Newsflash!
Transport Proteins on Strike!

by
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The Cast

PHIL LIPID, news anchor
CHLOE ESTEROL, reporter
PHOSPHOLIPIDS, workers at the Plasma Membrane
POLLY PEPTIDE, president of the TPWU
H2O, molecule
CO2, molecule
O2, molecule
GLUCOSE, molecule
AMINO ACID, molecule
PROFESSOR CY TOSOL, professor at Cell University
GENE NOME, spokesperson for The Cell

NARRATOR: The good molecules of The Cell have been on edge for days. The Cell has always been a vibrant place to live and work. But that is all in jeopardy now due to a threatened walkout by the Transport Protein Workers Union (TPWU), which has been unable to secure a satisfactory contract from the Cellular Membrane Transportation Authority, more commonly known as CEMTA (pronounced SEM-tah). CEMTA oversees all business at the Plasma Membrane, which forms the outer border of The Cell. The Plasma Membrane incessantly bustles with the activity of molecules entering and leaving The Cell. Much of that activity is critical, and it is not known how severely a strike by the TPWU will affect life at The Cell. Many molecules are tuned in to their local TV news stations, desperate to hear the latest, when the following breaking news report interrupts the regularly scheduled program.

(On TV)

PHIL LIPID: Good morning. This is PHIL LIPID in the newsroom at Channel Two Organic News with a LIVE Special Report. The Transport Protein Workers Union, or TPWU, has just held a press conference where they announced that they will strike as of midnight tonight. Negotiations between the TPWU and CEMTA have broken down and no new talks are scheduled at this time. CHLOE ESTEROL is standing by at the Plasma Membrane. CHLOE, what's the latest?

CHLOE ESTEROL: Good morning, PHIL. Talks with the TPWU have indeed broken down as of 10am this morning. Those talks were reportedly marked at times by heated and occasionally emotional exchanges from both sides. The TPWU has announced that they will strike beginning at 12 midnight. What that means is that all transport through any type of transport protein, whether by diffusion, facilitated diffusion, or active transport, will be shut down at midnight.

The PHOSPHOLIPIDS, who are represented by a different union, will remain on the job. As a matter of fact, the PHOSPHOLIPIDS are directly behind me. You can probably hear them now because, as you know, when the PHOSPHOLIPIDS are at work, they are constantly chattering and chanting.

(Camera zooms in on the phospholipid bilayer.)

PHOSPHOLIPIDS: (in unison) We are PHOSPHOLIPIDS. We are part of the Plasma Membrane. We let some things pass through, but other things cannot! (chanting) Some things can pass! Other things cannot! Some things can pass! Other things cannot! Some things can pass! Other things cannot!

(Camera moves back on CHLOE ESTEROL.)

CHLOE ESTEROL: The PHOSPHOLIPID chants, of course, have to do with their selectively permeable capabilities. And as I've already stated, the PHOSPHOLIPIDS are expected to remain on the job in the event of a strike by the TPWU.

Now, the TPWU is asking for better working conditions. They say they work long hours without a break. They say they have difficult jobs, shuttling important molecules across the Plasma Membrane. And, quite frankly, they feel they are not adequately rewarded for their efforts. Some transport proteins have claimed that the PHOSPHOLIPIDS receive all the attention and enjoy much better benefits due to their sheer numbers. Earlier, I caught up with POLLY PEPTIDE, president of the TPWU, and this is what she had to say.

(Cut to film clip of interview.)

CHLOE ESTEROL: Do you realize the dramatic effect a strike at the Plasma Membrane would have on The Cell?

POLLY PEPTIDE: (indignant) We do. But given the extreme pressure we are under, we feel this action is warranted. Our transport proteins work hard, day and night, night and day. We are reliable. We are always there taking care of business. We deserve better working conditions and a lot more respect for our dedication and our vital role in membrane transport operations.

(Return to LIVE broadcast.)

CHLOE ESTEROL: PHIL, this morning, I also spoke with some of the molecules that would be affected by the strike. Here's what they had to say:

(Cut to taped film segments.)

CHLOE ESTEROL: (speaking to one molecule in a large crowd): What is your name?

H2O: (caught off guard at being singled out) Uh, uh, well, I'm a water molecule.

CHLOE ESTEROL: How will you be affected by a TPWU strike?

H2O: Well, I use diffusion, but I'm small enough to cross the Plasma Membrane directly through the phospholipid bilayer. So I can get back and forth that way all right. My problem will be the aquaporins. If they shut down, I could be in trouble.

CHLOE ESTEROL: (moves toward other molecules in the crowd) Hello. Would you like to give our viewers your opinion on the strike?

CO2: Yes, hello. I am carbon dioxide. I enter and leave The Cell by diffusion. I can pass directly through the lipid bilayer.

CHLOE ESTEROL: (off camera) So you will not be affected by the strike?

CO2: No.

CHLOE ESTEROL: And you are?

O2: (standing next to CO2) I am oxygen, and I also enter and leave The Cell by diffusion. I can pass directly through the lipid bilayer, just like my friend CO2.

O2 and CO2: (in unison, with attitude) We can pass at any time! Yeah! (high five each other)

CHLOE ESTEROL: (speaking to another molecule in the crowd) What is your name and how will you be affected by the strike?

GLUCOSE: (somewhat snobbish) My name is GLUCOSE. I enter and leave The Cell by facilitated diffusion, so I *must* have a transport protein to cross the Plasma Membrane. You know my transport protein recognizes me only and no one else. It's like I have my own personal entrance. All the glucose molecules do!

CHLOE ESTEROL: (moving closer to another molecule) And you?

AMINO ACID: (self-assured, confident) I'm an amino acid. I get across by facilitated diffusion. My transport protein knows me and lets me through like that (snapping fingers). (proudly) No one else uses *my* transport protein. I'm needed in there. A strike will be a real hardship.

(Return to LIVE broadcast.)

CHLOE ESTEROL: PHIL, obviously a strike by the TPWU will be very disruptive to cellular activities. That can only be avoided with a return to the bargaining table. And at this time no meetings are scheduled. This is CHLOE ESTEROL reporting LIVE for Channel Two Organic News. Back to you, PHIL.

(In the studio.)

PHIL LIPID: Thank you, CHLOE. Now to get an objective viewpoint on the consequences of the strike, we have with us, by LIVE feed, PROFESSOR CY TOSOL of Cell University.

(Split screen image appears with PHIL LIPID on the left and PROFESSOR TOSOL on the right.)

PHIL LIPID: PROFESSOR TOSOL, welcome. We appreciate your taking the time to speak with us today.

PROFESSOR TOSOL: Thank you, PHIL. Glad to be here.

PHIL LIPID: PROFESSOR TOSOL, can you explain to our viewers exactly what impact a strike by the TPWU will have on The Cell and its operations?

PROFESSOR TOSOL: Well, we know the strike will have a direct impact on several major functions within the Plasma Membrane. These functions include diffusion, facilitated diffusion, and active transport.

PHIL LIPID: How will diffusion be affected? I thought diffusion involved the PHOSPHOLIPIDS only, which are not part of the strike.

PROFESSOR TOSOL: First of all, diffusion is the passive movement of molecules from an area of high concentration to an area of low concentration. While it is true that diffusion can occur directly through the lipid region of the bilayer, some, but not all, substances cross that way. Most ions, for example, require a type of transmembrane protein, called a pore or channel. They can't move directly through the phospholipids.

Water, of course, is very important. Small amounts of water can pass directly through the phospholipids, which shift about due to the fluidic nature of the bilayer. Water also passes through aquaporins, special water channels that are transmembrane proteins. In fact, this is the main route for water entering and exiting The Cell. The aquaporins are critical for osmosis to occur.

PHIL LIPID: You mentioned osmosis. What is osmosis, exactly?

PROFESSOR TOSOL: Osmosis is the passive movement of water through the Plasma Membrane. It occurs to keep a constant balance of water in The Cell relative to its environment.

PHIL LIPID: You mean water will move into and out of The Cell depending on external conditions?

PROFESSOR TOSOL: Yes. If The Cell is in hy*per*tonic (emphasizes second syllable) conditions, then there is too much of some substance, for example salt, outside of the cell, but not enough water. Therefore, water will leave The Cell until a balance is achieved. If the situation is extreme, too much water may leave The Cell and it will shrivel and die.

PHIL LIPID: We all remember the Great Dehydration scare a few years ago, when a stomach virus took its toll, affecting cellular communities far and wide. So those were hypertonic conditions?

PROFESSOR TOSOL: Yes. Of course, the stomach virus was quickly eliminated, but osmosis is critical to maintaining water balance. Now under hy*po*tonic (emphasizes second syllable) conditions, we have the opposite situation. Excess water floods The Cell, causing it to expand. Too much of this and The Cell could burst, killing it instantly.

PHIL LIPID: PROFESSOR, the scenarios you are describing seem to mean dire consequences for The Cell unless the strike is averted.

PROFESSOR TOSOL: Yes, PHIL. I would have to agree with your assessment. Ideally we want isotonic conditions, which is a nice balance of water on both sides of the Plasma Membrane. To achieve that, the aquaporins must function properly.

PHIL LIPID: Is there anything else our viewers should know?

PROFESSOR TOSOL: Well, if the strike does proceed, facilitated diffusion would be another lost service.

PHIL LIPID: What processes does facilitated diffusion entail?

PROFESSOR TOSOL: Facilitated diffusion is the passive movement of molecules across the Plasma Membrane that is aided by transport proteins. Without facilitated diffusion, large and important molecules like glucose and the amino acids can't get into The Cell.

PHIL LIPID: That would be very bad, for obvious reasons. PROFESSOR, everything you've discussed so far has been described as a *passive* movement. Why do you call them passive?

PROFESSOR TOSOL: Because they don't require energy. Diffusion, facilitated diffusion, and osmosis are all passive because The Cell does not use energy to drive the process. *Active* transport, however, *does* require The Cell to expend energy, usually in the form of ATP. Energy is needed whenever a substance must move "uphill," against the concentration gradient. That is to say, from an area of low concentration to an area of high concentration.

PHIL LIPID: And does active transport require the use of transport proteins?

PROFESSOR TOSOL: Yes, it does. So this is yet another function that would be lost during the strike.

PHIL LIPID: What kinds of molecules cross the Plasma Membrane by active transport?

PROFESSOR TOSOL: The sodium-potassium pump, for one, is a transport protein that needs ATP to run. That's a type of active transport that moves sodium and potassium ions across the Plasma Membrane. Regulation of sodium and potassium concentrations is critical to the survival of The Cell.

PHIL LIPID: Well, this has been very enlightening. It seems that The Cell could be in a great deal of trouble if the transport protein workers are on strike. Thank you for your time, PROFESSOR TOSOL.

PROFESSOR TOSOL: You're very welcome, PHIL. Glad I could help.

(Split screen dissolves. Return to single frame.)

PHIL LIPID: We now return to reporter CHLOE ESTEROL, LIVE at the Plasma Membrane with an important update.

CHLOE ESTEROL: PHIL, just moments ago, the TPWU and CEMTA announced that they will return to the bargaining table at 3pm. There is hope that they will be able to reach an agreement and avert the proposed strike that could have a devastating outcome for The Cell and its molecules.

PHOSPHOLIPIDS: (chanting, in the background) Some things can pass! Other things cannot! Some things can pass! Other things cannot!

CHLOE ESTEROL: As you know, the situation here at the Plasma Membrane is very tense. Many molecules could be stranded on either side of the Plasma Membrane if there is a strike. Molecules are worried about how they will get into and out of The Cell, if the transport proteins are not operating.

PHOSPHOLIPIDS: (chanting, in the background) Some things can pass! Other things cannot! Some things can pass! Other things cannot!

CHLOE ESTEROL: Here is a molecule on its way into The Cell now. You look concerned. How will you handle the strike?

O2: Being an oxygen molecule, I can cross the Plasma Membrane. The problem is what kind of chaos will I find once I get inside The Cell? I mean, cellular respiration requires both myself and GLUCOSE. If GLUCOSE can't get in, how can I do my job?

CHLOE ESTEROL: PHIL, a lot is resting on the continuation of talks between the TPWU and CEMTA. This is CHLOE ESTEROL Channel Two Organic News.

PHIL LIPID: Thank you, CHLOE. With us now is MR. GENE NOME, spokesperson for The Cell. (Talking to GENE NOME.) Thank you for joining us today.

GENE NOME: (nods in response) Please call me GENE.

PHIL LIPID: OK, GENE it is. GENE, what is The Cell doing to avert this strike?

GENE NOME: PHIL, The Cell is acutely aware of the magnitude of the situation. We have been present during talks with the TPWU, and we will again return to the table as talks resume shortly.

PHIL LIPID: Specifically, what must happen for the TPWU and CEMTA to reach a compromise and avert this strike?

GENE NOME: The Cell has always held a strong belief in fairly compensating all of our cellular workers. We believe that it is in the best interests of all involved that a strike be averted. And we firmly believe that an agreement can be reached in time for that to happen.

PHIL LIPID: GENE, thank you again for your valuable time.

GENE NOME: (nods in response) You're welcome, PHIL.

PHIL LIPID: Once again, the TPWU and CEMTA have announced a return to the bargaining table in an attempt to avert a strike scheduled to begin at midnight. We will continue to bring you LIVE updates as information becomes available.

(Return to regularly scheduled program.)

NARRATOR: At 9:35 pm, a LIVE press conference was broadcast to the molecules of The Cell announcing a resolution between the Transport Protein Workers Union and the Cellular Membrane Transportation Authority.

PHIL LIPID: We have just heard a LIVE press conference where it was announced that the strike has been called off. The TPWU has agreed to a contract with CEMTA. Reporter CHLOE ESTEROL is LIVE at the press conference.

CHLOE ESTEROL: PHIL, the TPWU has announced that they will sign a new contract with CEMTA. All of the details of that contract have not been released yet, but according to GENE NOME, spokesperson for The Cell, a major part of the agreement involves a collaboration between The Cell and CEMTA to ensure that the transport

proteins receive the attention and recognition they deserve in all biology textbooks. So, in effect, biology students everywhere will learn about the vital role of transport proteins in the Plasma Membrane and their importance to operations in The Cell.

This is CHLOE ESTEROL reporting LIVE on the edge of the Plasma Membrane. Channel Two Organic News.

THE END

Questions

1. What is the meaning behind the PHOSPHOLIPIDS' chant?
2. Why is H2O concerned about the aquaporins shutting down? What are aquaporins and how are they involved in plasma membrane transport? In addition to the use of aquaporins, what is another way H2O can cross the plasma membrane? Is this second way sufficient? Explain your answer.
3. Both GLUCOSE and AMINO ACID claim to have a special relationship with their respective transport proteins. What is the basis for their claims?
4. Could O2 and CO2 make the same claim as GLUCOSE and AMINO ACID? Why or why not?
5. The movement of oxygen and carbon dioxide into and out of the cell is called gas exchange. Which two body organ systems are involved in gas exchange? Which type of plasma membrane transport is used for gas exchange? Is this method best? Explain your answer.
6. PHIL LIPID and PROFESSOR TOSOL discuss the Great Dehydration. Explain what you think occurred during the Great Dehydration. Why are sports drinks recommended to prevent, or treat, dehydration?
7. In an interview with CHLOE ESTEROL, O2 says that if GLUCOSE can't enter The Cell, then cellular respiration would be affected. Explain the connection between glucose, oxygen, and cellular respiration.
8. What is the sodium-potassium pump? How does it work? Which body organ system depends on sodium-potassium pumps to function?
9. What are transport proteins and why are they important? What would happen to The Cell if the transport proteins went on strike?