

Physical Science DTAMS Assessment – Version 4
 Diagnostic Teacher Assessments in Mathematics and Science—Middle School

Date _____ Start time _____ Finish time _____

Please provide the following information about yourself:

Years teaching experience (0 if preservice) _____	Last 4 digits of Social Security number (or any 4-digit number you'll remember) _____ (used as identifier on score report)
Check grade level(s) currently teaching (or will be teaching if preservice). Mark one or more that best describes your situation. (please describe below if "other")	Check current (or future if preservice) teaching certificate grade level(s) . Mark one or more that best describes your situation. (please describe below if "other")
Number of college & graduate earth science courses _____	Number of college & graduate life science courses _____
Number of college & graduate physical science courses _____	Sex (M/F) _____
Content area of teaching certificate	
<p>Mark one or more that best describes your situation.</p> <p>If your certificate is a <u>general education certificate</u> that covers all subjects (e.g. as many elementary certificates do) but doesn't specifically include a separate science certification, please <u>mark "not science"</u>.</p> <p>If your certificate includes content areas in addition to science, please choose from the list on the right based on the science content portion only and <u>do not mark</u> the "not science" category.</p>	<p>not science _____</p> <p>general science _____</p> <p>biology/life science _____</p> <p>chemistry _____</p> <p>physics _____</p> <p>physical science _____</p> <p>earth science _____</p> <p>astronomy _____</p> <p>geology _____</p> <p>other science _____</p> <p>(please describe "other science")</p>

Multiple Choice

Identify and write in the space the letter of the choice that best completes the statement or answers the question.

- _____ 1. A teacher has two identical beakers of water that are at room temperature. She wraps one beaker of water in fur and the other beaker of water in aluminum foil and leaves them sitting on a lab bench. Which of the following would she expect to observe several hours later?
- The fur-wrapped beaker would show a higher temperature than the aluminum foil-wrapped one which stayed at room temperature because fur acts as an insulator.
 - The fur-wrapped beaker would show a lower temperature than the aluminum foil-wrapped one which stayed at room temperature because the fur removes heat by entrapping it.
 - They both would be the same temperature as when the experiment started because the ambient temperature isn't affected by the type of wrap.
 - The fur-wrapped beaker would show a higher temperature than the room and the aluminum foil-wrapped one would show a lower temperature than the room because fur acts as an insulator whereas the aluminum foil conducts heat away from the second beaker.
- _____ 2. Insulation in the walls and roofs of houses helps to improve the efficiency of heating a house in the winter because
- the insulation reflects waves of heated air back toward the interior of the house rather than propagating them to the outside.
 - the insulation generates warmth due to its thickness and nonconductive properties, reducing the need for the furnace to generate all of the warmth.
 - the air pockets trapped within the insulation don't conduct heat very well, and since the air is trapped the heat cannot flow through insulation by convection either.
 - the insulation traps the cold outside air and warms it up somewhat before that air has a chance to seep into the house.
- _____ 3. In blue light, a white T-shirt appears
- white because blue is in the visible spectrum and thus reflects the true color.
 - blue because that is the only light available for it to reflect.
 - green because the white dilutes the blue color toward the middle of the visible spectrum.
 - black because no light is reflected.

- _____ 4. A bowling ball accidentally falls out of the cargo bay of an airliner as it flies a straight line in a horizontal direction (to the right in diagram). At the moment the bowling ball hits the ground, where will the plane be located in relation to the ball and why? (*Ignore effects of air resistance for this question*).

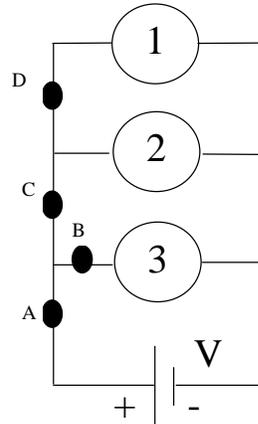


_____ The plane's location

- a. will be far behind the ball since the ball is smaller and will be able to move forward faster once it is free of the large weight of the plane.
 - b. is not known in relation to the ball's position since it depends how fast the plane was traveling.
 - c. will be far ahead of the ball since the plane had time to move quite a lot from the time the ball left the plane until it hit the ground.
 - d. will be approximately straight above the ball since the ball and the plane will move forward about the same distance while the ball is falling.
- _____ 5. A chemical reaction occurs when Alka-Seltzer® (a commercial antacid) is mixed with water, producing effervescence (bubbles). In an experiment using the reaction of Alka-Seltzer® in water, how would you demonstrate the effect of temperature on the rate of a chemical reaction?
- a. Put equal quantities of Alka-Seltzer® into water of different temperatures.
 - b. Get water from the tap on two different days when the outside temperature is different.
 - c. Mix Alka-Seltzer® with water and take the temperature of the reaction.
 - d. Perform the experiment at different times on a day with variable temperatures.
- _____ 6. Almost all of the first atoms in the early universe were hydrogen atoms. What mechanism is responsible for the production of heavier elements such as carbon, oxygen, and iron?
- a. Chemical bonding between multiple hydrogen atoms in the interiors of early stars.
 - b. Nuclear fission of hydrogen in the interiors of early stars.
 - c. Radioactive decay in the interiors of early stars.
 - d. Nuclear fusion of hydrogen in the interiors of early stars.
- _____ 7. A car speedometer measures
- a. average speed.
 - b. instantaneous acceleration.
 - c. instantaneous speed.
 - d. average acceleration.

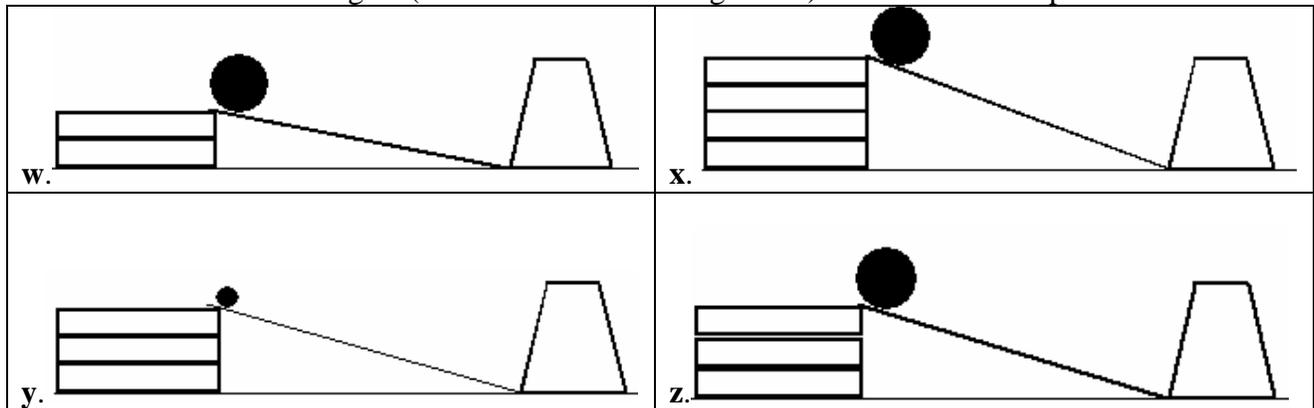
- _____ 8. When creating a solution by dissolving a solid in a liquid, the solid is identified by which of the following scientific terms?
- solute
 - solution
 - solvent
 - substance
- _____ 9. In a horizontal row of the periodic table of the elements (ignoring the transition metals), all of the elements in that row are organized in order of increasing
- chemical bonding from left to right.
 - number of electron shells from left to right.
 - number of valence electrons from left to right.
 - chemical reactivity from left to right.
- _____ 10. A student says "It is easier to pick up a wheelbarrow full of wet concrete if it has long handles rather than short ones because the long handles allow more energy to transfer to the weight of the concrete than the energy you put in at the handles." Why is this a misconception?
- The misconception is that the energy transfer is the key concept when in fact it is the power that is the critical concept for this situation. The long-handled wheelbarrow amplifies the power applied to the weight which is why it is useful in this scenario.
 - The misconception is that the energy transfer is the key concept to lifting the heavy wheelbarrow in this scenario. Instead, the advantage of the long-handles is that they reduce the weight of the concrete to be lifted.
 - The misconception is that energy is amplified when actually the energy output is essentially equal to the energy input. The advantage gained is that more torque is available with the longer handles, but at the expense of greater travel distance needed.
 - There is more energy transferred to the concrete; the misconception is that this is a function of the length of the handles. Any length handles will transfer more energy to the concrete, but the advantage of the long handles is that they give you more leverage for this energy transfer.

11. Students are assigned the task of designing electrical circuits with prescribed properties in a laboratory activity. In the following wiring diagram with three identical bulbs and a power source, where would you install switches so that you could independently turn bulbs 1 and 3 on or off without affecting any other bulb?



- Locations A and C.
- Locations A and D.
- Locations B and C.
- Locations B and D.

12. The diagrams below show different experimental setups of a board propped up on a stack of books. All books are the same thickness. A plastic cup is placed at the bottom of the ramp. Balls of two different weights (shown as small and large balls) are used in the experiments.



A student wants to use a controlled experiment to find out if the cup will move further when struck by a larger force. Which pair of experimental setups could be used for controlled experiments?

- set 1: x and y set 2: w and y
 - set 1: w and y set 2: x and z
 - set 1: w and z set 2: y and z
 - The student should compare all 4 trials (w, x, y, and z) each time.
13. As water changes phase from a liquid to a gas,
- vibrations between molecules are faster and faster.
 - its temperature rises.
 - vibrations between molecules are slower and slower.
 - its molecules change shape.

- _____ 14. In a laboratory experiment, you would like to compare the electrical conductivity of aluminum, steel, and tin wires. You plan on using each wire connected in parallel to a voltage source (e.g. a 9-volt battery) with an identical ammeter in each branch to measure current. Which of the following represents a control variable in this experiment?
- The voltage of the battery.
 - The composition of the wires.
 - The weight of the wires.
 - The ammeter readings.
- _____ 15. You would like to compare the thermal conductivity of copper, tin and aluminum. You plan on putting equal amounts of water in copper, tin and aluminum containers of equal volume, shape, and thickness. You will then simultaneously subject them to identical heat sources and measure the temperature of the water in each container after 5 minutes. Which quantity represents a control variable for this experiment?
- thermal conductivity
 - amount of water in each container
 - temperature of the water after 5 minutes
 - type of metal used to make each container
- _____ 16. In some parts of the world that have desert-like climates, people cool their homes by having fans blow hot outside air through wet burlap sacks into their house. Why is this technique almost never used in hot, tropical parts of the world?
- Tropical humid air is more dense than dry desert air, and so it overburdens the fans trying to blow it through the wet sack so that the fan motors tend to burn out quickly.
 - Air in tropical parts of the world tends to be already humid; thus this air doesn't need extra water from the burlap sacks added to it in order to cool down and can be blown directly into the house
 - Desert air is hotter than tropical air and thus the cooling water has a bigger effect on desert air, so this technique is more effective with the hotter desert air.
 - Dry desert air evaporates the water in the burlap sack, removing heat from the air so that it is cool when blown into the house; the already humid tropical air wouldn't evaporate much water and thus wouldn't be cooled significantly in this process.
- _____ 17. After a rainbow was seen by a student during a thunderstorm, he proposed that you only see rainbows after thunderstorms because you need the dark thunderstorm clouds as background in order to see the faint rainbow colors. To investigate this hypothesis, the teacher could lead students to develop an investigation with the following characteristics:
- Have students look for rainbows set against a clear sky, and on cloudy days set against white clouds rather than the dark thunderstorm clouds.
 - Have students experiment with making rainbows with prisms using different classroom light sources.
 - Have students wait for the next thunderstorm and then record observations at that time.
 - Have students spray water from a hose outside on cloudy days to look for miniature rainbows.

- ___ 18. Which is an example of gravitational potential energy?
- Rolling in a chair across the floor.
 - Holding a baseball over your head.
 - Pushing against a wall.
 - Holding a stretched spring.
- ___ 19. Friction is
- a measure of an object's tendency to move.
 - a force oriented in the opposite direction of an object's motion.
 - an acceleration due to gravity.
 - a property of an object when it is moving.
- ___ 20. In order for astronauts-in-training to experience the high thrust acceleration of a rocket taking off, NASA built a huge rotating arm with a seat in a box on each end of the arm; each seat faced toward the center of the arm. When astronauts are seated in this machine and it rotates at a high speed, they experience the sensation of being shoved back into the seat and their weight feels many times their normal weight. How does this machine produce this sensation?
- A new force is created because of the circular motion, and it pushes the astronauts back into their seats.
 - A centrifugal force is created by the circular motion which pushes all objects away from the center of rotation, including pushing the astronauts back into their seats.
 - The circular motion of the ride changes the direction of gravitational acceleration so that gravity pushes the astronauts back into their seats.
 - The astronauts' inertia resists a change in direction, but the circular motion of the machine means the back of the seat must constantly push against the astronauts to keep changing their direction.

Open Response Directions

Write responses to parts (a) and (b) in the space provided. If more space is needed, please use the back of the paper and indicate that your response continues on the back.

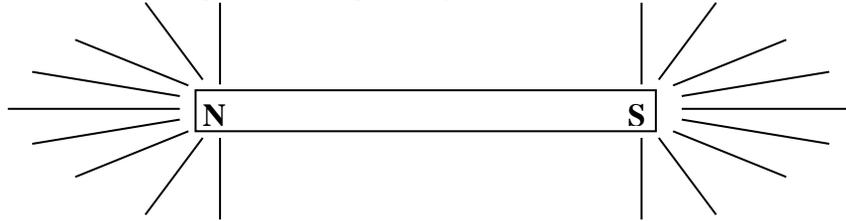
Directions for part (a):

In each question, students expressed a misconception. Please describe the currently accepted scientific explanation of the phenomenon that the students are not understanding. Explain the science in as much depth as possible, even if that level of depth would be inappropriate to expect middle school students to know. Your explanation should demonstrate a thorough knowledge of the underlying science – simply stating the opposite of the students' misconception without further explanation is not sufficient.

Directions for part (b):

Explain how you would address this misconception using best instructional practices. Please describe the classroom instruction, including what the students and teacher are doing, in enough detail so that the reader can envision what is happening. For example, if you refer to a specific lesson, textbook, activity, piece of equipment, or media, assume the reader is not familiar with it and explain how it is used to support student learning. Assume you have access to any equipment that would be available in a reasonably well-funded K-12 school setting so that your proposed instruction is feasible to implement.

22. During a unit on magnetism, students are drawing the magnetic field lines of a bar magnet. Some students drew these field lines as beginning at each pole, going out radially away from the pole, and ending somewhere in the middle of the paper (see diagram). When asked to explain their drawing, they state that the magnetic field starts only at the poles and goes radially out in all directions since the influence of magnets extends from the poles, and the field weakens and effectively dies out when you get far enough away.



- a. Please describe the currently accepted scientific explanation of the phenomenon that the students are not understanding. See directions at beginning of the open response section for more detailed directions.
- b. Explain how you would address this misconception using best instructional practices. See directions at beginning of the open response section for more detailed directions.

