AP BIOLOGY · UNIT 2 · TOPIC 2.4

Membrane Permeability

Learning objective 2.4.A Explain how the structure of biological membranes influences selective permeability.

Name: Date: Period:

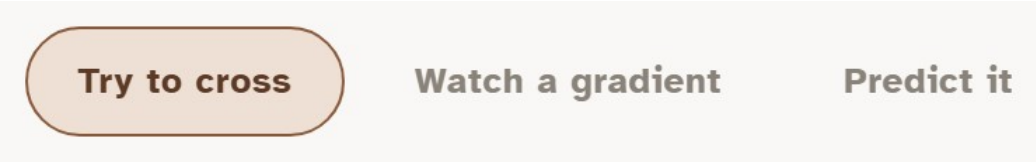
Use the tool **What Gets Through**. Work on the **Try to cross** tab for Parts 1 to 3, **Watch a gradient** for Part 4, and **Predict it** for Part 5. Start with every protein switched off. Where a Part asks for a prediction, write the prediction before you use the tool to check it.

switch tab *scroll down* *predict first*

record from the tool *score yourself*

The purple bar in the margin names the AP science practice a question uses.

Part 1 · Three properties, one answer



Use the **Try to cross** tab. It is the one showing when the tool opens.

With **no proteins** in the membrane, click each substance and drag it to the membrane. Record its three properties and what happens.

Substance	**Polar or nonpolar?** *circle one*	**Charged?** *circle one*	**Small or large?** *circle one*	**Gets through?** *circle one*
Oxygen	polar / nonpolar	yes / no	small / large	yes / slowly / no
Carbon dioxide	polar / nonpolar	yes / no	small / large	yes / slowly / no
Steroid hormone	polar / nonpolar	yes / no	small / large	yes / slowly / no
Water	polar / nonpolar	yes / no	small / large	yes / slowly / no
Glucose	polar / nonpolar	yes / no	small / large	yes / slowly / no
Sodium ion	polar / nonpolar	yes / no	small / large	yes / slowly / no

1. Two of the substances in the Part 1 table cross the membrane freely, with no help.
(a) Identify the two substances.

(b) Describe the two properties that these substances share.

Part 2 · The one that surprises people

Stay on the **Try to cross** tab.

Compare the **steroid hormone** with the **sodium ion**. The steroid hormone is much larger than the sodium ion.

2. Identify which of the two crosses the membrane with no proteins in it, and which does not.

3. (a) Identify the property that determines whether the steroid hormone and the sodium ion cross the membrane.

(b) Explain why size does not determine whether these two substances cross.

4. Open All eight possibilities in the tool. Identify the property shared by every row that ends in “needs a channel protein”.

Part 3 · Switch the proteins on

Stay on the **Try to cross** tab.

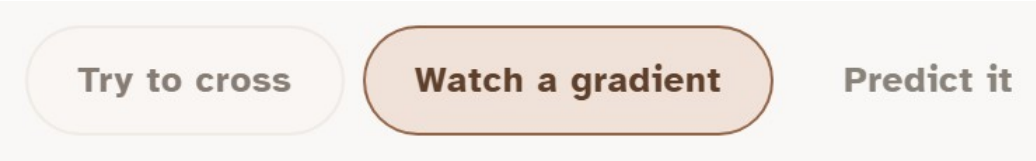
Turn on each protein in turn and find which substances it lets through. Drag each substance to the protein, not to a random spot on the membrane.

Protein added	Which substances it lets through	What those substances have in common
Ion channels		
Transport proteins		
Aquaporins		

SP 1 · CONCEPT EXPLANATION

5. Water crosses the membrane slowly with no proteins in it. Explain why aquaporins are important to cells, even though water can cross without them.

Part 4 · Gradients



Click the **Watch a gradient** tab at the top of the tool.

SP 6 · ARGUMENTATION

Each run starts with 100 outside and 0 inside. **Predict the gap after 200 steps before you press Run the clock, then record the result.**

Solute	Gap I predict	Gap after 200 steps	Was my prediction supported? *circle one*
Oxygen			yes / no
Water			yes / no
Glucose			yes / no
Sodium ion			yes / no

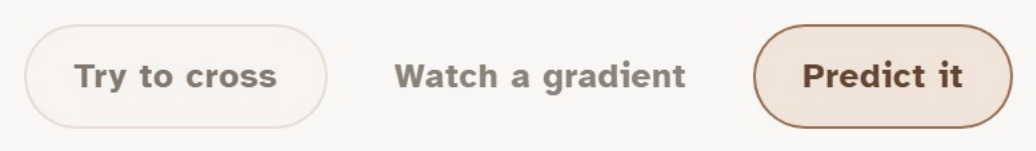
6. (a) Identify the solutes that kept the largest gradient and the solute that kept none.

(b) Explain the difference in terms of the permeability of the membrane to each solute.

7. Select glucose, press Add the right protein, and run the clock again.
(a) Describe the effect of adding the protein on the glucose gradient.

(b) Explain why the protein had this effect.

Part 5 · Predict from properties alone



Click the **Predict it** tab at the top of the tool.

Each card gives the properties of a substance but not its name. Work all twelve cards, then answer questions 8 to 10.

8. Explain how the selective permeability of a membrane allows a concentration gradient of a solute to form and persist.

9. A student predicts that any particle that is small enough will cross a membrane with no proteins in it.
(a) Propose a comparison of two substances in the tool that would test the student's prediction.

(b) Describe the result that would show that the prediction is incorrect.

10. Explain how selective permeability results from the structure of the membrane. In your answer, refer to both the interior of the membrane and the proteins embedded in it.

Part 6 · Learning check self-report

Scroll down to the **Learning check** at the bottom of the tool. Type an answer to each question, check it against the rubric, and check off the points you earned. Then record your score here and, for every point you did not earn, write what the rubric asked for that your answer left out.

Question	Points possible	Points I earned	Missed opportunities (what the rubric wanted that I left out)
1	2		
2	2		
3	2		
4	2		
Total	**8**		

What the model simplifies

Permeability is treated as four categories. In reality it is a continuous scale, and even the fastest-crossing molecule takes a finite time.

“Small” and “large” are treated as a yes-or-no property. Real permeability falls off gradually with molecular size, and there is no single threshold.

The gradient model is a simple relaxation: flow across the membrane is proportional to the concentration difference. That gives the right direction and the right shape of curve, not real rates in real units.

The tool's ion channels carry any ion. Real channels are usually selective for one, which matters a great deal in Topic 2.6.