Supplemental Materials
for
Using Pre-Assessment and In-Class Questions to Change Student Understanding of Molecular Movements

J. Shi\textsuperscript{1*}, Jennifer K. Knight\textsuperscript{2}, Hyonho Chun\textsuperscript{3}, Nancy A. Guild\textsuperscript{2}, and Jennifer M. Martin\textsuperscript{2}

\textsuperscript{1}Department of Integrative Physiology, University of Colorado Boulder, Boulder, CO 80309, \textsuperscript{2}Department of Molecular, Cellular, and Developmental Biology, University of Colorado Boulder, Boulder, CO 80309, \textsuperscript{3}Department of Statistics, Purdue University, West Lafayette, IN 47907

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*Corresponding author. Mailing address: Department of Integrative Physiology, 354 UCB, University of Colorado, Boulder, CO 80309-0347. Phone: 303-492-8078. Fax: 303-492-4009. E-mail: Jia.shi@colorado.edu.
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Appendix 1: Pre-assessment on MMTM.

Circle the molecules below that are NOT able to diffuse through a membrane composed only of phospholipids (without proteins). Provide one or two sentences explaining your reasoning.

A. \( \text{O} \equiv \text{O} \)

B. \( \text{H} \equiv \text{C} \equiv \text{C} \equiv \text{O} \equiv \text{H} \)

C. \( \text{CH}_2\text{OH} \)

D. \( \text{K}^+ \)

E. \( \text{H} \equiv \text{C} \equiv \text{H} \)

F. \( \text{N} \equiv \text{H} \equiv \text{H} \)

G. \( \text{Cl}^- \)

H. \( \text{O} \equiv \text{H} \)

I. \( \text{O} \equiv \text{C} \equiv \text{O} \)

J. \( \text{H} \equiv \text{C} \equiv \text{C} \equiv \text{O}^\equiv \text{O}^\equiv \text{H} \)

K. \( \text{H} \equiv \text{C} \equiv \text{C} \equiv \text{H} \)

The correct answers are polar molecules B, C, F, J and charged molecules D and G.

2. Which of the molecule(s) below will diffuse FASTEST through a membrane composed only of phospholipids (without proteins). Provide one or two sentences explaining your reasoning.

The correct answer is C.
Appendix 2: Diagnostic (questions 1-4) and assessment clicker questions (questions 5-8).

Question 1.

Which of the following is LESS able to diffuse through a membrane composed only of phospholipids (without proteins)?

A.  
H
H – C – OH
H – C – OH
H – C – OH
H

B.  
H
H – C – H
H – C – H
H – C – H
H

The correct answer for question 1 is A.

Question 2.

The reason(s) this molecule is LESS able to diffuse through such a membrane is because:

a) The molecule *can* interact chemically with the polar/charged head groups of the phospholipids.

b) The molecule *cannot* interact chemically with the polar/charged head groups of the phospholipids.

c) The molecule *can* interact chemically with the hydrophobic fatty acid tails of the phospholipid.

d) The molecule *cannot* interact chemically with the fatty acid tails of the phospholipid.

The correct answer for question 2 is D.
Question 3.

Which of the following will diffuse FASTEST through a membrane composed only of phospholipids (without proteins)?

A  
\[
\begin{array}{c}
\text{H} \\
\text{H-C-OH} \\
\text{H}
\end{array}
\]

B  
\[
\begin{array}{c}
\text{H} \\
\text{H-C-OH} \\
\text{H}
\end{array}
\]

C  
\[
\begin{array}{c}
\text{H} \\
\text{H-C-OH} \\
\text{H}
\end{array}
\]

The correct answer for question 3 is A.

Question 4.

The reason(s) that this molecule diffuses faster through such a membrane is because:

a) it’s the most polar.

b) it’s the most nonpolar.

c) it’s the smallest.

The correct answer for question 4 is C.
Question 5.

Which of the following will diffuse FASTEST through a membrane composed only of phospholipids (without proteins)?

A. \[
\begin{align*}
&H \\
&H - C - OH \\
&H - C - OH \\
&H - C - OH \\
&H
\end{align*}
\]

B. \[
\begin{align*}
&H \\
&HN \\
&H
\end{align*}
\]

C. \[
\begin{align*}
&O \\
&OH \\
&OH
\end{align*}
\]

D. \[
\begin{align*}
&O = O
\end{align*}
\]

E. \[
\begin{align*}
&H \\
&H - C - H \\
&H
\end{align*}
\]

The correct answer for question 5 is D.

Question 6.

Which of the following will diffuse SLOWEST through a membrane composed only of phospholipids (without proteins)?

A. \[
\begin{align*}
&H \\
&H - C - OH \\
&H - C - OH \\
&H - C - OH \\
&H
\end{align*}
\]

B. \[
\begin{align*}
&H \\
&HN \\
&H
\end{align*}
\]

C. \[
\begin{align*}
&O \\
&OH \\
&OH
\end{align*}
\]

D. \[
\begin{align*}
&O = O
\end{align*}
\]

E. \[
\begin{align*}
&H \\
&H - C - H \\
&H
\end{align*}
\]

The correct answer for question 6 is A.
Question 7.

Which of the following will diffuse FASTEST through a membrane composed only of phospholipids (without proteins)?

A. \[
\begin{array}{c}
\text{O} \\
\text{H} \\
\text{H}
\end{array}
\]

B. \[
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{H} \\
\text{H}
\end{array}
\]

C. \[
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{H} \\
\text{H} \\
\text{O} \\
\text{O}
\end{array}
\]

D. \[
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{H} \\
\text{H} \\
\text{C} \\
\text{H} \\
\text{H}
\end{array}
\]

E. \[
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{OH} \\
\text{H}
\end{array}
\]

The correct answer for question 7 is C.

Question 8.

Which of the following will diffuse SLOWEST through a membrane composed only of phospholipids (without proteins)?

A. \[
\begin{array}{c}
\text{O} \\
\text{H} \\
\text{H}
\end{array}
\]

B. \[
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{H} \\
\text{H}
\end{array}
\]

C. \[
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{H} \\
\text{H} \\
\text{O} \\
\text{O}
\end{array}
\]

D. \[
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{H} \\
\text{H} \\
\text{C} \\
\text{H} \\
\text{H}
\end{array}
\]

E. \[
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{OH} \\
\text{H}
\end{array}
\]

The correct answer for question 8 is E.
Appendix 3: Midterm exam questions on MMTM.

Which of the following molecules will diffuse the FASTEST through a pure lipid bilayer (without proteins)?

The correct answer is C.

Explain why you picked your answer (in two sentences):

_________________________________________________________________________________
_________________________________________________________________________________