

Supplemental Material

Chemical and Physical Change Assessment

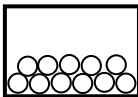
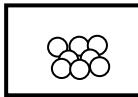
CPCA γ -version

This assessment can be fashioned into a quiz booklet using the following cover page. At the end of the quiz is a customized *Bubble Answer Sheet*. A standard Scantron[®] bubble sheet was used initially; however, several students were choosing option E when there was no such choice, filling in more than one answer per item, or filling out more item answers than were on the assessment. This could be a result of unfamiliarity or apathy in the assignment. For this reason, a unique answer sheet was made for future use of the assessment. It is suggested that the free response item be printed on the back of the *Bubble Answer Sheet* to limit the number of loose papers.

Answers

1. C
2. B
3. A
4. D
5. D
6. D
7. C
8. C
9. E
10. E
11. A
12. B
13. D
14. D
15. A
16. D
17. D
18. C

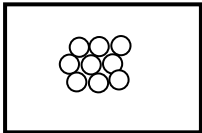
Grading Rubric
Free Response Item #19

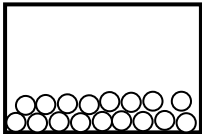
Score	0.5	0	0	0	0	0
Structure	Only solid drawing has structure. Structure is interpreted as rows of atoms or collective bunch of atoms in close proximity. S  S 	Solid does not exhibit structure.	Solid and liquid exhibit structure	Solid and gas exhibit structure	Liquid and gas exhibit structure	Solid, Liquid and Gas all exhibit structure

Score	0.5	0	0	0	0
Spacing	Spacing increases from solid to liquid to gas. Space increase designates a wider placement between atom circles in the drawing. Spacing does not have to be proportional to the phases, just clearly growing in distance from s --> l --> g S L G	Two phases have equal spacing	Three phases have equal spacing	Solid exhibits greatest spacing	Liquid exhibits greatest spacing

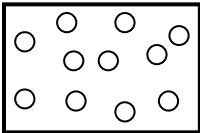
Add structure and spacing score. If equals 1 then student score is 1. If equals 0.5 or 0 then student score is 0
Examples of a Score of 1:

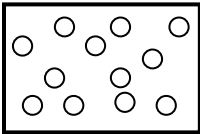
Solid



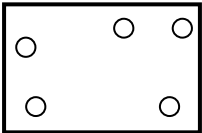


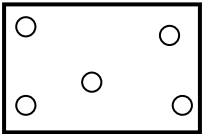
Liquid





Gas





Quiz

Directions:

1. Write name on the *Bubble Sheet*
2. Answer questions in test booklet on the *Bubble Sheet*
3. Answer free response question on back of *Bubble Sheet*

DO NOT WRITE IN QUIZ BOOKLET

Adapted From:

AAAS Science Assessment. <http://assessment.aaas.org> (last accessed April 2011)

Ardac, D. & Akaygun, S. (2004). Effectiveness of Multimedia-Based Instruction That Emphasizes Molecular Representations on Students' Understanding of Chemical Change. *Journal of Research in Science Teaching*, 41(4), 317-337.

Harvard College. *MOSART: Misconceptions-Oriented Standards-Based Assessment Resources for Teachers*, <http://www.cfa.harvard.edu/smgphp/mosart/index.html> (last accessed March 2011).

Yeziarski, E. J., & Birk, J. P. (2006). Misconceptions about the particulate nature of matter: Using animations to close the gap. *Journal of Chemical Education*, 83(6), 984-960.

Part I: Multiple Choice Questions

Read each question carefully and **bubble in** the letter corresponding to your answer on the *Bubble Sheet*. There is only one correct answer for each question.

1. Which is an example for a **physical** change?
 - a) Baking a cake
 - b) Spoiling of milk
 - c) Formation of clouds by evaporation
 - d) Digestion of food in the stomach

2. Which is an example of a **chemical** change?
 - a) Breaking bread into pieces
 - b) Frying an egg
 - c) Bending a metal wire
 - d) Melting a green crayon

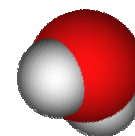
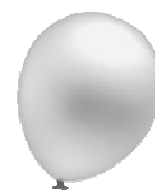
3. A clean brass rod is made mostly of two metals, copper and zinc. If you cut the rod in half what would the newly cut end look like?
 - a) Identical to the brass outside
 - b) Bits of copper and bits of zinc
 - c) Copper
 - d) Zinc
 - e) None of the above

4. A pot of water is placed on a hot stove. Small bubbles begin to appear at the bottom of the pot. The bubbles rise to the surface of the water and seem to pop or disappear. What are the bubbles made of?
 - a) Heat
 - b) Air
 - c) Oxygen gas and hydrogen gas
 - d) Water vapor
 - e) None of the above

5. Which change results in the disappearance of matter?
 - a) Sugar dissolving in water
 - b) Match burning
 - c) Iron rusting
 - d) Matter never disappears

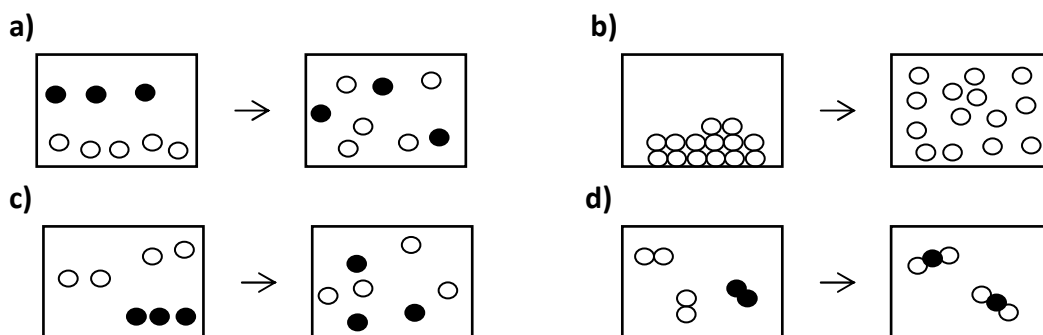
6. Which statement about matter is **TRUE**?
 - a) Atoms are not matter but they are contained in matter
 - b) Matter exists only when you can see it
 - c) Living things are not matter
 - d) Matter is made up of atoms

7. What is bigger, an atom or a grain of sand?
- The atom is bigger
 - They are the same size
 - The grain of sand is bigger
 - It depends on the kind of atom
8. You spill a little water on a tile floor but don't have time to wipe it up. A few hours later, most of the water is gone. What happened to the water?
- The water molecules were destroyed
 - The water molecules got smaller and now take up less space
 - The water molecules became a gas and are now in the air
 - The water molecules broke down into hydrogen and oxygen atoms, which are now in the air
9. Helium gas is used in balloons. When helium gas is cooled enough, it becomes a liquid. What do you think happens when helium turns into a liquid?
- The helium has turned into water
 - Some of the helium has turned into water
 - The helium has turned into a different liquid
 - Some helium has turned into water, some into another liquid and the rest is helium
 - It is all still helium, but in a liquid form
10. Which of the following will make a water molecule larger?
- Freezing
 - Melting
 - Evaporation
 - Condensation
 - None of the above
11. In which state of matter are the molecules spaced farthest apart?
- A gas
 - A liquid
 - A solid
 - All are equal
12. Which statement is **correct** for combustion (burning) reactions?
- All substances can burn
 - Oxygen (O_2) is needed for combustion to take place
 - There will be no new substance formed from burning
 - Carbon dioxide (CO_2) is needed for combustion to take place



A Water Molecule

13. The circles  and  represent two different types of atoms. Which representation shows a chemical reaction?



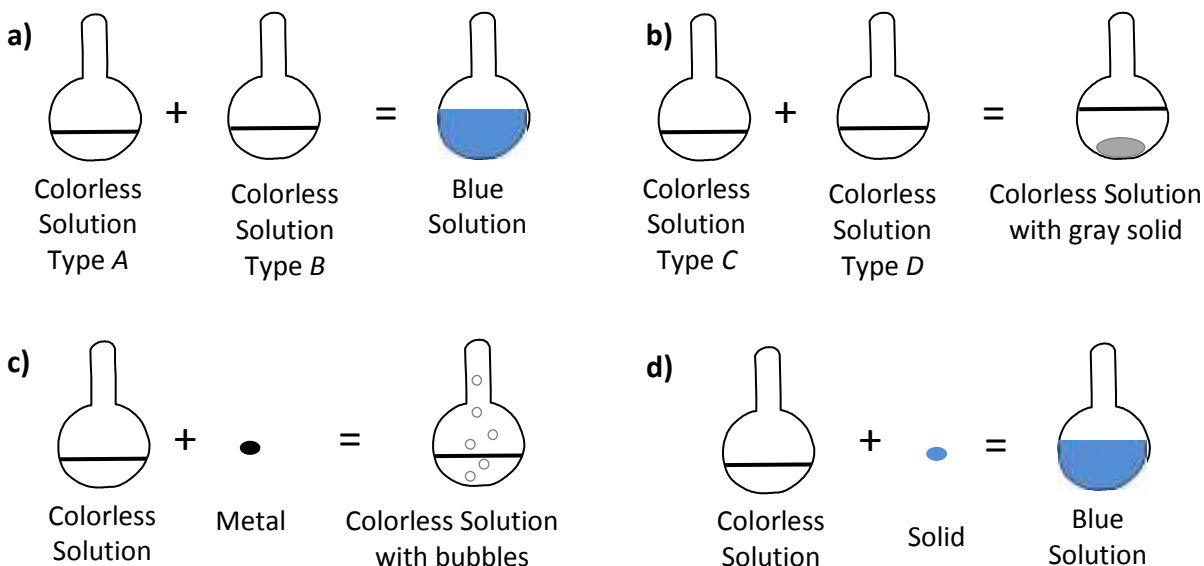
14. Suppose you have a cup of liquid water, which is **TRUE**?

- a) The molecules would stop moving if the liquid water in the cup became a solid
- b) The molecules would stop moving if the liquid water in the cup became a gas
- c) The molecules would stop moving if the cup became still
- d) The molecules would not stop moving in the cup

15. Imagine that you remove all the atoms from a chair. What remains?

- a) Nothing
- b) A pile of dust
- c) The same chair
- d) A chair that weighs less

16. Four experiments were conducted. Which experiment shows a physical change?



17. If you were to hammer some gold into a thin gold metal sheet, the atoms:

- a) Would each flatten out
- b) Weigh less
- c) Are pushed closer together
- d) Are unchanged

18. When liquid water is changed into a gas, it is changed into:

- a) Hydrogen gas and oxygen gas
- b) Hydrogen gas only
- c) Gaseous water
- d) Air, hydrogen gas, and oxygen gas
- e) Oxygen gas only

Question #19 on Bubble Sheet

Name : _____

Bubble Answer Sheet

1. ☐ A ☐ B ☐ C ☐ D
2. ☐ A ☐ B ☐ C ☐ D
3. ☐ A ☐ B ☐ C ☐ D ☐ E
4. ☐ A ☐ B ☐ C ☐ D ☐ E
5. ☐ A ☐ B ☐ C ☐ D
6. ☐ A ☐ B ☐ C ☐ D
7. ☐ A ☐ B ☐ C ☐ D
8. ☐ A ☐ B ☐ C ☐ D
9. ☐ A ☐ B ☐ C ☐ D ☐ E
10. ☐ A ☐ B ☐ C ☐ D ☐ E
11. ☐ A ☐ B ☐ C ☐ D
12. ☐ A ☐ B ☐ C ☐ D
13. ☐ A ☐ B ☐ C ☐ D
14. ☐ A ☐ B ☐ C ☐ D
15. ☐ A ☐ B ☐ C ☐ D
16. ☐ A ☐ B ☐ C ☐ D
17. ☐ A ☐ B ☐ C ☐ D
18. ☐ A ☐ B ☐ C ☐ D
19. ☐ A ☐ B ☐ C ☐ D ☐ E

TURN PAGE OVER for number 19

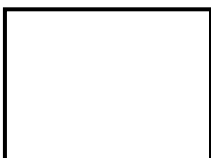


Free Response

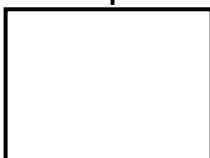
Part II: Atom Sketching

19. Imagine you had a microscope powerful enough to see atoms. Sketch the arrangement of atoms in solids, liquids and gases. Use a circle, ○, to represent an atom.

Solid



Liquid



Gas

