

**A New Hampshire e-Learning for Educators Online Professional Development Course**

**Course:** Matter and Energy: Basic Concepts of Science Literacy 1

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**Course Description**

This course is designed to provide you with an understanding of the nature of the matter and energy from which the universe is made. These concepts are basic to the development of science literacy in both teachers and students alike. Throughout this seven-week course, you will explore and discuss the meaning of the fundamental concepts necessary for literacy in science. The course will increase foundational knowledge and understanding of the nature of science, Newton's laws of motion, energy, atoms and bonding, and quantum mechanics. Video from Annenberg Media ([www.learner.org](http://www.learner.org)) will be used to enhance the content. You will be facilitated through an inquiry-based approach to learning as you explore web sites and online tutorials to uncover concepts. The course is appropriate for educators of all positions and grade levels. This course is the first in a series of three courses based on "Science Matters: Achieving Science Literacy" by Robert Hazen and James Trefil (Anchor, 1991).

<b>Unit 1</b>	<b>Making Yourself at Home in an Online Course</b>	
As an orientation to the course, you will read two articles. The first article will introduce you to online learning and give you some insight into the uses and development of online learning over the years. The second article will prepare you with prior knowledge or information you might need to understand the content of the course. You will also explore the course and try out various content delivery features that we will be using throughout the course.		
<b>Unit 2</b>	<b>Order in the Universe</b>	
The earliest attempts at understanding the universe were those which considered the heavens. One of the first things human being noticed was the regularity of day and night. Night followed day and the day followed night. The cycle of night and day, and the visible elements of the night sky were the first signals that the universe had order. This order suggests that the universe is predictable. If a certain cause produces an effect, that same cause will always produce the same effect. Natural events can be predicted if we can study them long enough to determine the cause. Understanding science is really about understanding cause and effect. In this unit, we will explore the order in the universe and look at Newton's Laws of Motion.		
<b>Unit 3</b>	<b>Energy</b>	
In this unit, we will attempt to discover the nature of energy, its many forms, and how it transfers from one form to another. Two of the most fundamental laws of nature, the first and second laws of thermodynamics, came from our understanding of energy. Those laws give us a good indication of how the universe works. The energy in the universe is constant. You can't create it or destroy it, just transform it from one form to another, just like matter. However energy, unlike matter, has a direction. Heat always flows from hot to cold, and not the reverse.		
<b>Unit 4</b>	<b>Electricity and Magnetism</b>	
Electricity and magnetism were two phenomena that were of great interest to scientists. Each of the forces seemed to be able to have distinguishable properties and effect objects in predictable ways. When, quite by accident, it was discovered that they are two aspects of the same thing, scientists were able to fully understand exactly how that interrelationship works, and how each depends on the other.		
<b>Unit 5</b>	<b>The Atom</b>	
The smallest parts of nature give us the most interesting study. There are several very good pieces of evidence to support the idea of atoms. We know they exist. Throughout the process of discovering atoms, there were several models suggested for what they might be. The first were very simple. An atom was a solid object, like a marble, that was an indivisible piece of an element. But as we obtained the technology to pull atoms apart, we saw that there was underlying structure. Each of the parts of atoms was discovered independently of the other particles by a different group of scientists.		
<b>Unit 6</b>	<b>Quantum Mechanics</b>	
The weird thing about quantum mechanics is that it describes a universe that becomes very fuzzy when you get very small. This disturbs many people who are uncomfortable thinking that physical objects might not be as "solid" as we originally thought. Atoms are arranged into areas, such as nucleus, or electron orbitals (shells), which contain a set number of particles, protons, neutrons, or electrons. As a model, that works great, but what exactly happens at the atomic level to allow the atom to act in such predictable ways?		
<b>Unit 7</b>	<b>Chemical Bonding</b>	
By their very nature, atoms are not stable. While neutral in charge, they have electron orbitals that are not completely filled. That instability is the reason atoms bond to each other. In that bonding, they achieve the stability in their orbitals that they cannot achieve otherwise. All atoms want to be stable and neutral in charge. Chemical bonding accomplishes that mission, producing the natural materials which comprise our Earth. Living matter, too, results from chemical reactions between unstable atoms that follow the second law of thermodynamics and seek stability. And we use those chemical principles everyday to create the materials that we use.		

## Course Final Project

For your final project in this course you will use the backward design process to design a lesson using a concept you learned in this course. Note, the content of this course is designed for your professional growth in science, and as such is delivered at the high school/college level, which may not be appropriate for your students. However, all the material covered in this course is found in the New Hampshire Framework for Science Literacy. As we proceed through the course, we will use the New Hampshire science standards and design a lesson that will meet the appropriate grade level standards for your students.

## Course Expectations

This course is divided into seven one-week sessions beginning with an orientation week. Each session includes readings, activities, and an online discussion among workshop participants. The time for completing each session is estimated to be five to six hours.

Your instructor will review and assess your progress throughout the course. At the conclusion of each session, your instructor will update your course Gradebook. It is important to review the assessment criteria in the course rubric that will be used to determine your grades. In short, if you pay attention to the following, you will do just fine:

1. Make sure you complete the readings each week and do the activities each week. Afterwards, your first posting in the discussion area should make reference to the readings and activities in such a way that your instructor can tell you read the material and engaged in the activities.
2. Make sure you post at least 2 message replies in the discussion area each week, and that each posting contains substantial comments (i.e., a comment like "oh, that's interesting" is NOT substantial).
3. Choose at least 2 different days each week when you will participate in the discussions. We suggest posting at least once within the first few days of the week, with your second post at least two days before the next week begins. If you only post on one day each week, you will not receive full credit because one posting a week does not help the group develop rich ongoing discussions.
4. Make sure you post on time, not after everyone else has moved on to the next week's discussion.
5. Keep up with your weekly journal. While you may not be asked to submit your journal, it will be very helpful to you as you work on your final project.

In order to be eligible to receive a **Certificate of Completion**, you must participate in at least 5 out of the 7 weekly discussions and complete all assigned tasks. Participants will be evaluated on the frequency and quality of their participation in class discussions. Participants are required to post a minimum of three substantial comments for each discussion, including one that addresses the discussion starter and demonstrates understanding of the course/unit concepts, citing examples from the readings. Additional postings should provide substantive comments to other participants, which are thoughtful, relevant, and serve to extend the discussion.

Progress will be reviewed and assessed throughout the course. At the conclusion of each unit, the course Gradebook will be updated to reflect the quality of your participation in the course.

In order to receive a **Certificate of Completion** at the end of the course, you must earn a passing grade of 60% or more in the course requirements, earning at least 150 out of 250 points.

## Graduate Credit

If you choose to take the course for graduate credit, there is an additional requirement to complete a Reflection Paper, which is worth an additional 50 points. The guidelines and rubric for this paper are posted in each course. You will need to (a) send your tuition registration form with payment directly to the university graduate studies office no later than the start of Unit 7 of your course and (b) notify your instructor that you have registered for graduate credit. If taking the course for graduate credit, a passing grade is 70% or more, earning at least 170 out of 300 points.