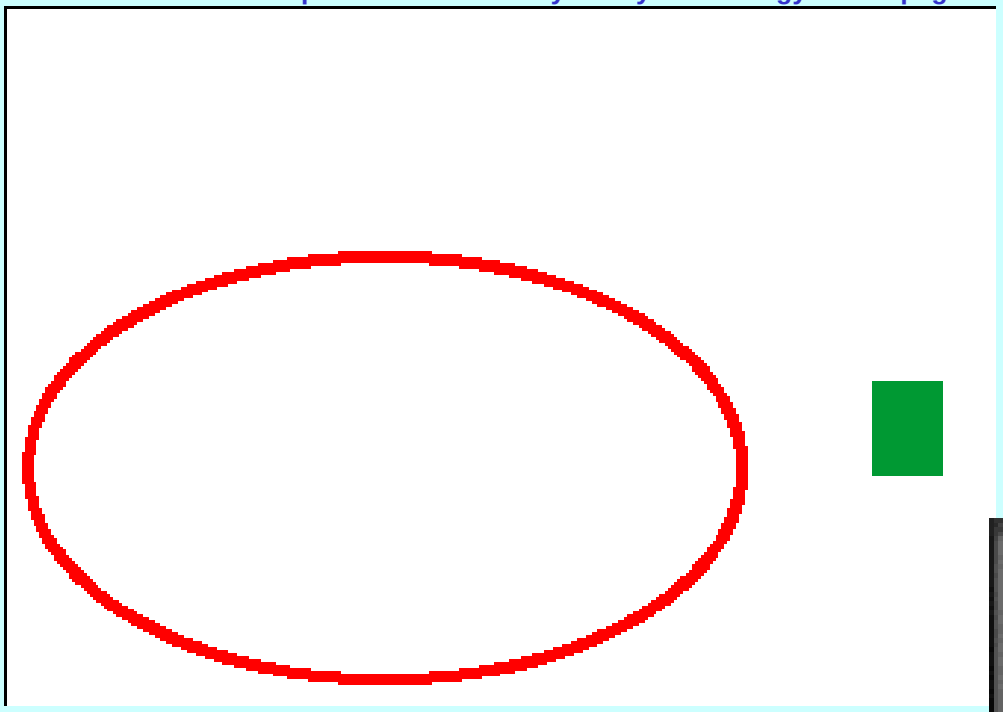
- ACTIVE transport (requires energy)
- Uses VESICLES to carry substances
- Can move molecules from low concentration to high

Examples in cells:

- one celled organisms eat this way
- white blood cells get rid of bacteria this way

ENDOCYTOSIS

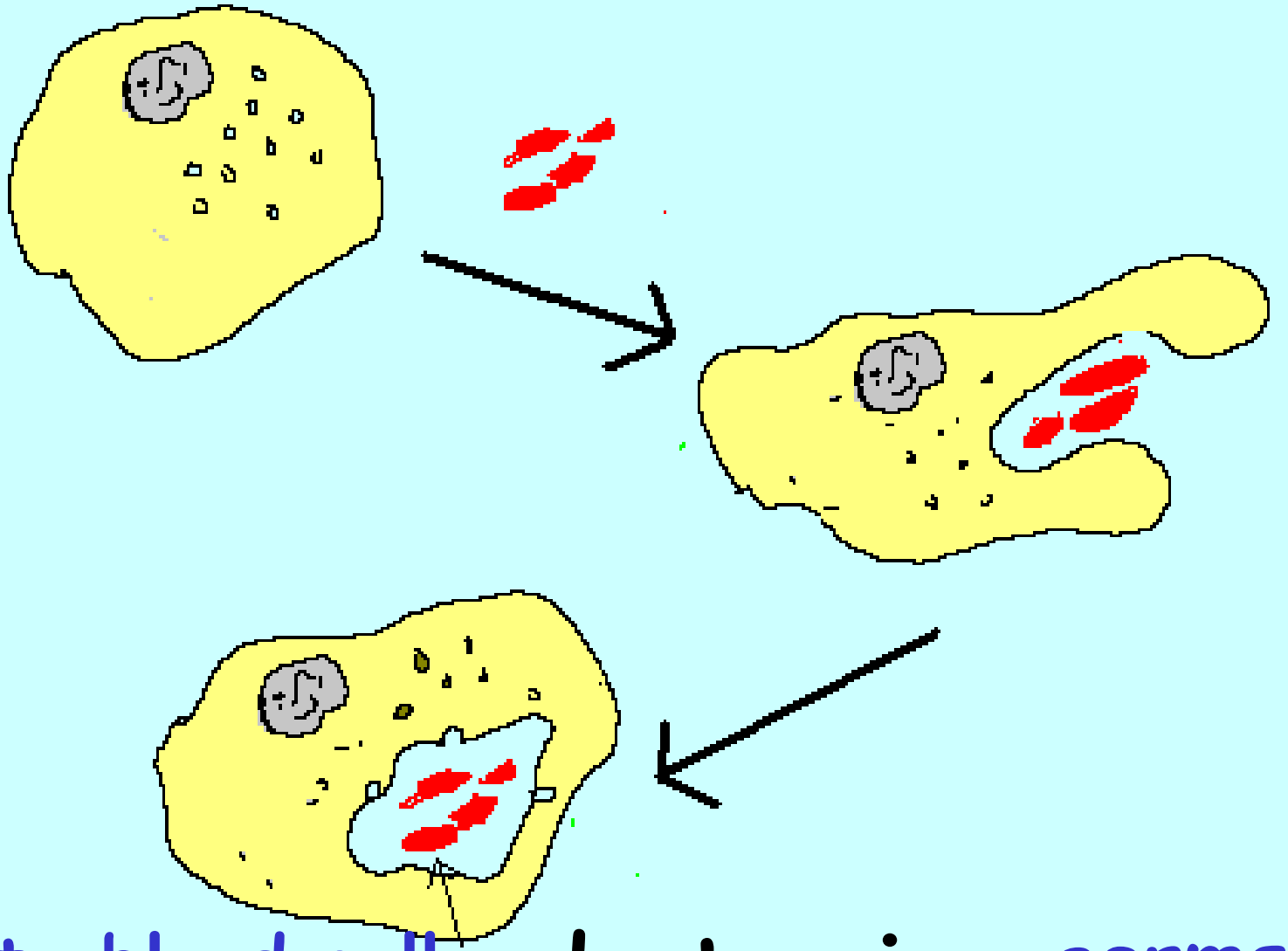
Animation from: http://academic.brooklyn.cuny.edu/biology/bio4fv/page/cell-movement.html



Protist eating another

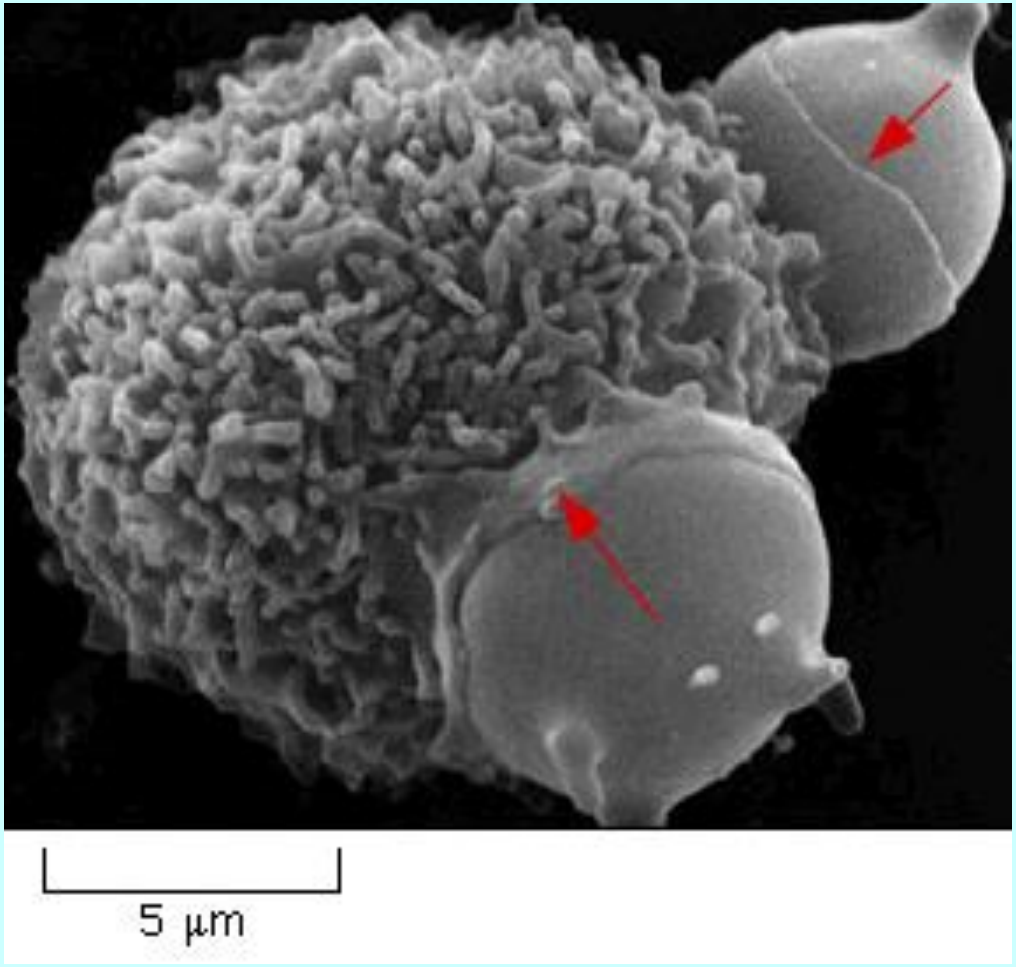
http://www.accs.net/users/kriel/chapter%20nine/

PHAGOCYTOSIS



White blood cell destroying germs

WHITE BLOOD CELL ENGULFING BACTERIA (Phagocytosis)



http://fig.cox.miami.edu/~cmallery/255/255ion/fig14x28.jpg

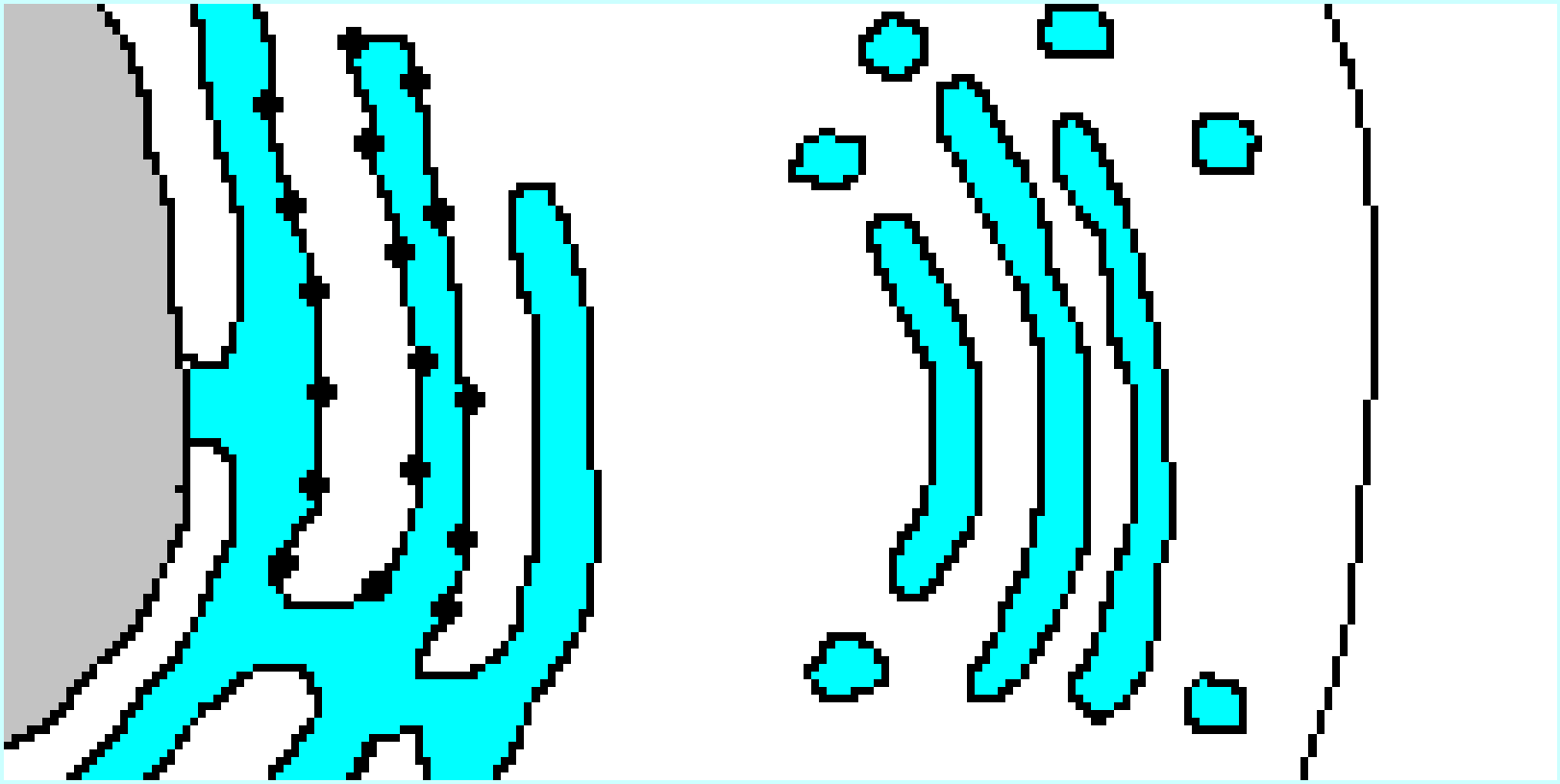
EXOCYTOSIS

Substances released outside of cell

- ACTIVE transport (requires energy)
- Uses VESICLES to carry substances
- Can move molecules from low concentration to high
- Examples in cells:
  - GOLGI release packaged proteins this way

Video: http://www.southtexascollege.edu/tdehne/BC_ShockwaveAnimations/07SWF-TourOfTheCell/07-16-EndomembraneSystem.swf

GOLGI BODIES USE EXOCYTOSIS



Animation from: http://www.franklincollege.edu/bioweb/A&Pfiles/week04.html

See a Golgi movie

Videos from:
http://www.pleasanton.k12.ca.us/avhsweb/thiel/apbio/notes/chp8/exocytosis_endocytosis.mov
http://trc.ucdavis.edu/biosci10v/bis10v/week2/endocytosis.mov

Endocytosis & Exocytosis

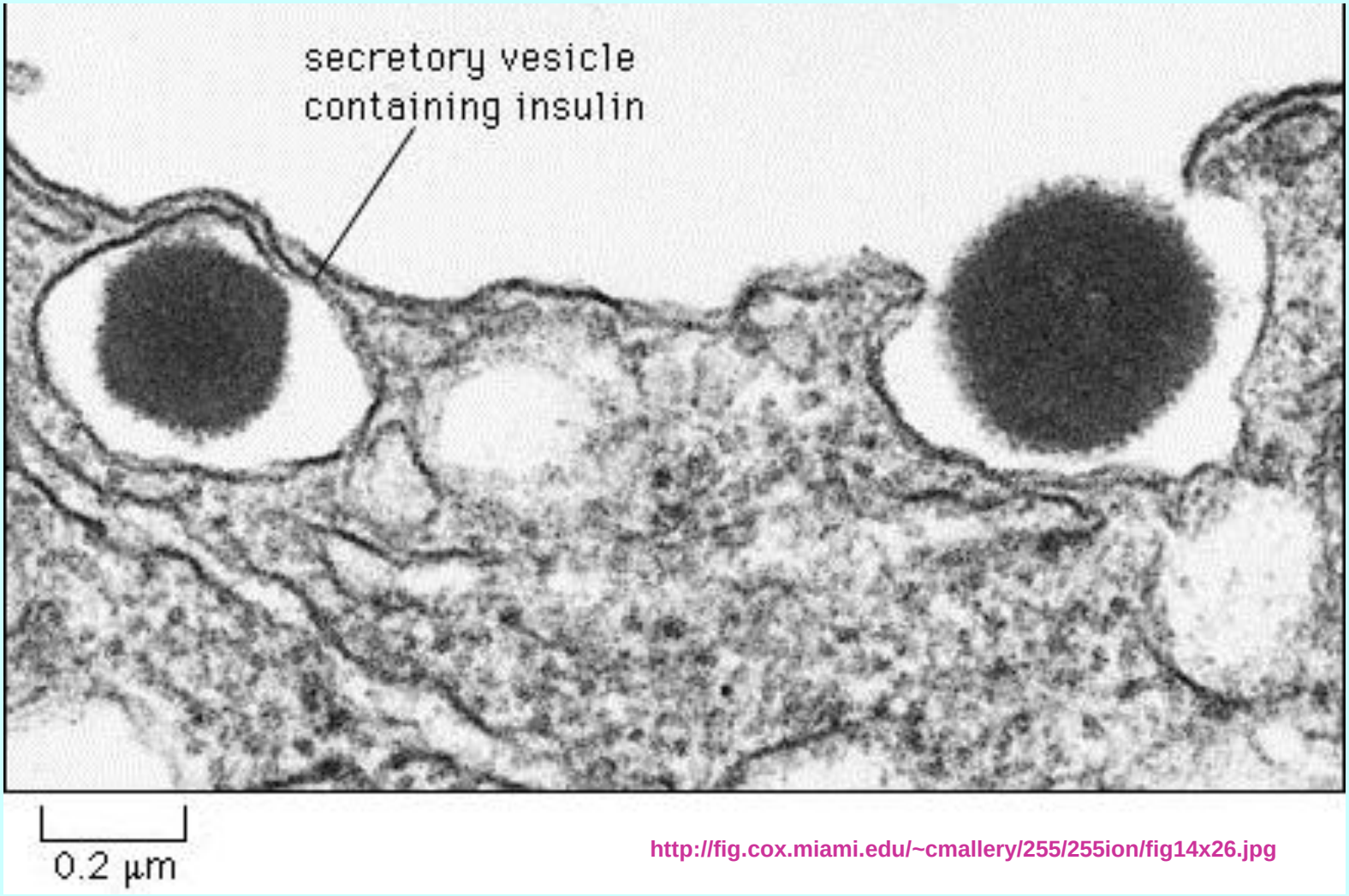
Watch a video clip about endo/exocytosis

Watch a video clip about endo/exocytosis

video

Choose Screen/Switch programs to view

INSULIN being released by pancreas cells using exocytosis

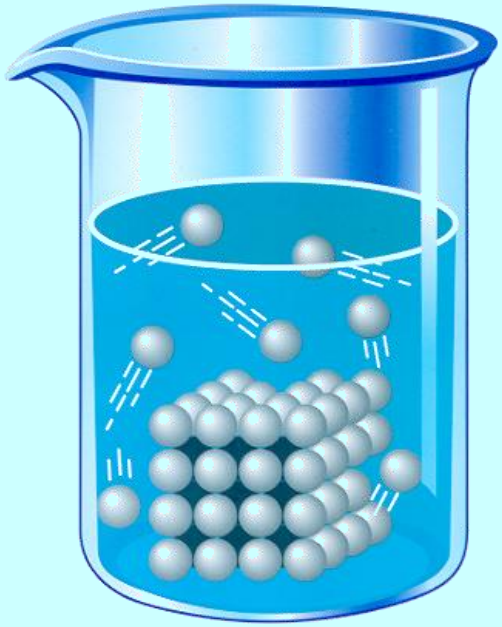


http://fig.cox.miami.edu/~cmallery/255/255ion/fig14x26.jpg

VOCAB

SOLUTE = substance that is dissolved in a solvent to make a solution

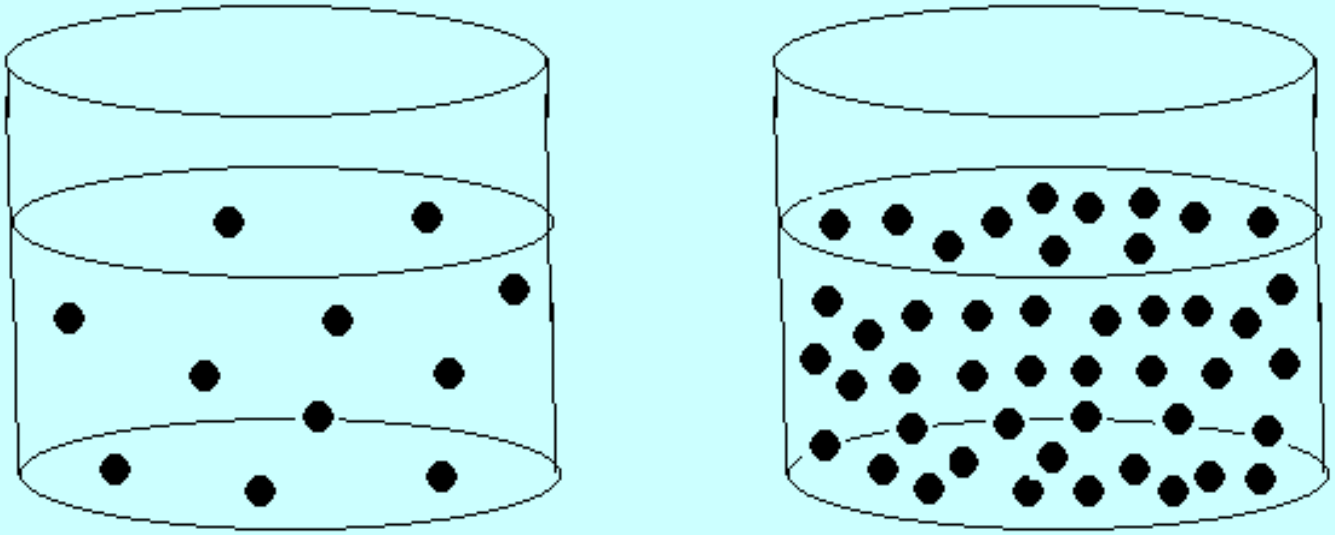
SOLVENT = substance in which a solute is dissolved



http://www.makash.ac.il/h_school/hst/hstsb/chem/luach/dissolve.jpg

Images by Riedell

CONCENTRATION = mass of a solute in a given volume of solution



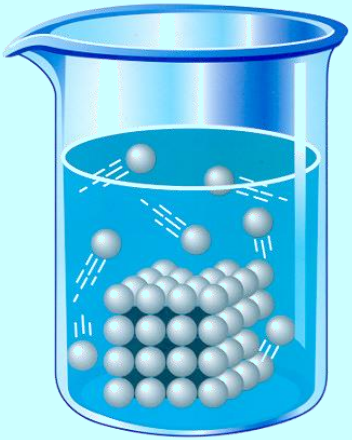
The **MORE** molecules there are in a given volume the **GREATER** the concentration

Use new vocab to make Koolaid

Solutes = Koolaid powder **&** sugar

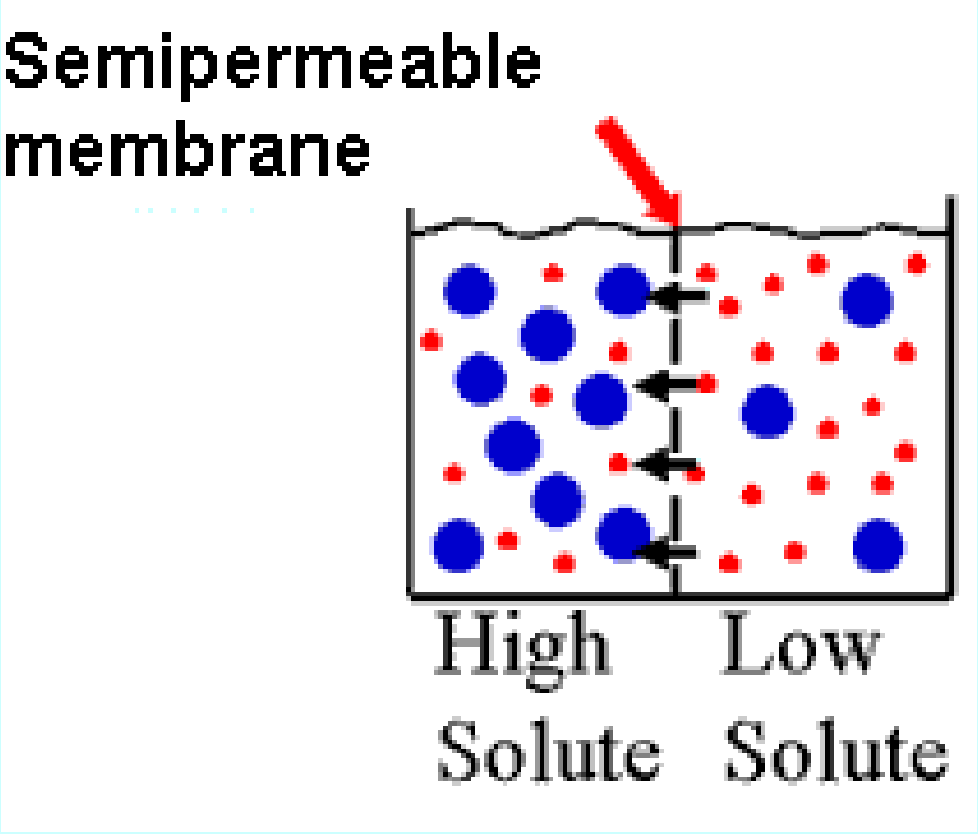
Solvent = Water

Koolaid drink = solution



http://www.makash.ac.il/h_school/hst/hstsb/chem/luach/dissolve.jpg

What if there is a difference in concentration but solute molecules can't move across a membrane?

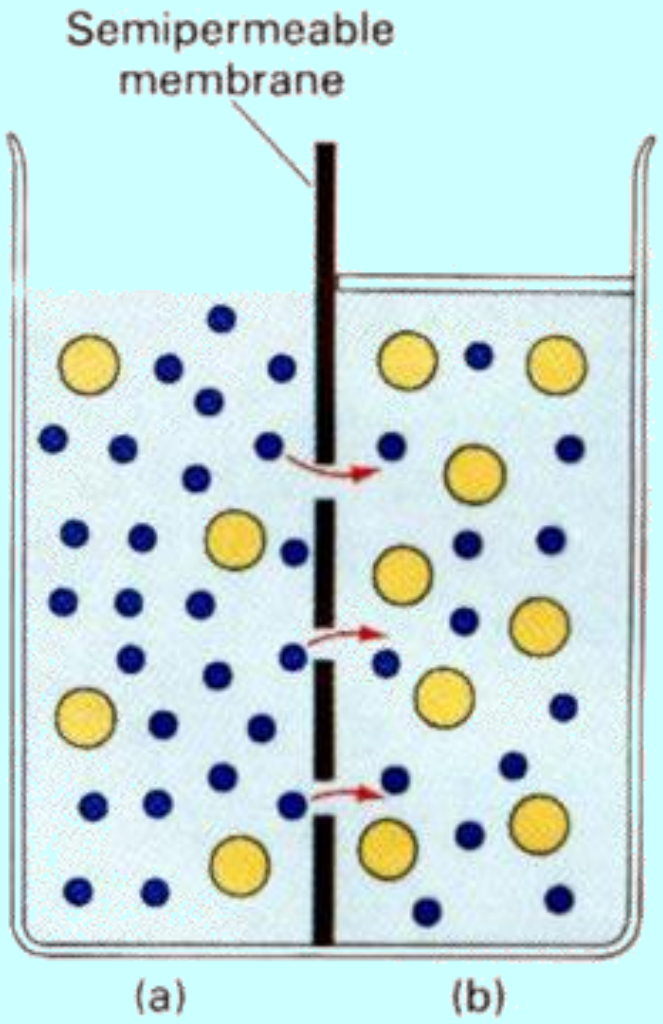


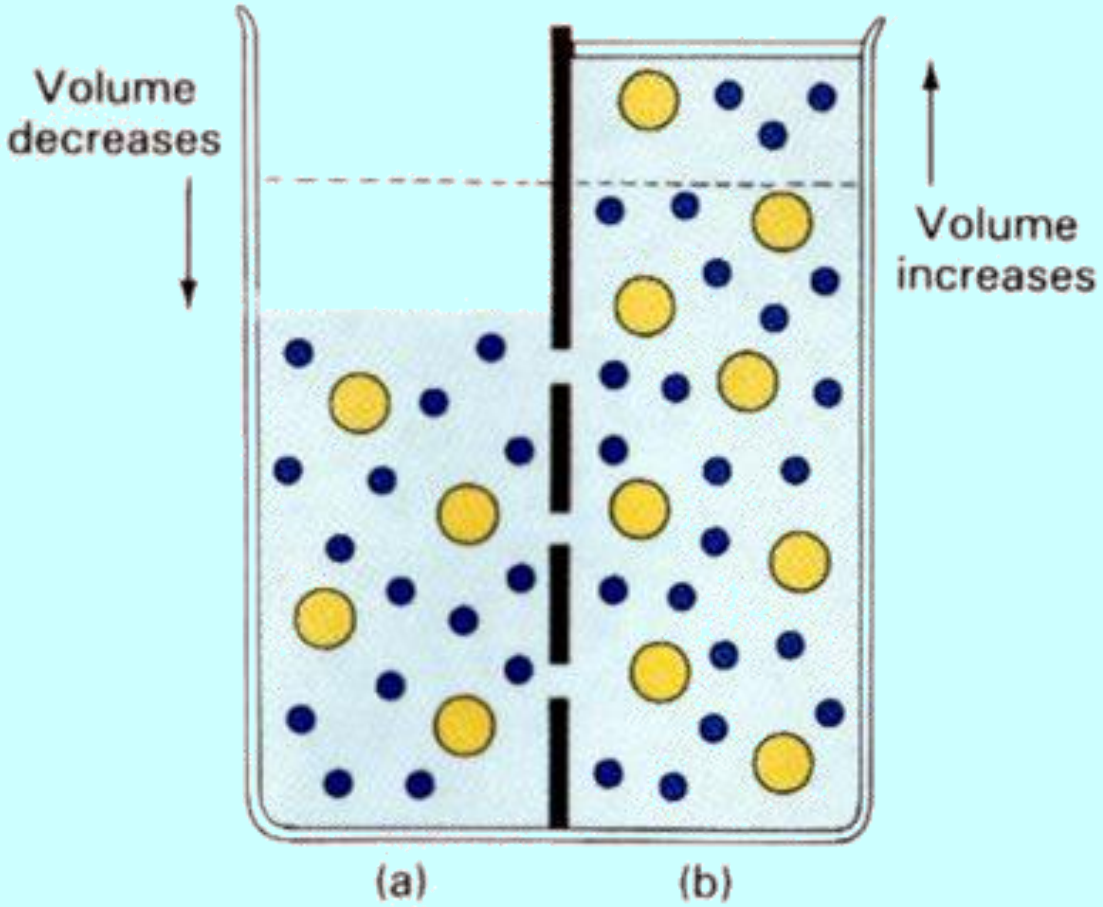
WATER will move until concentration reaches equilibrium

See a video clip about OSMOSIS -7B

Animation: http://www.ouhscphysio.org/humanphys/animations/osmosis1.swf

See an animation
Osmosis1

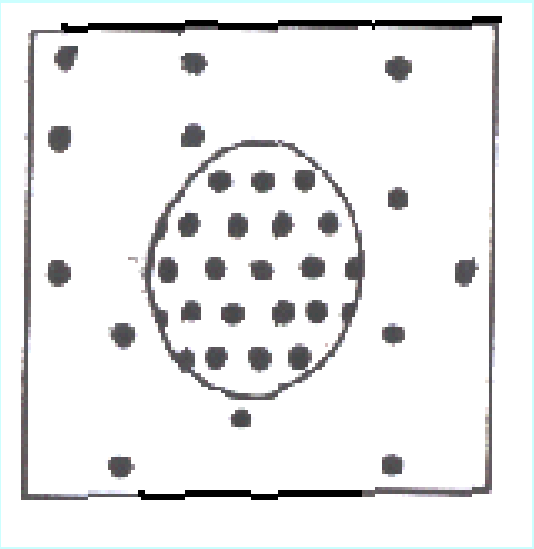




http://faculty.etsu.edu/currie/images/osmosis1.jpg

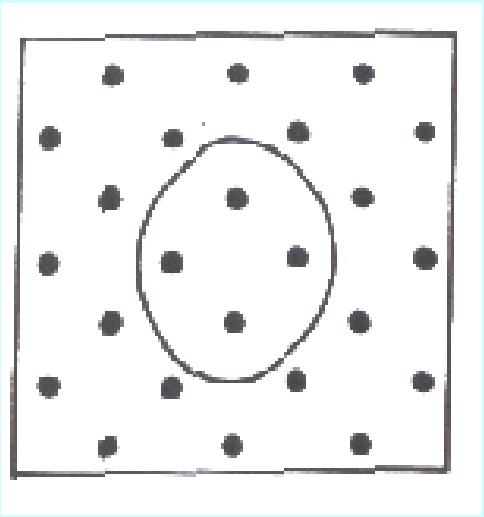
Animation

Solute concentration



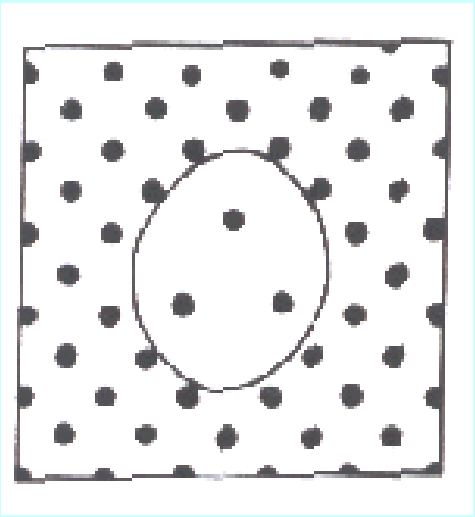
Lower outside than inside

HYPOTONIC



Equal outside and inside

ISOTONIC



Greater outside than inside

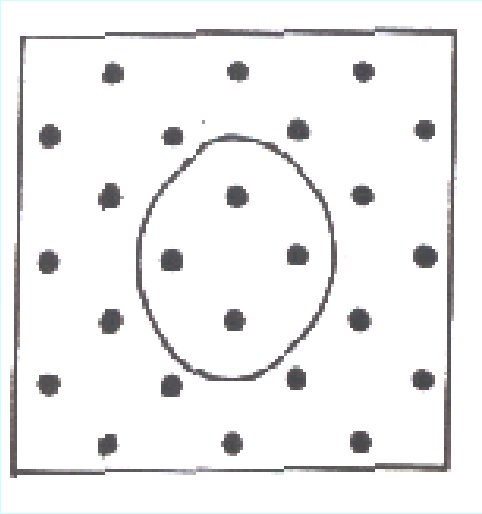
HYPERTONIC

What will happen to an animal cell placed in different solutions?

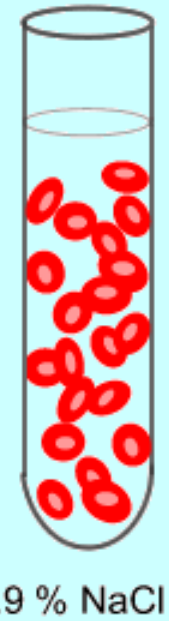
Remember:

Cells try to "maintain stable internal conditions = HOMEOSTASIS

http://bioweb.wku.edu/courses/biol121/Osmosis/Osmosis.asp



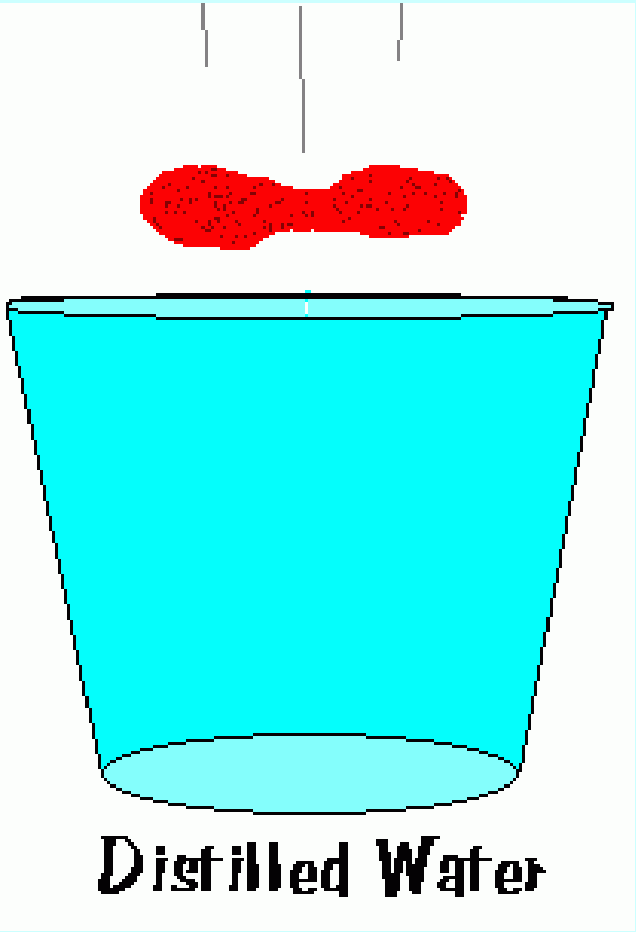
So an animal cell in ISOTONIC conditions stays same size

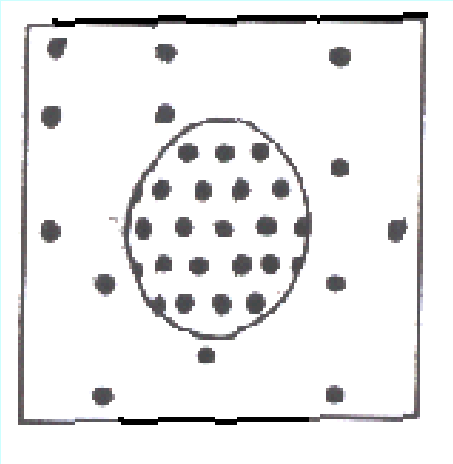


Water entering = water leaving

Video Choose Blood Isotonic link

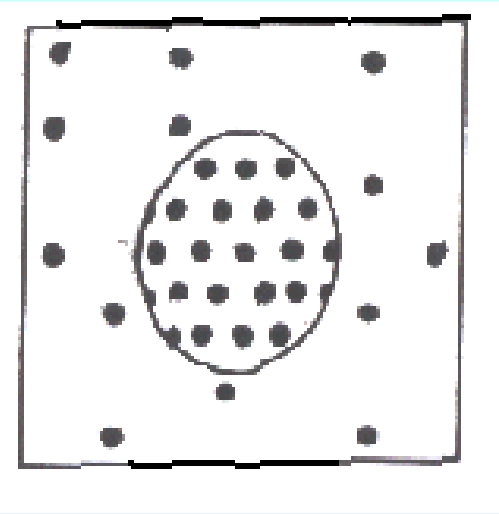
If cells can't maintain "stable internal conditions" . . . damage can result and cells can die.





http://www.the-aps.org/education/lot/cell/Quiz.htm

Animation from: http://www.ouhscphysio.org/humanphys/animations/osmosis3.swf



OSMOSIS

See an animation
Osmosis3

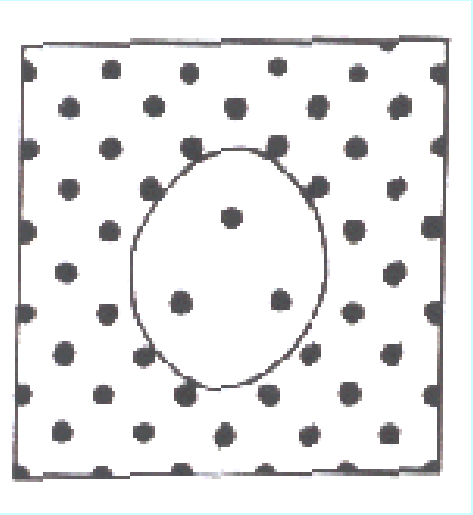
Video

Choose Blood
Hypotonic link

HYPOTONIC:

Concentration outside cell is
LESS THAN inside the cell

More water enters than leaves cell so cell will swell and possibly burst



Animation from: http://www.ouhscphysio.org/humanphys/animations/osmosis4.swf

OSMOSIS

See an animation
OSMOSIS 4

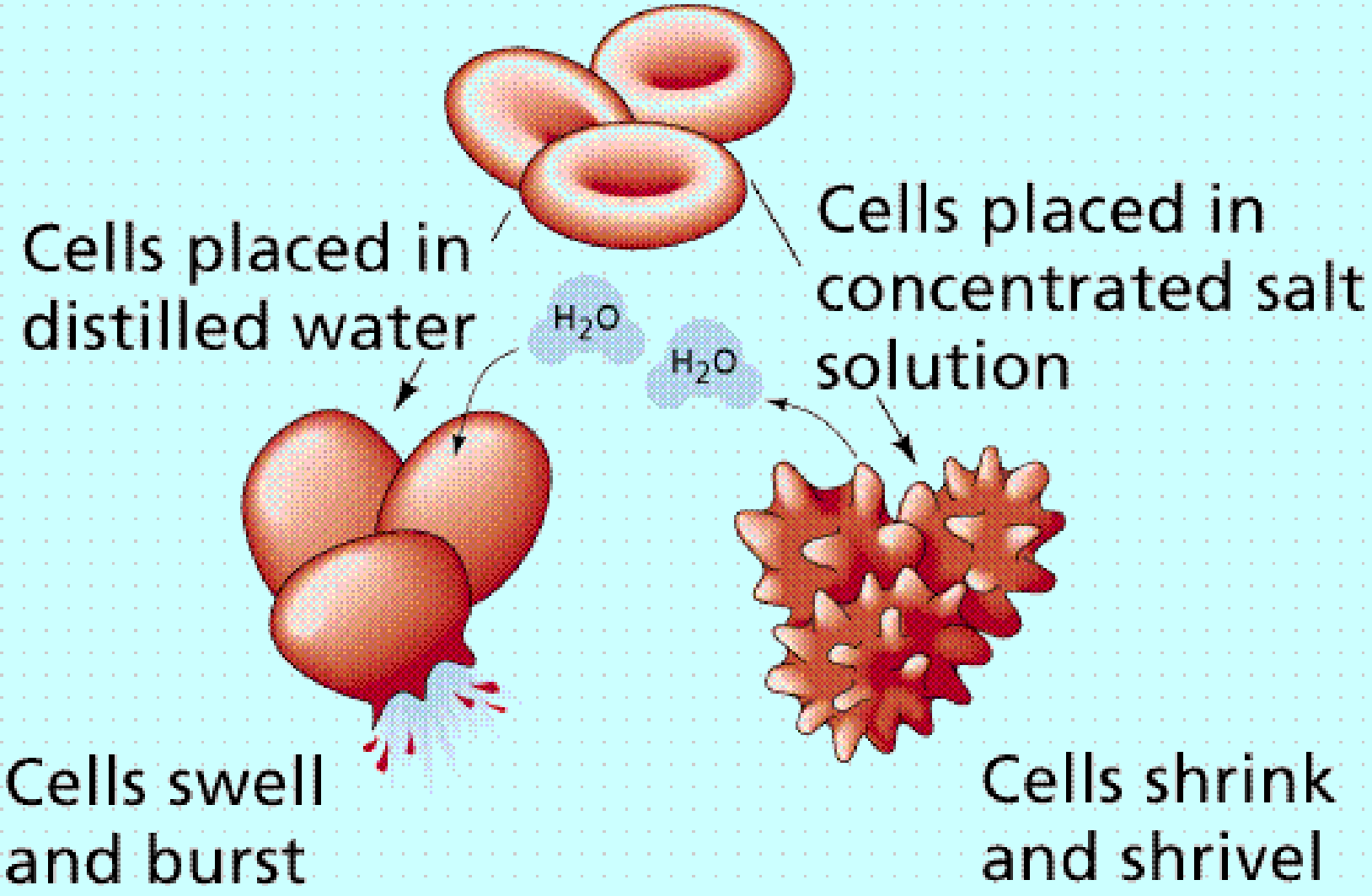
HYPERTONIC: Concentration outside cell is **GREATER THAN** inside cell

More water leaves cell than enters so cell **shrinks**

Video Choose Blood Hypertonic link

http://www.stchs.org/science/courses/sbioa/metenergy/bloodcells.gif

Animal cells

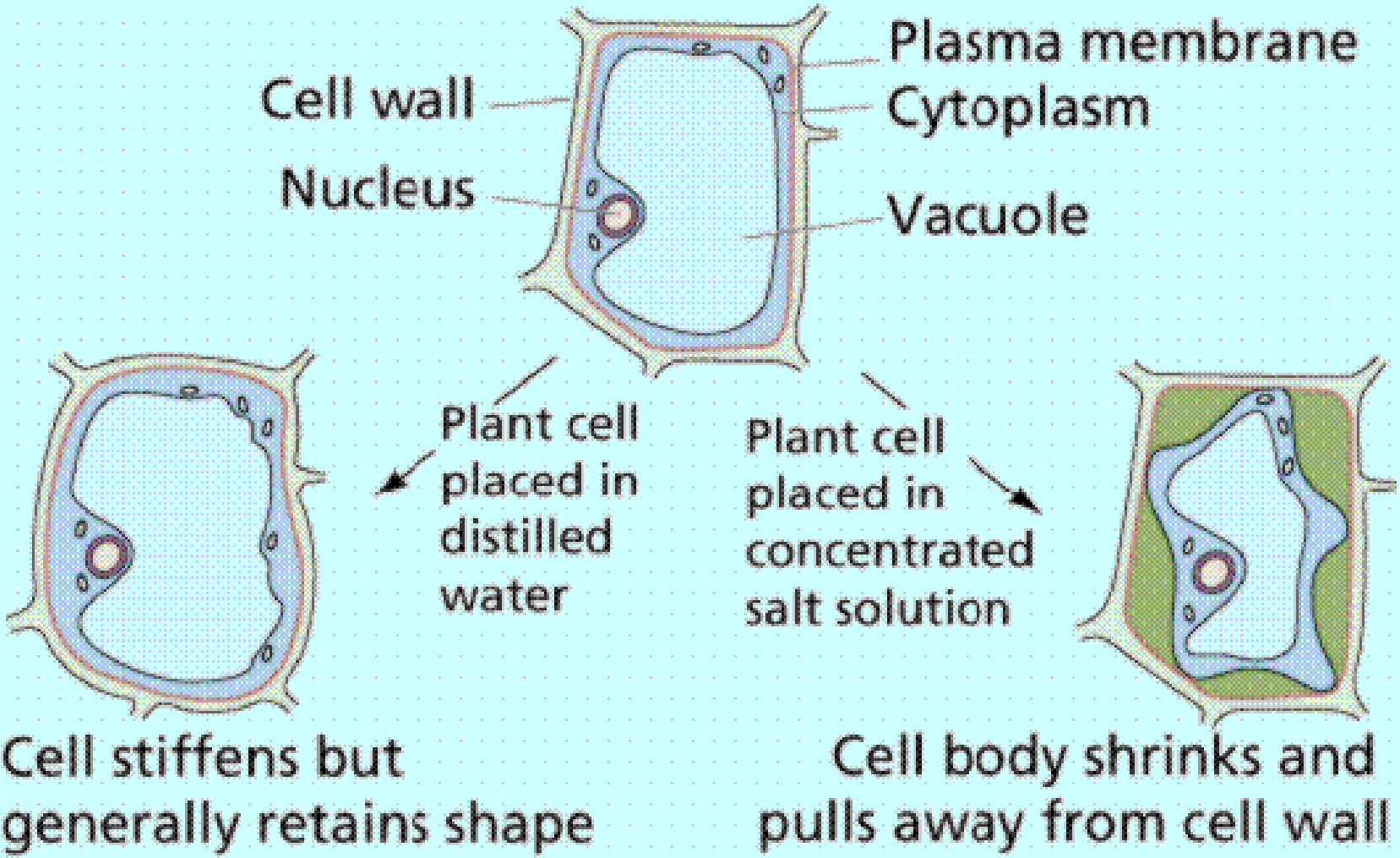


= CYTOLYSIS

= CRENATION

http://www.stchs.org/science/courses/sbioa/metenergy/aplantturgor.gif

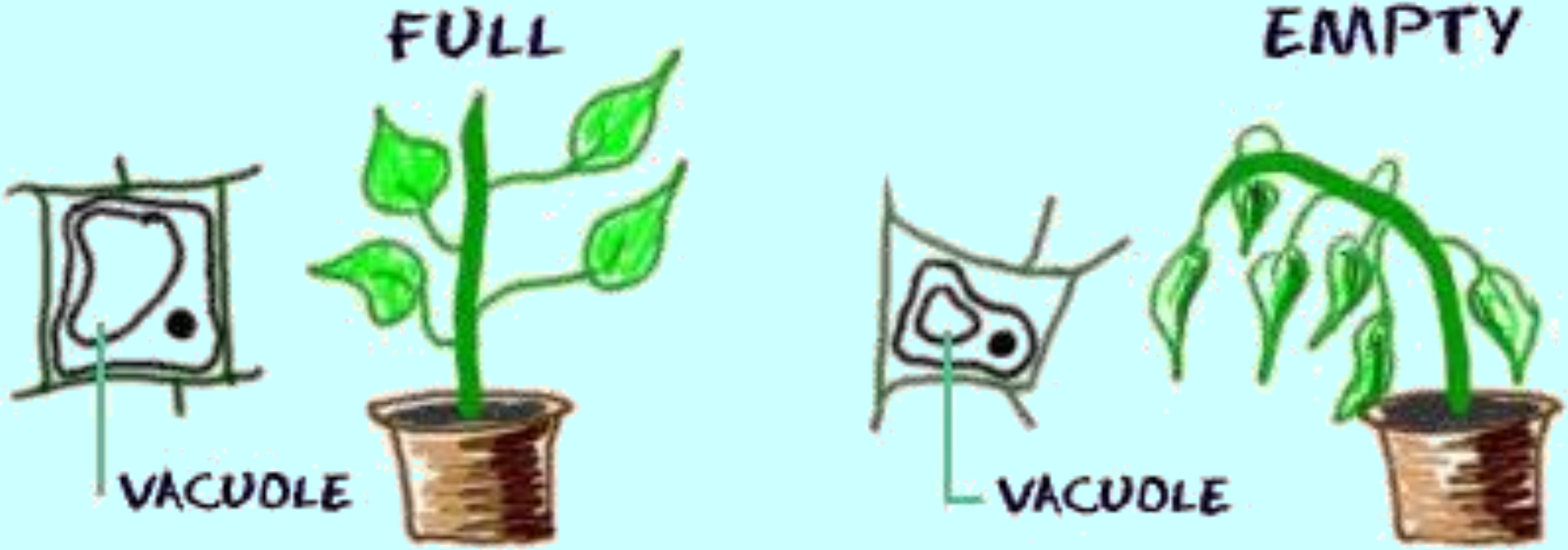
Plant cells



CELL WALL keeps plant cells from bursting

= PLASMOLYSIS

VACUOLES store WATER



http://www.biology4kids.com/files/cell_vacuole.html

OSMOTIC PRESSURE =

Pressure exerted by the movement of water during osmosis

SO WHAT?

Bath water is

___hypotonic___

compared to you

Sitting in the bathtub causes your fingers and toes to wrinkle up when water

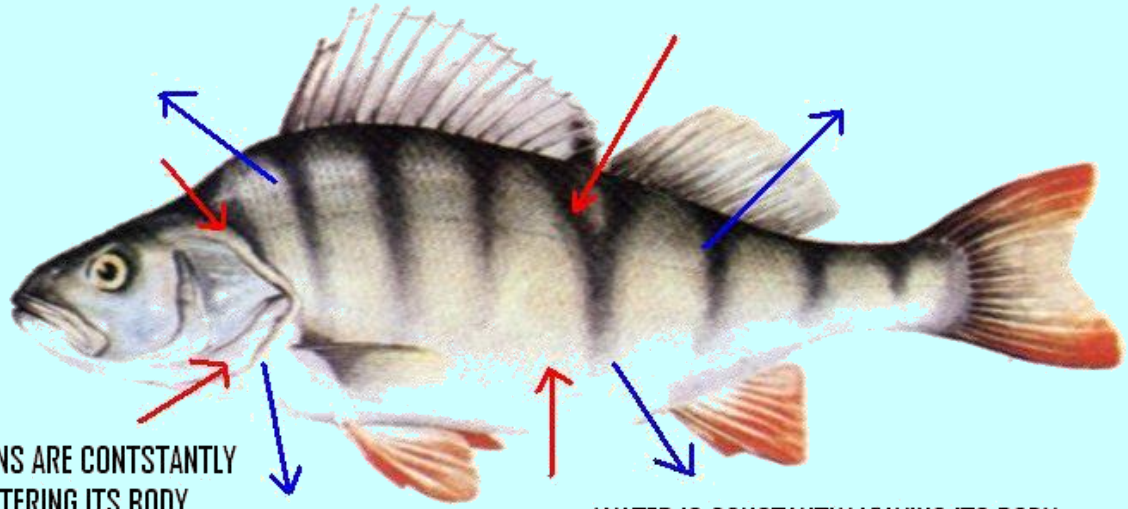
__enters__ your skin cells by osmosis

Grocery stores spray water on their veggies to “plump them up”

http://www.painetworks.com/photos/gt/gt0461.JPG

SO WHAT?

A SALT WATER FISH LIVES IN A HYPERTONIC SOLUTION:



A FRESHWATER FISH LIVES IN A HYPOTONIC SOLUTION: