The Particle Adventure Project Page.

Name_____ Date _____ Per.

Part I. Complete the attached Prequiz **NOW**, and turn it in.
Part II. You must access the Web Page "***The Particle Adventure***" to answer, in as much detail, the questions identified belo. Begin your study at this URL:

http://www.particleadventure.org

Once you have arrived at this web page, read each successive page. You can use the "Next" and "Back" arrows on each page to advance or retreat as necessary. You will encounter many hyperlinks to related topics which you are free to explore, but remember to always return to the page you left off on, or you can end up way off track and find it difficult to complete the activity.

1. Who first classified the fundamental elements as earth, air, fire, and water?
2. What does ***fundamental*** mean in the particle physics context?
3. Is the atom fundamental? Explain.
4. Are protons and neutrons fundamental? Explain.
5. Precisely, What percentage of the volume of an atom is just space?
6. About how many particles, fundamental and otherwise, have physicists discovered all together?
7. What is the name of the theory that attempts to describe all matter and forces in the universe (except for gravity).
8. What are the TWO MAIN types of particles?
9. What is antimatter?
10. Why is there more matter than antimatter in the universe?
11. What are quarks?

12. What are the "flavors" of quarks, and how did they get their silly names?
13. Who first proposed the concept of quarks, and when?
14. What is a hadron?
15. What are the two classes of hadrons? Give examples of each
16. How are hadrons bound together?
17. What are the leptons? Make a list of all 6 leptons
18. What is the difference between leptons and quarks as to how they exist in relationship to other particles?
19. Why are the heavier leptons not found in ordinary matter?
20. How did physicists knowledge of momentum lead to the hypothesis of the presence of neutrinos?

21. Why are there so many neutrinos in space?
22. What is meant by "Generations" of matter particles?
23. Since protons are all positive, explain how they are held together in the nucleus, rather than separating according to the rules of electromagnetism.
24. What is a gluon? how does it behave in relation to quarks in a nucleu
25. What is meant by color charge? What particles can carry it?
26. Why is the world around us made of only the least massive particle types?In what ways can fundamental particles interact with each other?
27. What is the difference between an interaction and a force?
28. What, precisely, is a force? (such as magnetism)?
29. What is a force carrier? Explain and give examples.
30. Why isn't gravity included in the Standard Model?

31. What holds atoms together to make molecules, if most atoms have no electrical charge?
32. What is the meaning of life?
33. What is the effect called the residual electromagnetic force?
34. We would expect an atom's nucleus to burst apart due to electromagnetic repulsion between the like charges of the protons. But, most atoms' nuclei are very stable! What accounts for the energy required to counteract the electromagnetic repulsion?

35. What is the effect known as the residual strong interaction?
36. What phenomena is the weak interaction responsible for?
37. What are the carrier particles of the weak interactions? Which are charged and which are not?
38. Make a list of all the interactions, and their respective carrier particles, that can act on leptons.
39. Make a list of all the interactions, and their respective carrier particles, that can act on quarks.
40. Which is the weakest interaction for quarks in a proton?

41. Which interactions act on neutrinos?
42. Which interaction has heavy carriers?
43. Which interactions act on the protons in you?
44. Which force carriers cannot be isolated? Why?
45. Which force carriers have not been observed?
46. Briefly describe what the Pauli Exclusion Principle attempts to explain.
47. What governs whether an atom is a boson or a fermion?
48. What's the difference between nuclear decay and particle decay?
49. Define radioactivity in terms of energetic particles.
50. Define radiation in terms of particles, and list the three major types.

51. Explain the difference between the strong force and the residual strong force.
52. What happens to the missing mass after a radioactive decay?
53. What change in mass is there when a particle decays? What is always produced as a result of particle decay?
54. Fundamental particles can decay into other fundamental particles. How is this possible?
55. What is a virtual particle?
56. What are the three particle properties that determine which interaction and force-carrier particle will mediate a given decay
57. What force carrier is associated with the decay of fundamental particles
58. What happens during a particle annihilation?
59. List the 5 steps involved in neutron beta decay. Write the nuclear expression that represents this decay.
60. How much time is involved for a neutron to decay.?

61. What particles are actually involved in a proton-antiproton decay?
62. What is the Standard Model Theory attempt to explain?
63. Is the Grand Unifying Theory a more complex or simpler theory than the Standard Model?
64. Briefly explain the supersymmetry theory.
65. Briefly state what string theory proposes.
66. What are "small dimensions" and what theories depend upon them?
67. Evidence indicates that "dark matter" may not be made up of what typical particles?
68. List some examples of how we know all of this particle stuff anyway.
69. What principle is used by scientists to increase the momentum of a probing particle in particle accelerators?
70. List the 4 steps involved in particle acceleration.

71. Explain how physicists get the particles they want to study.
72. Briefly describe two major particle accelerators: SLAC and Fermilab
73. What are the "colors" used to identify color charge?
74. Where or how do the colors cyan, magenta and yellow fit with the idea of color charge?
75. Obtain your "quiz" from the instructor and re-take it. Compare your results to what you did the first time.

The Particle Adventure: PreQuiz

Name_____ Date _____ Per___

"What is the world made of?
What holds it together"

Democritus (460-370 B.C.)

People have asked these questions for thousands of years. But only recently has a clear picture of the "building blocks" of our universe been developed. The scientists who have developed this picture work in an exciting and challenging field called high-energy particle physics. Their discoveries are summarized in the chart, Standard Model of Fundamental Particles and Interactions.

How much do you know about the latest theories and research on these ancient questions? You can find out by reading each of the statements below and placing a check mark in the proper box to indicate whether you agree or disagree.

Agree	Disagree	
❑	❑	1. There are subatomic particles that have no mass and no electric charge.
❑	❑	2. Some particles can travel through billions of miles of matter without being stopped (interacting).
❑	❑	3. Antimatter is science fiction and not science fact.
❑	❑	4. Particle accelerators are used for cancer treatment.
❑	❑	5. The smallest components of the nucleus of an atom are protons and electrons.
❑	❑	6. Particles and antiparticles can materialize out of energy.
❑	❑	7. Particle physicists need larger accelerators in order to investigate larger objects.
❑	❑	8. Magnets are used in circular accelerators to make the particles move faster.
❑	❑	9. Work done by particle physicists at accelerators is helping us understand the very early development of the universe.
❑	❑	10. Gravity is the strongest of the fundamental forces of nature.
❑	❑	11. There are at least one hundred different subatomic particles.
❑	❑	12. All known matter is made of leptons and quarks.
❑	❑	13. Friction is one of the fundamental forces of nature.