Test for **Thermal (Brownian) Motion** Activity

Name_____ Date_____
Teacher _____ Class _____

Check one:
___ Pretest
___ Posttest

1. In 1827, using a microscope, the botanist Robert Brown observed that particles inside of pollen grains suspended in water moved in apparently random directions.

The following is a metaphor for Brownian Motion based on one found in Wikipedia *(http://en.wikipedia.org/wiki/Brownian_motion).*

> Consider a large balloon of 10 meters wide. Imagine this large balloon in a football stadium. The balloon is so large that it lies on top of many people in the crowd. Because they are excited, the members of the crowd wave their arms and hit the balloon.

Describe how the different parts (listed below) of the balloon story relate to the experiment by Robert Brown.

A. The Balloon_____

Response includes…	
The balloon represents a **pollen grain.**	1
Pollen grains	.5
Other	0

B. Members of a crowd _____

Response includes…	
The members of the crowd represent **water molecules**.	1
Other	0

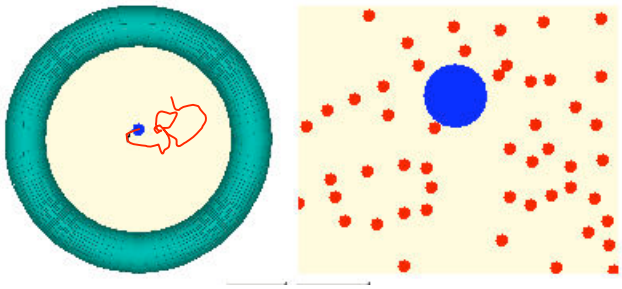
C. The Football Stadium _____

Response includes…	
The stadium represents **the water container.**	1
The stadium represents the container	.5
Other	0

1a. Now describe the movement of the balloon. Describe the forces (crowds pushing on the balloon) and how this could account for the movement you described.

Response includes…	
The balloon, if it were viewed from above would appear to move erratically (randomly) short distances in various directions. The people in the stadium moving (hitting the balloon) cause the balloon to move. The movement is a result of uneven forces on the balloon, so for example, if the hits on one side of the balloon have a total force greater than the hits on any other side, the resulting movement of the balloon is opposite the direction of the greatest force.	3
The balloon moves randomly. It is a result of the movement of the crowd. The balloon moves in whatever direction it is forced to move by the crowd. (The movement is in response to the force applied) OR the balloon moves in a straight direction until it is hit and then the balloon changes direction.	2
The balloon moves randomly into an open space. OR It moves away from the crowd because they are pushing it. Not both	1
Other	0

2.The big blue particle on the right can be considered a dust particle, while the smaller particles around it can be considered gas molecules. The view on the left is that of the same blue particle as seen by someone through a microscope. In the left-hand illustration, in the circle, draw a possible path of the particle you might expect to see over time.



Response includes…	

The drawing shows a squiggly line indicating erratic movement based on the collisions.	1
Other	0

2b. Describe how the interactions of the gas molecules and the dust particle on the right can cause the path you drew on the left.

Response includes…	
The dust particle will move in a straight line until it collides with gas molecules. The collision of the particle with the gas molecules will shift the direction the dust particle is moving. The collisions with many gas molecules cause the apparent random motion as seen in the drawing.	2
The dust particle moves in a straight line and then will collide and move in another direction. (doesn't take into account how collisions with many gas particles result in the pathway.)	1
Other	0

3. A certain enzyme has to reach its target in solution using only thermal motion. How might temperature relate to its ability to find its target? Explain your answer.

Response includes…	
The increase in temperature would increase the thermal motion of the enzyme, making it likely to encounter its target in less time. However, if the thermal motion is too great it may make the enzyme move too fast to interact with its target.	2
Only includes one of the above reasons.	1
Other	0