

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. Predicting: wherever a Part asks you to predict, write a specific number or word and one reason before you touch the tool, in the form “I think ... because ...”. A wrong prediction costs nothing; a prediction made after looking is not a prediction.



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

Try to cross

Watch a gradient

Predict it



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 at the membrane. Record its three properties and what happens.

Substance	Polar or nonpolar? <i>circle one</i>	Charged? <i>circle one</i>	Small or large? <i>circle one</i>	Gets through? <i>circle one</i>
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 these substances get through with no help at all. Name them, and state the two properties they 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 is by far the bigger molecule.

2. Which of the two gets across the bare membrane, and which does not?

3. Explain why size is not the deciding factor here. Name the property that is.

4. Open the eight-row table in the tool. Find every row that ends in “needs a channel protein”, and state what all of those rows have in common.

Part 3 · Switch the proteins on



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

Turn on each protein in turn and work out exactly which substances it rescues. Drag the substance **at the protein**, not at a random spot on the membrane.

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

5. Water gets through the bare membrane slowly on its own. Explain why a cell would bother having aquaporins at all.

Part 4 · Gradients

Try to cross

Watch a gradient

Predict it



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



Each run starts with 100 outside and 0 inside. **Predict the final gap before you press Run**, then record what actually happened.

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

6. State which solute held the largest gradient and which held none, and explain the difference in terms of permeability.

7. Select glucose, press “Add the right protein”, and run again. Describe what happened to the gradient and explain why.

Part 5 · Predict from properties alone

Try to cross

Watch a gradient

Predict it



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



Each card gives you the properties and hides the name. Work all twelve, then answer these.

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 molecule small enough will cross a membrane unaided. Design a comparison from this tool that would test that prediction, and state what result would show the prediction is wrong.

10. Explain why selective permeability is described as a direct consequence of membrane structure. Refer to both the interior of the membrane and the proteins in it.

Part 6 · Learning check self-report



Scroll down to the **Learning check** at the bottom of the tool. Type each answer in your own words, check it, and tick 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.