THE HAPPY TRANSPORT GAME

TEACHER'S INSTRUCTIONS

This activity supports the teaching of cellular transport (2.1.1 l-m) and organelle interrelationship (2.1.1 o). This activity must follow the teaching of those learning outcomes. The cards give clarity to areas often causing confusion or omitted by students. These include confusion over the use of carrier proteins for facilitated diffusion or active transport and the relevance of bulk transport compared to other means of cellular transport.

The award system employed with this game introduces hydrogen bonding and begins to emphasise the importance of water molecules in all aspects of the cell. Students often fail to appreciate the fundamental nature of the hydrogen bond and this activity helps to cement their importance. Thus it can be played as a plenary/starter prior to teaching 2.1.2 a-b as a way of introducing the concepts or after this has been taught.

This game is a good way of showing differentiation as different cards can be added depending on ability and/or requirement. The Happy Transport cards (black text) can be played with or without the bonus cards (red text) and Happy Exocytosis cards (blue text). The latter cards are an aid to the precision required in order to explain a process in discrete steps, where students often overlook certain steps and thus lose mark points.

A slightly different game can be played with the toxic maid card. The toxin on this card is self-explanatory but can be explored prior to the game in connection with the teaching of the role of the cytoskeleton or used as an open discussion just before the game/after the game. It is an interesting point for stretch and challenge questions, which allow students to extrapolate their knowledge of a function to an effect arising from a lack of that function.

LINKS TO OTHER TOPICS

The game also introduces concepts to be covered later in the course and could be used as talking points after the game. They are good ways of showing links from this topic to later topics. This includes links to:

2.2.1 a the need for mass transport

3.2.2 b the mode of action of phagocytes

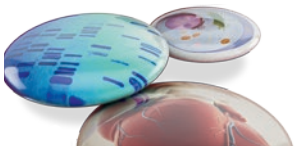
5.3.2 b the regulation of blood glucose

EXAMINER'S TIPS AS BONUS CARDS (RED TEXT)

The examiner tips cards address common errors seen in previous exam papers.

They are useful when revising these topics, perhaps when approaching an exam that will cover 2.1.1 in particular. As it links to second year topics, it can be used as a way of reminding students what they need to remember from the beginning of the course and how it could be linked, in the exam, to later topics.

The game works best if all the cards are laminated before cutting them out so it can be used many times, including the individual water molecules.



ADDITIONAL ACTIVITIES FOR DIFFERENTIATION

BONUS CARDS (RED TEXT)

When a player possesses a bonus card they can use their go by reading out the card to the group and gain 2 water molecules. That card then comes out of play.

EXTENSION (MORE CHALLENGING) GAME

There is a set of sequence cards (Happy Exocytosis cards, blue) that can be collected alongside the Happy Transport cards.

If they are collected and placed down in the correct sequence, the number of water molecules achieved is doubled.

If the sequence is incorrect, the cards are added back to the pack (shuffled) and the game continues.

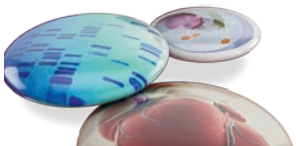
ADDITIONAL GAME

An additional game called 'Toxic Maid' can be played with the existing cards but a slightly different mode of play. The theme of the game is analogous to 'Old Maid'.

1. In the same groups of 4, all the cards are dealt, including the 'toxic maid' card.
2. Each player needs to collect a Happy Transport family but can do this in sets of two cards (and only 2). It does not matter in which order they collect the set but the pairs must be linked to the same Happy Transport family.
3. To start, the players check their cards for any 'pairs' they may already have in their hand. Pairs must be placed face down so other players cannot see what family each player is trying to collect. Once a pair is placed down, the player is obliged to collect that family. Of course, one player can collect more than one family.
4. The first player fans their cards out, face down, and allows the player to the left to pick a card.
5. If that player wants to keep that card they can and they can put down any 'pair' that it may provide. If they don't use the card they still have to keep it but fan their cards out for the player on their left.
6. The play continues until all cards have been played and only the 'toxic maid' card is left. The pair cards are then turned over and checked by the group. Any incorrect pairings cannot get the award water molecule.
7. The loser has the 'toxic maid' card, regardless of how many water molecules have been accrued as the game progressed. The winner will be the player that can make the most hydrogen bonds, as before.

We'd like to know your view on the resources we produce. By clicking on the 'Like' or 'Dislike' button you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you.

If you do not currently offer this OCR qualification but would like to do so, please complete the Expression of Interest Form which can be found here: www.ocr.org.uk/expression-of-interest



THE HAPPY TRANSPORT GAME

ANSWERS SHEET

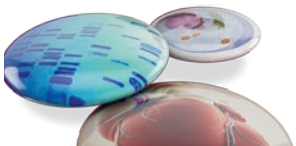
The correct tranport family sets are as follows:

1. Active transport
2. Movement of molecules (polar) molecules against a concentration gradient.
3. This transport system becomes saturated (cannot increase in rate) at high molecule concentrations. This is due to a limited number of carrier proteins in the plasma membrane.
4. This process requires energy in the form of ATP. If cyanide is added to cells, which stops the production of ATP, active transport also stops.
5. This process is highly specific due to molecules binding to carrier proteins, which have a binding site complementary to the molecule.
6. Examples include; absorption of amino acids from the gut into the blood and the exchange of sodium and potassium ions which allows conduction of nerve impulses.

1. Simple diffusion
2. The rate of this transport is summarised by Ficks Law which states: (surface area x concentration difference) / length of diffusion path.
3. This type of transport's rate is affected by: temperature, concentration gradient, diameter of molecules, diffusion path and surface area.
4. This transport is non-specific as molecules/atoms pass directly through phospholipids of membranes and it is not saturated at high concentrations of molecules.
5. This process is passive and molecules/atoms move down their concentration gradient, from a region of high concentration to a region of low concentration.
6. Examples of this type of transport are non polar carbon dioxide and oxygen across plasma membranes the alveoli.

1. Mass Flow
2. This type of transport is also known as bulk flow or mass transfer.
3. This transport occurs to move molecules over large distances.
4. This transport brings molecules within diffusion distances so molecules can then pass into cells.
5. This transport occurs in multicellular, complex organisms and movement occurs due to differences in pressure.
6. Examples of this type of transport are ventilation in mammals and the transport of water through a plant.

1. Facilitated Diffusion
2. This transport moves polar molecules/atoms/ions down their concentration gradient from high concentration to low concentration.
3. This transport is specific and does become saturated due to a limited number of protein channels.
4. Most proteins involved in this transport are channel proteins so which can open and close.
5. Channel proteins are needed for this transport as they protect the polar molecules from the non polar phospholipids of the membrane.
6. Examples of this transport are glucose uptake from the blood into the liver and amino acid uptake from the kidney filtrate into the blood.



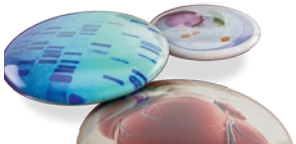
1. Exocytosis
2. This transport involves movement of large amounts of material from the inside of a cell, rather than individual molecules.
3. Vesicles containing proteins bud from the Golgi apparatus where the proteins may have been modified.
4. If the material is a liquid, this process is called reverse pinocytosis.
5. This process requires energy in the form of ATP as vesicles need to move material from organelles to the plasma membrane.
6. An example of this type of transport includes secretion of proteins from a cell.

1. Endocytosis
2. This transport involves movement of large amounts of material into a cell, rather than individual molecules.
3. This transport requires energy in the form of ATP as vesicles need to move from the plasma membrane into the cell.
4. This transport is involved in the uptake of pathogens and is then called phagocytosis.
5. This transport can be specific and involve proteins attached to receptors. It is then known as receptor-mediated.
6. Another example of this transport is the uptake of low density lipoproteins into cells so cholesterol is removed from the blood and cannot deposit around arteries.

1. Osmosis in Plant Cells
2. This transport is passive and involves the movement from a high water potential to a low water potential and combines with hydrostatic pressure to form the transpiration stream.
3. Water will move out of a cell with a lower solute concentration which means higher water potential. The cell will become flaccid. The cell wall prevents complete collapse of the cell.
4. Water will move into a cell with higher solute concentration which means lower water potential. The cell will become turgid. The cell wall prevents further net movement in.
5. This transport controls whether the cell is turgid or flaccid. If all cells are fully turgid, the plant is upright (non lignin containing) and if some cells are flaccid the plant is wilting.
6. Examples of this is the movement of water from the soil into the root hairs following the uptake of ions from the soil.

1. Osmosis in animal cells
2. Water will move into a cell with higher solute concentration which means lower water potential. The cell will burst. For red blood cells this is called haemolysis.
3. Water will move out of a cell with a lower solute concentration which means higher water potential. The cell will become crenated.
4. This transports rate can be altered by solute concentration, temperature and pressure.
5. This transport is passive and involves the movement from a high water potential to a low water potential and regulates the concentration of solutes in the blood.
6. An example of this transport is the movement of water into the blood plasma when there is a high salt level in the blood.

Correct sequence of Happy Exocytosis cards:
Exocytosis of insulin in beta cells of pancreas > Insulin is synthesised from insulin mRNA on ribosomes attached to the rough endoplasmic reticulum. > Insulin moves to the Golgi Apparatus where it is packaged into vesicles. > Insulin can stay in vesicles in the cytoplasm of the beta cell until a trigger occurs for its release. > Insulin containing vesicles now move towards the plasma membrane using the cytoskeleton. > Insulin containing vesicles fuse with the plasma membrane and release insulin into the extracellular fluid where it can then be taken into the blood.



THE HAPPY TRANSPORT GAME

PLAYER'S INSTRUCTIONS

This activity is based around the 'Happy Families' card game. The families here are transport families!

AIM OF THE GAME

The object of the game is to achieve the most hydrogen bonds from collected water molecules.

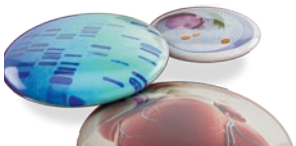
Water molecules are awarded when a complete transport family is collected.

The first student to get a 'family' will claim 6 water molecules, the second student to get a 'family' will claim 4 water molecules and the third student will claim 2. This can be adjusted depending on how many in your class and how competitive/sensitive they are.

The water molecules are placed on a plain piece of paper (if necessary) and the number of hydrogen bonds drawn, with different colours for each player. The player with the most hydrogen bonds is the winner. This could just be calculated for top set students without having to draw them out.

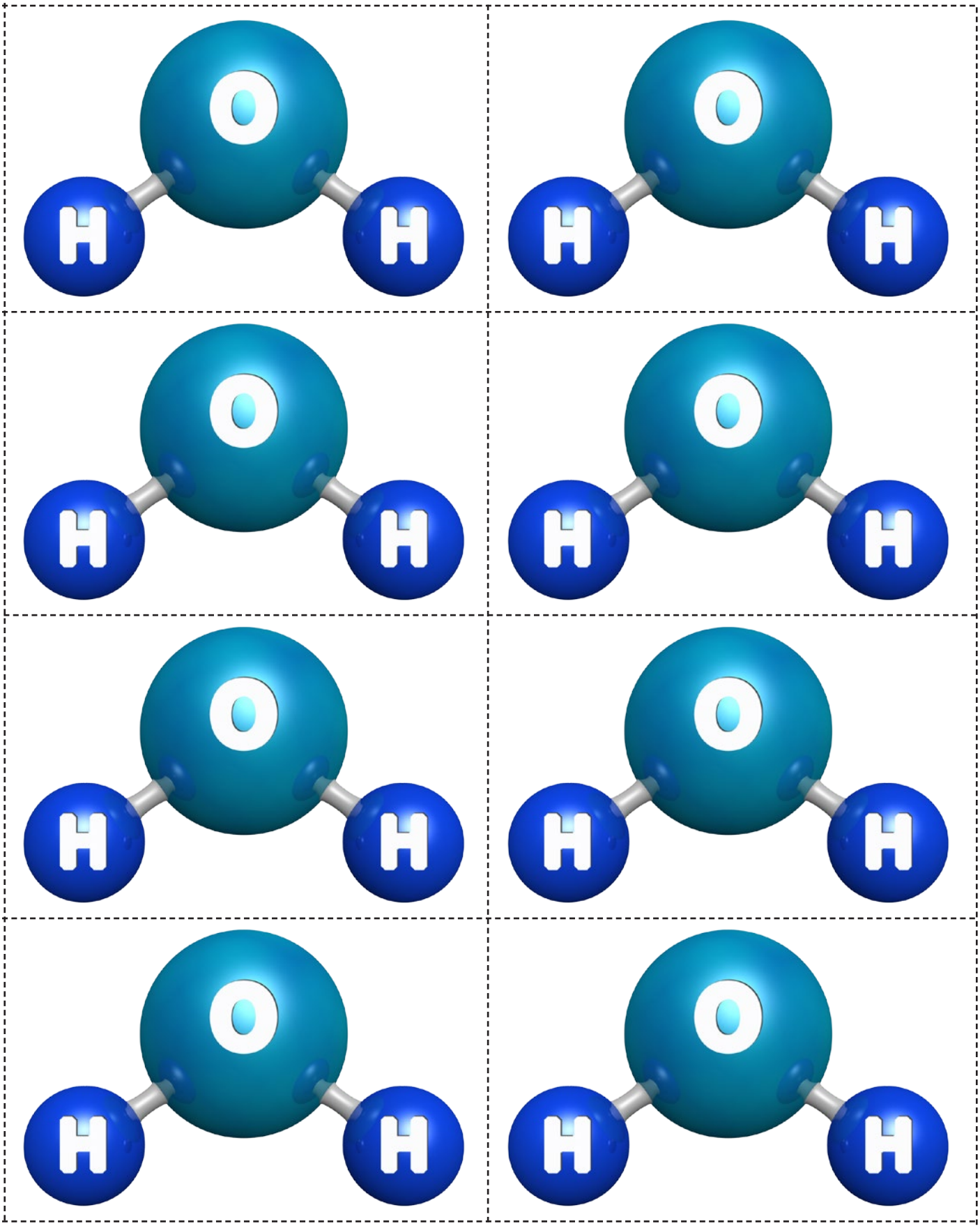
BASIC GAME INSTRUCTIONS

1. Players play the game in groups of 4 but each player works independently.
2. The Water Molecule cards are placed face up in the centre of the group.
3. The Happy Transport cards are shuffled and 6 cards are dealt to each player.
4. The remaining cards are placed, face down, in the centre of the group.
5. The first player picks up a card from the pack in the middle. If they wish to keep that card they must place another card in the centre, writing side up, next to the main pack.
6. The next player can either take that card or take another from the main pack. As before, if they wish to keep the card, they must put down another card from their hand.
7. When a player believes they have collected all the cards in a family they must declare this and show the cards to the rest of the group. Each family comprises of 6 cards.
8. If a collected family is correct the player receives their allocated number of Water Molecule cards. If a collected family is incorrect, all the cards must go back in to the main pack, shuffled and 6 cards dealt to that player again, who effectively starts from scratch.
9. This continues until all the Happy Transport families are successfully collected.
10. The winner is the player that can create the most hydrogen bonds from the Water Molecule cards that they have collected.



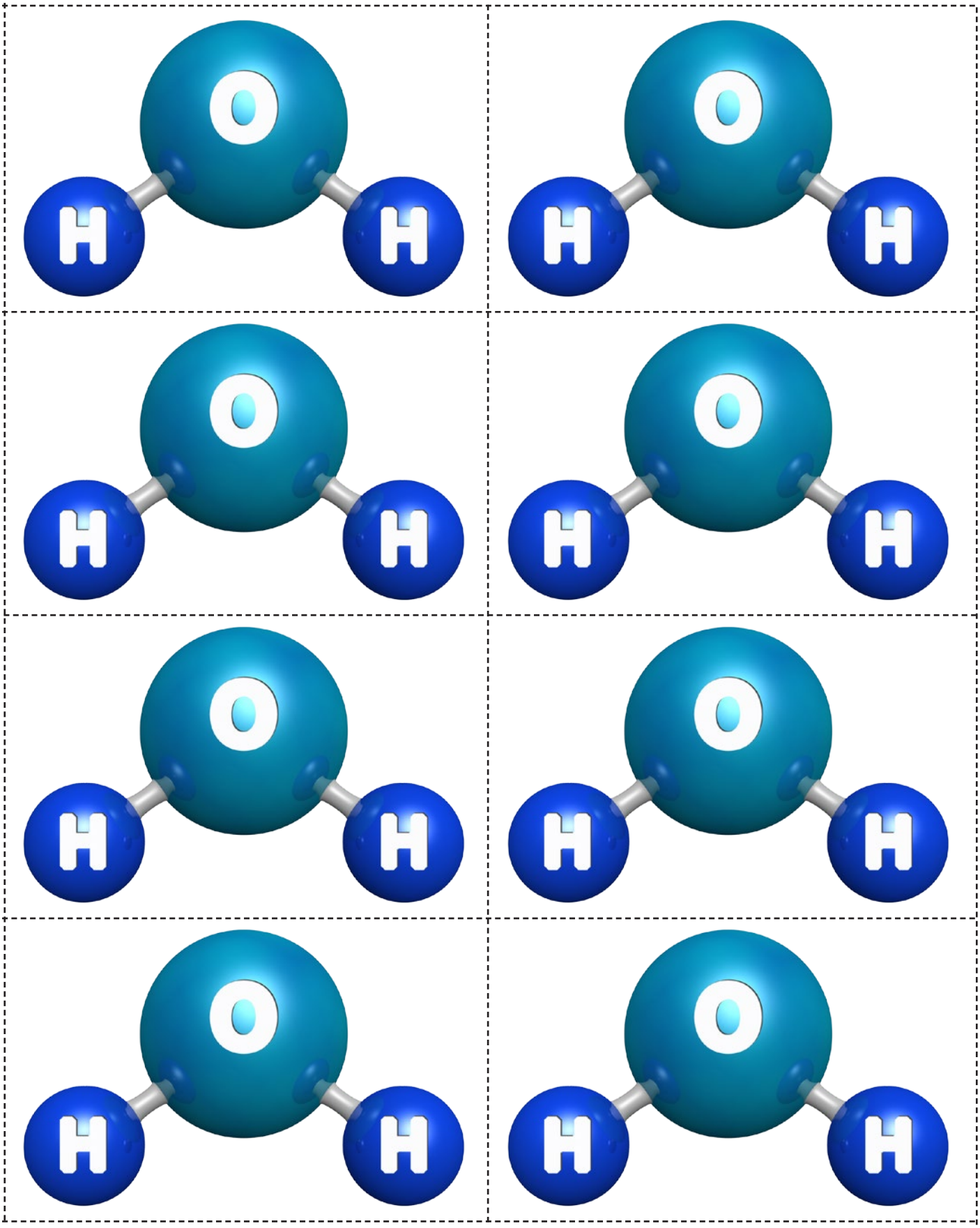
WATER MOLECULE CARDS

Cut out to use. You may need to print extra copies of these cards.



WATER MOLECULE CARDS

Cut out to use. You may need to print extra copies of these cards.



HAPPY TRANSPORT CARDS

Cut out to use.

This transport system becomes saturated (cannot increase in rate) at high molecule concentrations. This is due to a limited number of carrier proteins in the plasma membrane.

This process requires energy in the form of ATP. If cyanide is added to cells, which stops the production of ATP, active transport also stops.

Movement of molecules (polar) molecules against a concentration gradient.

Active transport

Examples include: absorption of amino acids from the gut into the blood and the exchange of sodium and potassium ions which allows conduction of nerve impulses.

This process is highly specific due to molecules binding to carrier proteins, which have a binding site complementary to the molecule.

Examples of this type of transport are non polar carbon dioxide and oxygen across plasma membranes the alveoli.

This type of transport's rate is affected by: temperature, concentration gradient, diameter of molecules, diffusion path and surface area.

Water will move into a cell with higher solute concentration which means lower water potential. The cell will become turgid. The cell wall prevents further net movement in.	This transport controls whether the cell is turgid or flaccid. If all cells are fully turgid, the plant is upright (non lignin containing) and if some cells are flaccid the plant is wilting.
An example of this transport is the movement of water into the blood plasma when there is a high salt level in the blood.	This transport is passive and involves the movement from a high water potential to a low water potential and regulates the concentration of solutes in the blood.
Osmosis in animal cells	This transports rate can be altered by solute concentration, temperature and pressure.
Water will move into a cell with higher solute concentration which means lower water potential. The cell will burst. For red blood cells this is called haemolysis.	Water will move out of a cell with a lower solute concentration which means higher water potential. The cell will become crenated.

The rate of this transport is summarised by Ficks Law which states: (surface area x concentration difference) / length of diffusion path.	This transport is non-specific as molecules/atoms pass directly through phospholipids of membranes and it is not saturated at high concentrations of molecules.
Simple diffusion	This process is passive and molecules/atoms move down their concentration gradient, from a region of high concentration to a region of low concentration.
Examples of this type of transport are ventilation in mammals and the transport of water through a plant.	This type of transport is also known as bulk flow or mass transfer.
Mass Flow	This transport occurs to move molecules over large distances.

This transport brings molecules within diffusion distances so molecules can then pass into cells.	This transport occurs in multicellular, complex organisms and movement occurs due to differences in pressure.
Channel proteins are needed for this transport as they protect the polar molecules from the non polar phospholipids of the membrane.	Examples of this transport are glucose uptake from the blood into the liver and amino acid uptake from the kidney filtrate into the blood.
Most proteins involved in this transport are channel proteins so which can open and close.	This transport is specific and does become saturated due to a limited number of protein channels.
Facilitated Diffusion	This transport moves polar molecules/atoms/ions down their concentration gradient from high concentration to low concentration.

Vesicles containing proteins bud from the Golgi apparatus where the proteins may have been modified.	If the material is a liquid, this process is called reverse pinocytosis.
Exocytosis	This transport involves movement of large amounts of material from the inside of a cell, rather than individual molecules.
An example of this type of transport includes secretion of proteins from a cell.	This process requires energy in the form of ATP as vesicles need to move material from organelles to the plasma membrane.
This transport requires energy in the form of ATP as vesicles need to move from the plasma membrane into the cell.	This transport is involved in the uptake of pathogens and is then called phagocytosis.

This transport can be specific and involve proteins attached to receptors. It is then known as receptor-mediated.	Another example of this transport is the uptake of low density lipoproteins into cells so cholesterol is removed from the blood and cannot deposit around arteries.
Endocytosis	This transport involves movement of large amounts of material into a cell, rather than individual molecules.
This transport is passive and involves the movement from a high water potential to a low water potential and combines with hydrostatic pressure to form the transpiration stream.	Water will move out of a cell with a lower solute concentration which means higher water potential. The cell will become flaccid. The cell wall prevents complete collapse of the cell.
Osmosis in Plant Cells	Examples of this is the movement of water from the soil into the root hairs following the uptake of ions from the soil.

HAPPY EXOCYTOSIS CARDS

Cut out to use.

Insulin containing vesicles now move towards the plasma membrane using the cytoskeleton.	Insulin containing vesicles fuse with the plasma membrane and release insulin into the extracellular fluid where it can then be taken into the blood.
Exocytosis of insulin in beta cells of pancreas.	Insulin is synthesised from insulin mRNA on ribosomes attached to the rough endoplasmic reticulum.
Insulin moves to the Golgi Apparatus where it is packaged into vesicles.	Insulin can stay in vesicles in the cytoplasm of the beta cell until a trigger occurs for its release.

BONUS CARDS

Cut out to use.

Examiner Tip
Make sure you use the word fuse when describing vesicles interacting with the plasma membrane. If lipids are interacting with lipids it is always 'fuse'.

Examiner Tip
Always refer to water movement in terms of water potential (gradient) and NOT water concentration (gradient).

Examiner Tip
Make sure you do not state carrier proteins for facilitated diffusion as this implies an active transport mechanism.

Examiner Tip
Make sure you state the vesicles (containing insulin) move across the cell and that the vesicles fuse with the plasma membrane, not the insulin.

Examiner Tip
Be clear you are referring to the plasma membrane or cell surface membrane, just membrane could imply any internal membrane.

Toxic Maid Card

Cytochalasin B: this toxin blocks the formation of the cytoskeleton