AP BIOLOGY · UNIT 2 · TOPIC 2.6

Facilitated Diffusion

Learning objective 2.6.A Explain how the structure of a molecule affects its ability to pass through the plasma membrane.

Name: Date: Period:

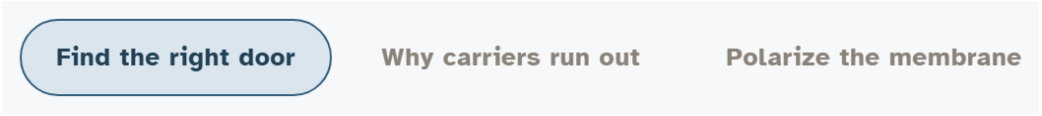
Use the tool **Through the Channel**. Work on the **Find the right door** tab for Parts 1 and 2, **Why carriers run out** for Part 3, and **Polarize the membrane** for Part 4. Where a Part asks for a prediction, write the prediction before you use the tool to check it.

switch tab *scroll down* *predict first*

record from the tool *score yourself* *reset the tool*

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

Part 1 · Which door fits which solute



Use the **Find the right door** tab. It is the one showing when the tool opens.

Select each solute in turn and drag it to each of the four proteins. Record which protein accepts it, if any.

Solute	**Which protein accepts it**	**Channel or transport protein?** *circle one*
Potassium ion K^+		channel / transport protein / none
Sodium ion Na^+		channel / transport protein / none
Chloride ion Cl^-		channel / transport protein / none
Glucose $C_6H_{12}O_6$		channel / transport protein / none
Water H_2O		channel / transport protein / none

SP 1 · CONCEPT EXPLANATION

1. One solute in the Part 1 table has no protein in this membrane that accepts it.
(a) Identify the solute.

(b) Explain why this solute cannot cross this membrane.

2. A sodium ion is smaller than a potassium ion, yet a sodium ion does not pass through the potassium channel. Explain what this observation indicates about how a channel protein selects the ions that pass through it.

Part 2 · Prove it is still passive

Stay on the **Find the right door** tab and scroll down to **the section headed The thing students get wrong**.

SP 6 · ARGUMENTATION

Open The thing students get wrong and use the small flow model. For each row, press Start from a gradient or Start from equilibrium to set the starting condition, write your prediction, then press Run it.

Starting condition	What I predict	Final outside / inside	ATP used
Outside 90, inside 10			
Outside 50, inside 50			

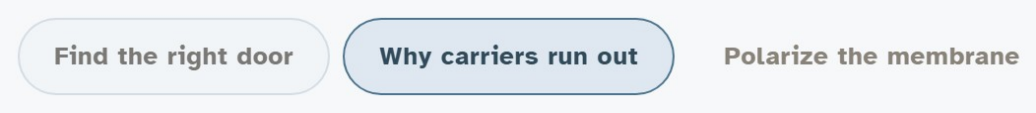
3. (a) Identify the final concentrations outside and inside for the run that started at outside 90, inside 10.

(b) Explain why net movement stopped at these concentrations.

4. When the starting concentrations were equal, no solute moved. Explain how this result shows that facilitated diffusion is passive, not active.

5. Facilitated diffusion requires a protein. Explain why a process that requires a protein does not necessarily require energy.

Part 3 · The graph that separates them



Click the **Why carriers run out** tab at the top of the tool.

Set the gradient slider to each value in the table and record both rates.

Gradient	Channel rate	Carrier rate	Which is faster?
10			
40			
80			
160			

6. (a) Describe the relationship between the gradient and the channel rate.

(b) Describe the relationship between the gradient and the carrier rate.

7. At a small gradient the carrier rate is greater than the channel rate, but at a large gradient the channel rate is greater. Explain why the channel rate becomes greater than the carrier rate as the gradient increases.

8. Explain why a transport protein has a maximum rate and a channel protein does not. In your answer, refer to what each protein must do for every molecule it moves.

Part 4 · Make a charge difference



Click the **Polarize the membrane** tab at the top of the tool.

SP 6 · ARGUMENTATION

For each row, predict which way each ion will move and whether a charge difference will build up. Then open those channels, press **Let ions cross**, wait until the flow stops on its own, and record the reading **Inside relative to outside**. Press **Reset** between rows.

Channels open	**Which way will each ion move? (predict)**	**Polarized? (predict)** *circle one*	**Inside relative to outside (actual), and polarized?**
K^+ only		yes / no	
Na^+ only		yes / no	
Cl^- only		yes / no	
K^+ and Na^+ together		yes / no	
K^+ and Cl^- together		yes / no	

SP 1 · CONCEPT EXPLANATION

9. (a) Using the Part 4 table, describe the conditions in which the membrane becomes polarized.

(b) Describe the conditions in which the membrane does not become polarized.

10. (a) Explain how the selective permeability of a membrane can produce a difference in electrical charge across the membrane.

(b) Identify one other result of selective permeability.

11. In the runs with a single channel open, the ions stopped crossing before the concentration difference was gone. Explain why the net movement of ions stopped.

Part 5 · 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

Each protein here carries exactly one substance. Real channels and transporters vary in how selective they are, and some carry more than one thing at once.

The carrier's saturating curve is a smooth mathematical relationship rather than a simulation of individual proteins binding and cycling. The shape is right; the numbers are arbitrary units.

Membrane potential is shown as a plain count of net charges, not in millivolts. A real membrane potential also depends on the membrane's capacitance, and on the fact that only a tiny fraction of the ions present actually cross.

The resting populations (potassium higher inside, sodium and chloride higher outside) are the usual animal-cell picture with made-up counts. The electrical pull on an ion is a single opposing term: each unit of net charge across the membrane counts the same as one ion of concentration difference, so the flow slows and stops at a simple balance point rather than at a true equilibrium potential.