Physical Science 100  
section 058  

Instructor: Laralee Ireland

Ways to satisfy the G.E. requirement  
• Take Physical Science 100 (or challenge it)!  
• Take classes from the Chemistry, Geology, and/or Physics department (must be from 2 different departments)  
• If you are in elementary education, take Physical Science 110A/110B, not 100

Stuff to get  
• Course syllabus (on Blackboard)  
  – Course philosophy  
  – Exam schedule and grading policies  
  – Homework, quizzes info  
• Text: Physical Science Fundamentals  
  by the BYU College of Physical and Mathematical Sciences
Resources

• Text and lecture
  read your chapter before coming to class

• T.A. lab in N252 ESC, 422-3307
  M 9-7, T, Th 9-9:00, W 9-9:30*, F 9-6, Sa 10-2
  closed Tuesday 10:45-12:15 for devotions/forums
  *will stay open for evening students – provided students are there

• Lecture notes on web at http://ps100.byu.edu
  follow the link to my page (Ireland)

Resources (continued)

• Practice questions on the web page
  http://ps100.byu.edu and follow the link

• Semester Online
  http://ps100.byu.edu & follow link to semester online

• Me (Laralee Ireland)
  766-9809 (home)
  lireland@byu.edu (Make sure to put Physical
  Science 100 in the subject heading some place.)

Grading

• Exams 1-4 140 points (35 points each)
  • 30 multiple choice questions
  • 1 essay question

• Final 100 points
  • comprehensive and required!
  • 100 multiple choice questions

• Vocabulary quizzes 20 points (5 points each)

• Homework 80 points
  • Due weekly (2 pts each)

• Quizzes 60 points
  • One per chapter and review - in class and on Blackboard (2
    pts each)
Grading (continued)

• Final grade is based on:
  – The final only or
  – The total points (final, 4 exams, pretests, homework and quizzes) or
  – The challenge exam

The highest grade will be taken automatically.

Study Suggestions

• Keep Up!!
• Read assigned chapters before class
• Do the homework and quizzes
• Study Comprehension and Analysis questions
• Write out Synthesis questions
• Review
• Pray

Goals

• Gain a conceptual understanding of important principles
• Apply these principles to observations
• Gain an understanding of how science works
• See how scientific advances fit into the larger scope of human endeavors
• See that science and faith are not mutually incompatible
Alma to Korihor: (Alma 30:44)

…The scriptures are laid before thee, yea, and all things denote there is a God; yea, even the earth, and all things that are upon the face of it, yea, and its motion, yea and also all the planets which move in their regular form do witness that there is a Supreme Creator.

D & C 88: 42, 43, 47

• v. 42 And again, verily I say unto you, he hath given a law unto all things, by which they move in their times and their seasons;
• v. 43 And their courses are fixed, even the courses of the heavens and the earth, which comprehend the earth and all the planets.
• v. 47 Behold, all these kingdoms, and any man who hath seen any or the least of these hath seen God moving in his majesty and power.

Ways to obtain knowledge

• Authority: what others tell us that we accept
• Intuition: knowledge obtained through methods outside of our 5 physical senses
• Reason: self-evident or accepted truths lead to logical, inescapable conclusions
• Sensory Data: what we measure or experience (data) – the core of science
The goals of science
Science seeks to understand the physical world from which sensory data originates.
- Relatively few laws and general principles to understand broad range of phenomena
- Use laws to create models of reality.
- Keep those that work, modify or discard those that don’t work.

Self-evident truths
- Existence
- Causality
- Position symmetry
- Time symmetry
- Principle of non-contradiction
- Occam’s razor

Henry Eyring:
To find truth you have to try and you have to persist in trying. Sometimes it’s fun. Sometimes it’s hard or boring. But it’s always worth it. (Emphasis added)
The Four Forces

<table>
<thead>
<tr>
<th>Force</th>
<th>Strength</th>
<th>Range</th>
<th>Acts upon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong Nuclear</td>
<td>#1</td>
<td>Atomic nuclei</td>
<td>Nucleons</td>
</tr>
<tr>
<td>Electromagnetic</td>
<td>#2</td>
<td>Earth diameter</td>
<td>Charged matter</td>
</tr>
<tr>
<td>Weak Nuclear</td>
<td>#3</td>
<td>Atomic nuclei</td>
<td>Nucleons</td>
</tr>
<tr>
<td>Gravity</td>
<td>#4</td>
<td>Entire universe</td>
<td>Mass</td>
</tr>
</tbody>
</table>

Scientific Notation

- positive powers of ten: one with that many zeroes
  - \(10^6 = 1 \times 10^6 = 1,000,000\)
  - \(2 \times 10^{10} = 20,000,000,000\)
- negative powers of ten: one is that many places to the right of the decimal point
  - \(10^{-3} = 1 \times 10^{-3} = .001\)
  - \(5 \times 10^{-4} = .00000005\)

Relative Sizes of Things

- nuclear matter: \(10^{-15}\) meters, \(10^{23}\) sec
- atom: \(10^{-10}\) meters, \(10^{-18}\) sec
- molecule: \(10^{-9}\) meters, \(10^{-17}\) sec
- cell: \(10^{-6}\) meters, \(10^{-14}\) sec
- person: 1 meter, \(10^4\) sec
- earth: \(10^7\) meters, \(10^9\) sec
- solar system: \(10^{13}\) meters, 10 hours
- galaxy: \(10^{21}\) meters, \(10^6\) years
- galaxy cluster: \(10^{23}\) meters, \(10^7\) years
Elementary Particles

• Characteristics
  – no size or structure
  – cannot be divided further
• electrons
  – one unit of negative charge
• quarks
  – positive or negative charge of 1/3 or 2/3
  – no free quarks

Nuclear Matter

• Size ~ 10^{-15} meters
• Only 2 nucleons
  – Protons: charge = +1
  – Neutrons: no charge
• Their masses are essentially the same
• They are thought to be composed of quarks.

Nuclear Matter

• The Strong force holds the nucleus together.
• The electromagnetic force pushes the protons apart.
• The weak force tries to break up the nucleons.
• Gravity is felt but is very, very, very weak.
Atoms

- Size ~ $10^{-10}$ meters (100,000 times larger than nucleus). An atom is mostly empty space!
- The only relevant force is the electromagnetic one which holds the electrons to the nucleus.

Group Activity: Size Perspective

- If the nucleus were the size of a basketball, the electrons would be
  a) at the edge of campus
  b) at I-15
  c) at the Point of the Mountain
  d) at the Utah/Idaho border

Molecules

- Size ~ $10^{-10} - 10^{-8}$ meters
- Held together by the electromagnetic force via sharing electrons.
Molecular Complexes

- Size ~ $10^{-7} - 10^4$ meters.
- Us! And anything we build, hold, etc.
- Again held together by the electromagnetic force.

Earth

- Size ~ $10^7$ meters
- Held together by gravity.

Solar System

- Size ~ $10^{12}$ meters
- Held together by gravity.
- Almost entirely empty space.
Milky Way Galaxy

- Size ~ $10^{21}$ meters
- Stars held together by gravity.
- An enormous entity, $10^{11}$ times larger than the solar system and only $10^5$ times smaller than the entire universe!

Galaxy Clusters

- Local Group
  - one other spiral galaxy
  - other fainter objects
- Other Clusters
  - some contain as many as 10,000 galaxies!

The Universe

- Size ~ $10^{26}$ meters
- Held together by gravity
- Over 50 billion galaxies.
Enoch: And were it possible that man could number the particles of the earth, yea millions of earths like this, it would not be a beginning to the number of thy creations; and thy curtains are stretched out still... Moses 7.30