BUBBLE WRAP MODEL OF A RENAL TUBULE

Author: Jim Elder, Tulsa Community College, Copyright 2007
contact: jelder@tulsacc.edu

Students sometimes have a problem visualizing the 3 dimensional aspects of anatomy. Most illustrations in text and lab books are drawn in a single plane.

This exercise could be used either as an instructor demonstration or as a group lab exercise.

* Each student group receives a section of bubble wrap, about 1 foot in length. The ½ inch bubble size is easier to handle and manipulate.

* Have the students identify the "bubble" side of the wrap as the luminal membrane and the flat side as the basal membrane. Spaces between the bubbles are the tight junctions between cells.

* Using some small colored stickers, to illustrate channels, aquaporins, pumps, etc. – have the students place some of these stickers on the appropriate sides of the wrap, luminal or basement membrane, using their lecture notes and text as a guide. I found the ¼ inch Avery stickers worked best with this size of bubble wrap, but you may want to experiment with other sticker options.

* Roll the bubble wrap as illustrated below, with the "bubbles" on the inside to illustrate the luminal membrane and the smooth side of the wrap as the basal layer membrane. This model will give the students a 3-D perspective of a typical renal tubule.

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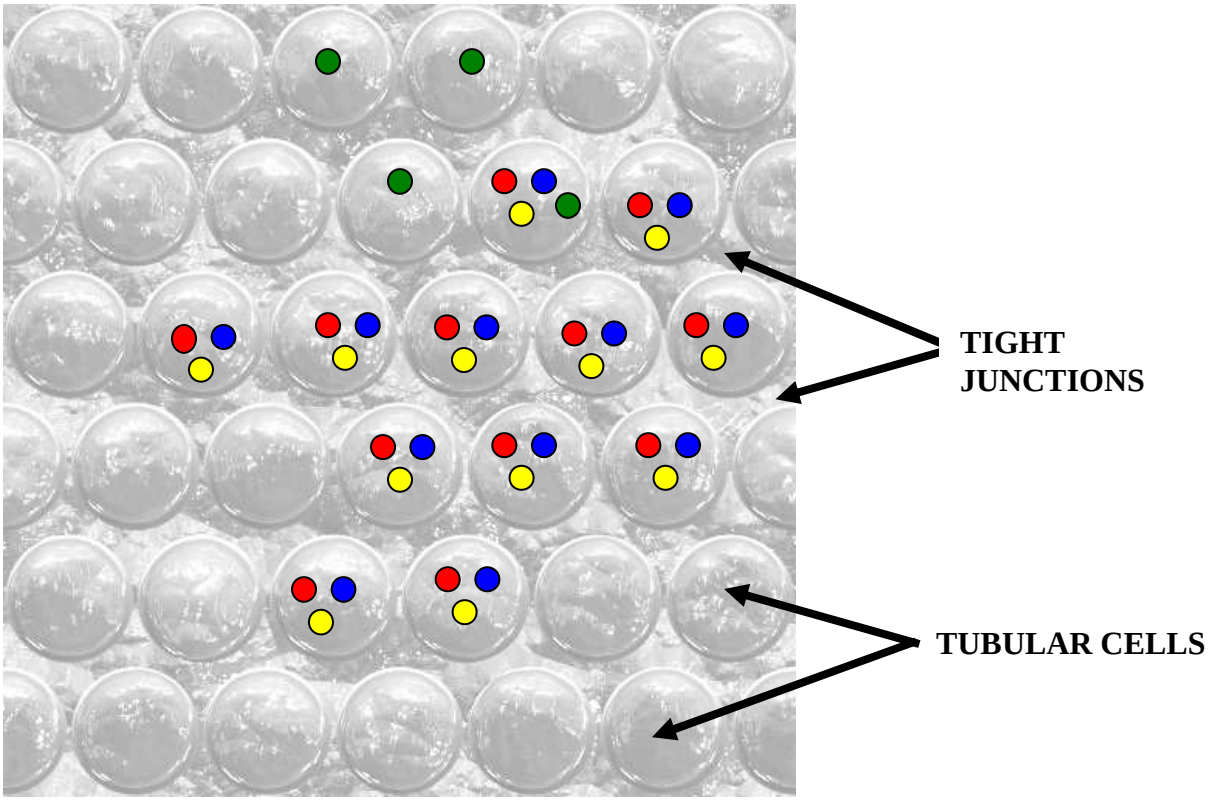
BUBBLE WRAP MODEL OF RENAL TUBULE

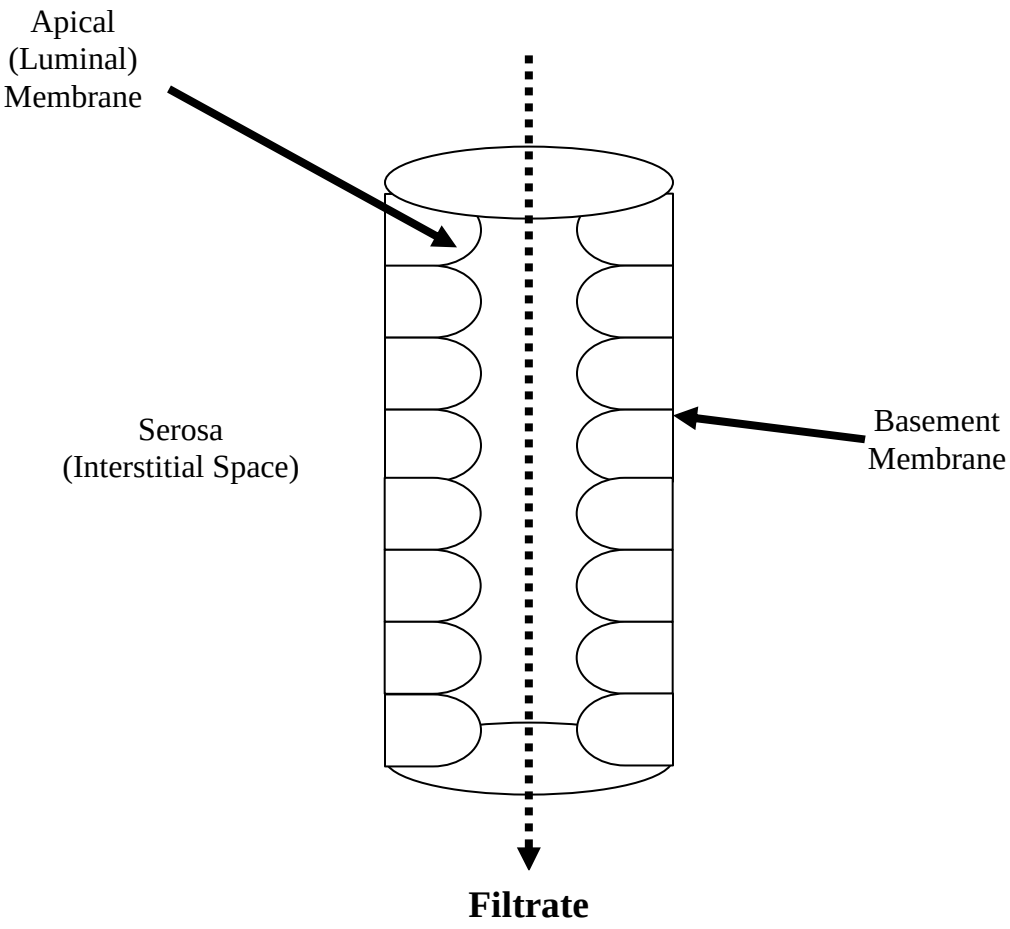


COLOR STICKER LEGEND

- Illustrate an Aquaporin channel
- Illustrates an ion channel
- Illustrates a Symport, Antiport, or uniport channel
- Illustrates an ATPase pump

Note: The above display just illustrates placement of the stickers, they could be on either the basal lateral or luminal membranes depending on type of transporter and it function.

Model of renal tubule (roll of bubble wrap)



RENAL TUBULE LAB EXERCISE

This exercise will aid the students in understanding functions of the various ion channels, ATP pumps, aquaporins, etc. associated with the luminal and basal membrane. It can be used as a lab exercise or small group classroom activity with the students using lecture notes, textbook, and other available sources for reference.

Magnetic/dry erase boards will be used. Each board will have a general diagram of a typical kidney tubule (drawn in permanent ink). Various colored magnets would be used to illustrate the different transport mechanisms associated with tubular cells. This exercise will concentrate on the *proximal convoluted tubule* because major reabsorption of Na and water occurs here. The board does allow for further concentrated study on other sections of the tubular system; Loop of Henle, DCT, and Collecting ducts.

Students working in groups of 2 or 3 will place the appropriate channels, pores, pumps, etc. (colored magnets) on either the luminal membrane or basement membrane. Students would then use dry erase makers to draw the appropriate ions or molecules associated with each magnet, using arrows to illustrate membrane transport across membranes.

The advantage of the system:

- **Allows boards to be used repeatedly for other sections of the renal system.**
- **The magnetic boards can be handled by several students.**
- **Boards could be used for student presentations in front of the class.**

The magnetic/dry erase boards come in various sizes and can be purchased at any office supply store. Various size magnets can be found at many hobby shops. You may be able to purchase colored magnets, but colored stickers attached to the magnets were used for this example. Be sure to make several duplicate magnets of each kind, so students can experiment with various placement options.

Lab Exercise:

The reabsorption of sodium, water, and chloride are related to one another and the amount absorbed varies within the tubular segments. Refer to your notes and text for specific details. This exercise concentrates on the Proximal tubule.

Proximal convoluted tubule (PCT)

65% of the Sodium, 65% of the water, and 60% of the chloride in the filtrate is reabsorbed in the PCT. Most of the Na^+ enters the cell across luminal membrane using antiports with protons (H^+). The majority of the Chloride (Cl^-) reabsorption occurs via paracellular diffusion. Some of the other transport mechanisms are; Na-glucose/amino acid symports, Na-phospate symports, Na-HCO_2 symports, Cl-K symports, Na-K ATP pump, and Cl-base (Cl-anion).

* **How many of these transport systems can you identify and illustrate using the magnet/dry erase board (illustrated on the next two pages).**

* **Place the magnets on the board to illustrate the location of various transport mechanisms. The illustrations on the following pages just show how the board and magnets are used. The transporters can be on either the luminal or basal layer membrane, depending on the type and their specific function.**

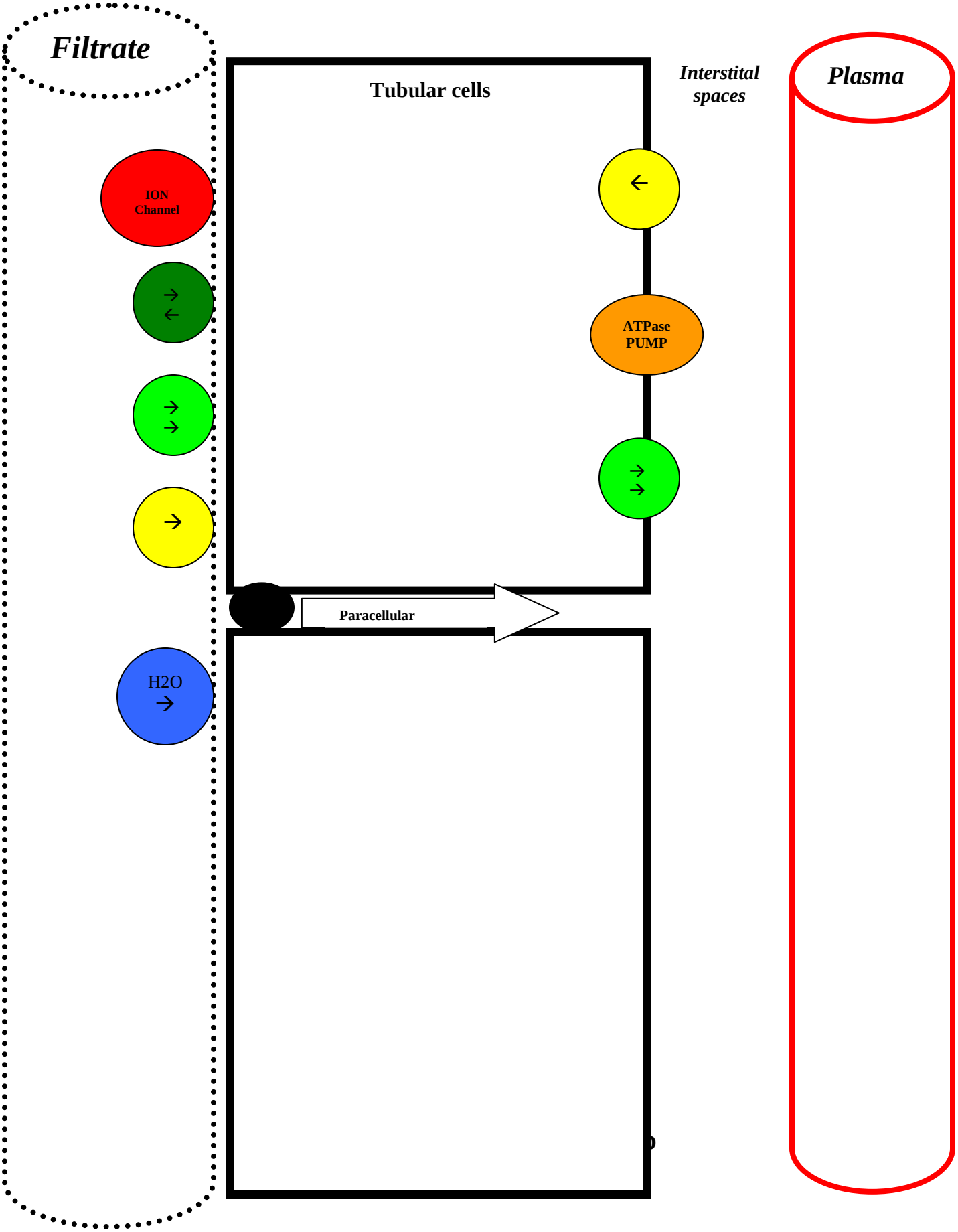
* **Using dry erase markers, draw the names of various ions, H_2O molecule, and other substances associated with each transport system. Use arrows to illustrate direction of movement. Make sure you move each ion/molecule completely from the tubule lumen to capillary to accomplish reabsorption. Label the board as to what portion is the filtrate/lumen, interstitium, and capillary/plasma regions.**

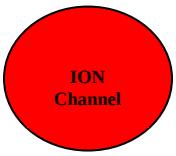
* **Remember that reabsorption is not just movement moving it into the cell, but also out of the cell and into the interstitium and plasma.**

* **Indicate which substances move via either transcellular or paracellular processes.**

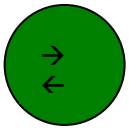
* **Remove the magnets and erase the board when the assignment is complete.**

Renal Tubule Type: _____

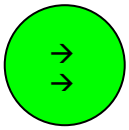




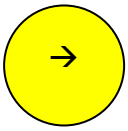
ION CHANNEL
example K^+, H^+, Cl^-



ANTIPORT

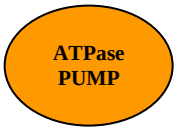


SYMPORT



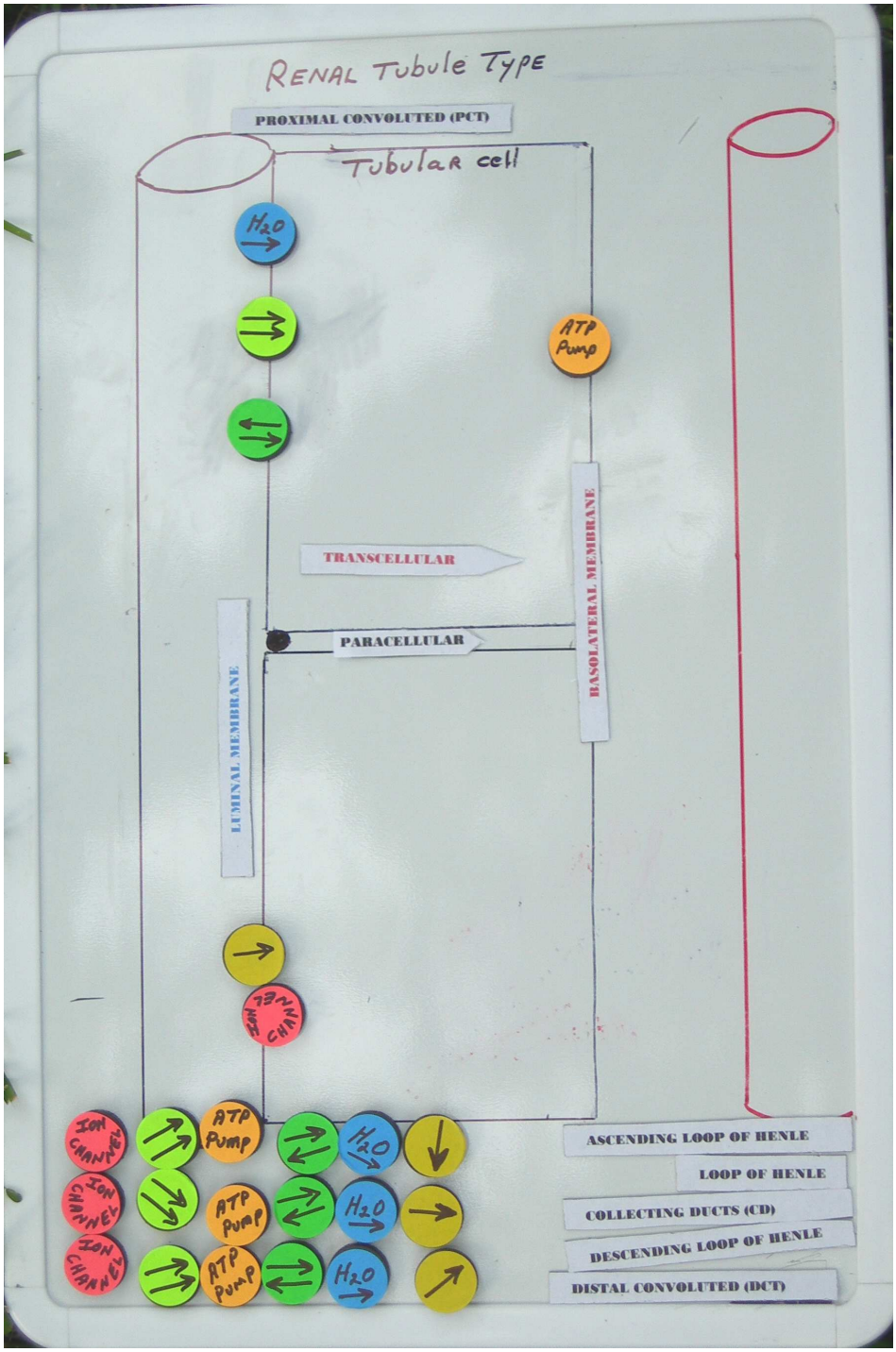
UNIPORT

AQUAPORIN



ATP PUMP

TIGHT JUNCTIONS



Magnetic/dry erase board showing various labels and transporters (magnets) available for appropriate placement.

References:

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