"What does my child *really* need to learn in science?"

Have you ever picked up a textbook, filled out a worksheet, or done a science activity and wondered: *"What is my child really learning with this?"* Parents wonder exactly what bases they should cover for their kids to understand science before they hit the high school or college scene. However, this is a difficult question to answer, partly because it depends on what your ultimate goals are. If your child wants to just get his feet wet and see what all the fuss is about, then grab a couple of science kits and just play. On the other hand, if your kid reads every science text on the planet and is still thirsty for more, there are a few basics you can cover to be sure she is both well-rounded and happy about learning.

Before you can teach your kid science, you're going to need a basic science understanding yourself. We've prepared a science quiz to see where you are and how you're doing. This is portion of the same quiz we give the kids during our science workshop, so you can test them again after the workshop is over to see how well they've pick up the stuff. So take a few minutes and give it your best shot. It's supposed to be fun and challenging!

1. What would happen if you belched in Antarctica? (a) the carbon dioxide in the burp would freeze into a solid (b) the carbon dioxide in the burp would sublimate (c) nothing special (d) the oxygen and carbon dioxide will form will liquefy into carbon trioxide (e) are you serious?

2. When the sun runs out of fuel, what do you think will eventually happen? (a) it will go supernova (b) it will turn into a black hole (c) it will turn into a hard, black diamond the size of the earth (d) it will snuff like a candle

3. When you cap a lit candle in a glass jar, what happens? (a) the flame eventually goes out because fire eats air and the flame runs out of oxygen which is required for combustion (b) nothing special (c) the flame gets brighter and lasts longer (d) an explosion takes place that shatters the jar

4. What does the word LASER stand for? (a) Light Amplification by Stimulated Emission of Radiation (b) Lost Another Scientist Eating Raisins (c) Light And Sound Emitting Raygun (d) Light And Sensory Emitting Reflector (e) 'LASER' stands for something?

5. What is the difference between a light bulb and a laser beam? (a) the laser is a focused beam, while the bulb is a scattered beam (b) the laser is a scattered beam and the bulb is a focused beam

(c) lasers emit photons and bulbs emit only electrons (d) this is why I dropped out of science (e) they're both breakable and not allowed anywhere near my kids

6. Which one generates light by electrifying a gas? (a) incandescent bulb (b) neon sign (c) fluorescent bulb (d) car headlight

7. What happens when you scuff across the carpet in socks on a dry day? (a) you can zap your kids (b) you store up an electric charge in your body (c) you store up extra neutrons in your body (d) the same thing that happens to blankets in the dryer

8. What is an atom made up of? (a) photons, electrons, and positrons (b) neutrinos, positrons, and bosons (c) protons, neutrons, and electrons (d) gluons, muons, and gravitons (e) what on earth is a 'boson'?

9. Which are the three primary colors of light? (a) red (b) blue (c) green (d) yellow (e) pink

10. If you inflate a balloon (don't tie the end), which direction does the air in the balloon and the balloon itself travel? (a) both the same way (b) in opposite directions (c) nothing happens (d) inside-out

11. What happens if a tank of oxygen leaks and fills an entire room, and you walk in and strike a match? (a) nothing (b) BOOM!!! (c) the match will burn brighter (d) I don't even want to know

12. When you drop an effervescent tablet into water, what happens? (a) bubbles foam up (b) it belches (c) carbon dioxide gas is released (d) it produces a chemical reaction that can propel a rocket skyward

13. If you blow up a balloon and stick it in the freezer, what happens? (a) it gets bigger (b) it gets smaller (c) nothing (d) it glows

14. Where is the area of higher pressure in a balloon? (a) on the inside (b) on the outside (c) both are the same (d) none of the above

15. When you wire up a circuit and it does not work, you should (a) check for good metal-to-metal connections between wires (b) see if the batteries are in the right way
(c) replace the entire thing (d) reverse the wires powering your electrical component

16. What does it mean when batteries get hot to the touch? (a) they are working well (b) they are about to explode (c) you have a short in your circuit (d) they are about to leak acid everywhere

17. What makes a cell phone vibrate? (a) little green men (b) magnets (c) a tiny, off-center eccentric drive system (d) a tiny gear drive system

18. Does pure water conduct electricity? (a) yes (b) no (c) not sure (d) I can't believe you're asking this… exactly what are you teaching my child?

19. Higher pressure does which? (a) pushes (b) pulls (c) decreases temperature (d) causes winds, storms, and airplanes to fly (e) meows

20. What is the phone number for poison control? (a) 1-800-POISON-ME (b) 1-800-222-1222 (c) 911 (d) 0 (e) Wait a second… exactly why do I need to know this?

21. What happens when you put a large chocolate bar in the microwave without a turntable? (a) it melts only in certain spots (b) it freezes (c) you can measure the speed of light (d) the chocolate bar emits radiation

22. Which of the following are examples of light? (a) radio (b) TV remote controls (c) ultrasounds (d) microwaves (e) sunburns

23. The electricity from an electrical outlet is the same kind as (a) lightening (b) the shock you get from scuffing along the carpet (c) the electrons that flows in a circuit (d) the electricity from a battery (e) the light show from wool socks fresh from the dryer

24. What happens when you combine a red beam of light with a green beam of light? (a) you see polka-dots (b) you get yellow light (c) you get cyan light (d) you get that muddy-looking color just like when you mix all the paints together (e) nothing – they stay the same

25. If an apple is the size of the earth, then the atoms inside the apple are the size of: (a) Manhattan (b) a grain of sand (c) the size of the original apple (d) Alaska (e) zooplankton

26. What are the four states of matter? (a) solid, liquid, gas, and plasma (b) earth, wind, fire, and water (c) oxygen, fuel, spark, and heat (d) ice, water, bubbles, and steam

27. Which of the following are seriously dangerous chemicals? (a) dihydrogen monoxide (b) sodium chloride (c) sodium tetraborate (d) sodium bicarbonate (e) all of these (f) none of these

The answers to the quiz are on the following pages.

Extra Credit

Basic Scientific Principles

There are 18 scientific principles, ten of which your child needs to understand before they hit college. The following list of questions address the basic scientific principles your child needs to know, understand, and use before they register for university classes. We've tried to make these as fun as possible, so see how you *both* do… good luck!

1. Why do airplanes fly?
2. Why do you get shocked on dry days?
3. Why does a compass needle flutter near an electrical cord?
4. Why does my food come out of the microwave with hot and cold spots?
5. What two colors make yellow light?
6. Why does soda explode when you shake it?
7. What happens when you fart in space?
8. Why does the water come out of the hose faster if you put your thumb over the end?
9. Why does the ball roll down the hill faster if you start it higher up?
10. Why do rockets have fins instead of wings?
11. Why don't the planets go flying off into space instead of orbiting the sun?
12. If you scream in outer space, can anyone hear you?
13. What happens to a cup of hot coffee on a cold morning? Why?
14. What happens when I stick an inflated balloon in a freezer?

The answers to the quiz and quick explanations to these extra credit problems are on the following pages.

Basic Scientific Principles: Unveiled

Listed below are the main scientific principles kids need to learn, work with, understand, and explain to others. Once kids have wrapped their heads around these ideas, they can pretty much explain the universe around them, including why airplanes fly, how electricity works, and why socks disappear in the dryer.

Let's see where you are on the scientific spectrum so we can help you close the gap from where you are to brainiac extraordinaire. On the back of this sheet, describe or sketch out how you would show your child these classic scientific principles. It doesn't need to be fancy – you can demonstrate all of these spades of science for dirt cheap.

Basic Scientific Principles

1. Higher pressure always pushes. (Why do airplanes fly?)

2. Like charges repel; opposites attract. (Why do I get shocked on dry days?)

3. Moving charges have magnetic and electric fields. (Why does a compass needle flutter near an electrical cord?)

4. Light travels like a wave but interacts like a particle. (Why does my food come out of the microwave with hot and cold spots? What two colors make yellow light?)

5. There are four states of matter: solid, liquid, gas, and plasma. (What happens if you fat in space?) There is a fifth date of matter: BEC, but this is only in a lab.

6. In a system, stuff in equals stuff out, such as: energy in=energy out, momentum in=momentum out … (Why does the water come out of the hose faster if you put your thumb over the end? Does the ball roll down the hill faster if you start it higher up?)

7. Objects at rest stay at rest unless acted upon by an external force. (Does a sitting ball ever spontaneously move on its own?)

8. For every action, there is an equal and opposite reaction (Why do rockets have fins instead of wings?)

9. Three of the four Fundamental Forces of Nature: Strong, Gravitational, and Electromagnetic. (Why don't the planets go flying off into space instead of orbiting the sun?)

10. Heat flows from hot to cold. (Why does the hot coffee get colder and not hotter?)

11. For gases, when volume decreases, the pressure increases (What happens when I stick an inflated balloon in a freezer? Why does soda explode when you shake the can?)

Answer Key for Multiple-Choice Quiz and Science Questions:

1. A
2. C
3. A
4. A
5. A
6. B, C
7. A, B, D
8. C
9. A, B, C
10. B
11. C
12. A, B, C, D
13. B
14. A
15. A, B, D
16. B, C (and D if you're using alkaline)
17. C
18. B
19. A
20. B
21. A, C
22. A, B, D, E
23. A, B, C, D, E
24. B
25. C
26. A
27. F (a: water, b: salt, c: laundry soap, d: baking powder)

1. Higher pressure always pushes: Blow hard over the top of a sheet of paper and watch it fly up.

2. Like charges repel; opposites attract: Rub your head with a balloon and hold the charged balloon near your head so the positively charged hair sticks to the negatively charged balloon.

3. Moving charges have magnetic and electric fields: Wrap wire around a nail and connect to power to create a simple electromagnet that can pick up paper clips.

4. Light travels like a wave but interacts like a particle: Wave: Grab red, green, and blue-tinted flashlights and make shadow puppets on a white wall. Particle: Charge a glow-in-the-dark object with a camera flash. The energy in (flash) causes the electrons to bump into a higher orbit, but when the flash shuts off, the electrons relax back down to their regular state and emit a photon (in a different wavelength, or color of light… which is the color of your glowing object).

5. There are four states of matter: solid, liquid, and gas: Grab a can of soda. The tin can is the solid, the drink is the liquid, and the bubbles are the gas. Plasma is what happens to a gas when you add more energy to it (like the plasma grape experiment). The fifth state of matter has only been shown to exist in a lab, and happens only in a *very* short temperature range.

6. In a system, stuff in equals stuff out: Energy in = Energy out: a marble rolling down a hill. The amount of energy the marble had while at rest at the top of the hill (potential energy) turns into kinetic energy while it zips to the bottom. Momentum in = Momentum out: Place your thumb partway over the end of a garden hose. The water shoots

out faster because the same amount of "stuff" has to pass through the exit. When the exit area decreases, less mass can pass through at one time, so the velocity increases.

7. Objects at rest stay at rest unless acted upon by an external force: Place an object on the floor and wait very carefully for it to move on its own. (Ready for more action? Kick it… and there's your external force.)

8. For every action, there is an equal and opposite reaction: Hold a balloon between your fingers and let it go. Note which way the air inside the balloon goes relative to the balloon itself initially.

9. There are four fundamental forces of nature: strong, weak, gravitational, and electromagnetic: The protons and neutrons on an atom are glued together via the strong force (which is broken when you dump salt into water and measure the temperature increase). Gravitational forces happen every time you throw a ball. Make the electromagnet mentioned above experiment to demonstrate electromagnetic forces. (Skip the weak force for now.)

10. Heat flows from hot to cold: Leave a cup of hot coffee out on the table.

11. For the Ideal Gas Law: When temperature increases, pressure and volume increase - Blow up a balloon and stick it in the freezer. When volume decreases, pressure increases - Connect two syringes together with tubing and press one plunger.

