Intro

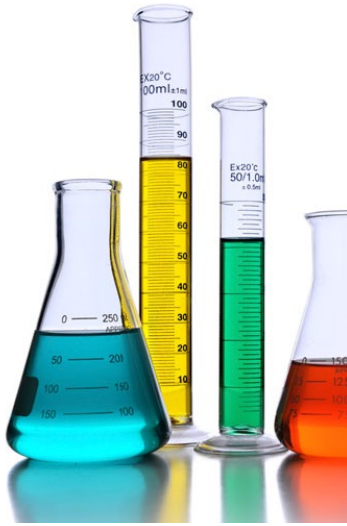
Pick up a copy of each handout (unless you downloaded and have that handout)

What is chemistry?

Welcome to Chem 210 Section AC

General Chemistry part 1

If you are enrolled or on the wait list–sign the roll sheet!
If you are trying to add the class, add your name!



version 1.6

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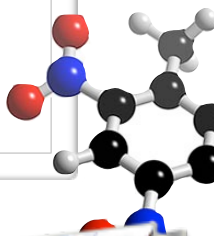
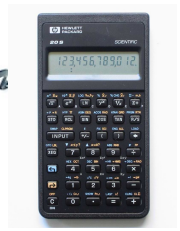
Class Introduction



- Are you in the right room?
  - Instructor
  - Requirements
    - Pre-req's
    - Schedule
      - Dates & Times
    - Materials
  - Evaluation (Grades)
    - Assignments & Assessments
    - Reports
      - Knowing how you're doing.
  - Other Resources



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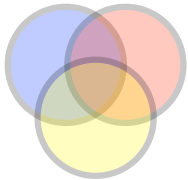
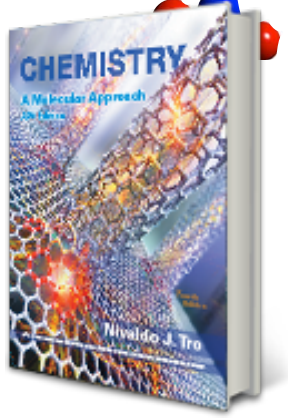
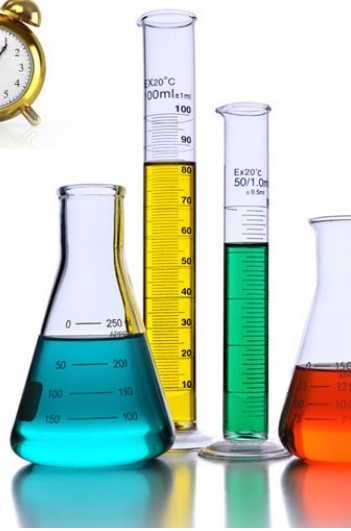
    - What this class offers.







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or on the wait list–sign
the roll sheet!
(so I know not to drop you)
If you are trying to add the
class, add your name!

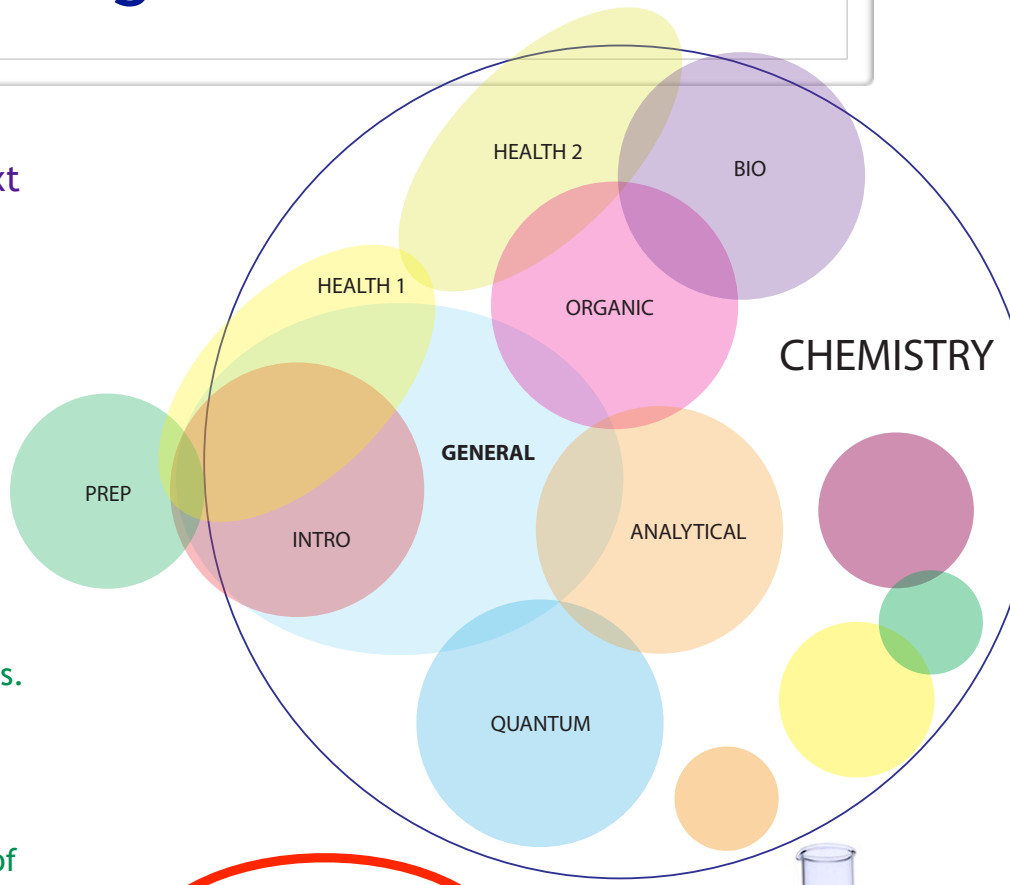
- This class is Chem 210: **General Chemistry (part 1)**

section AAX	section ABX
CRN 92010	CRN 92633

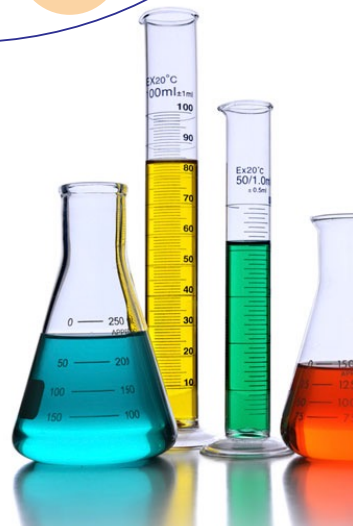
  - There are other sections this semester, check the CRN!
- This class has a lab and lecture component, you can't take one without the other.
- General Chemistry is
  - A university level entry course into chemistry.
    - The purpose of general chemistry is to provide a foundation for the study of chemistry and other sciences.
      - Many "first" courses in physics, engineering, and biology will require you to take General Chemistry.
    - This class is equivalent with what you will receive at most universities and colleges and portable to their programs.

Are you taking the right course?

- Chemistry is big subject. There is more than one place to start. Many first courses cover similar topics, but the context and depth in which we go over those topics is very different.
- The big three "first" chemistry courses are:
  - GOB Chemistry (Chem 410)
    - Health chemistry: General, Organic & Biochemistry (GOB) won't get into the full depth of topics it shares with General Chemistry.
    - It will include some topics in Organic and Biochemistry.
    - GOB Chem is optimized for students in the health care industry, for students seeking entry into many nursing programs.
    - It's also meets the requirements of some certificate programs.
  - Introductory Chemistry (Chem 192)
    - Intro chemistry is the short version. It meets the General Education (GE) science requirement.
    - If you are curious about chemistry or want to get a preview of what's in General Chemistry you may want Intro Chemistry.
      - This is the story of chemistry, not training in using chemistry.
  - General Chemistry (Chem 210/220)
    - This is the complete story. If you are a STEM major you may need to be taking General Chemistry (a three quarter series).
      - Note: some nursing programs and technical certificates (PT is often one) require General Chemistry. Check with a counselor if you are uncertain what the program you're targeting requires.



Chem 210 is General Chemistry



Intro

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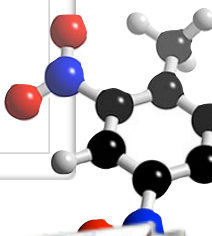

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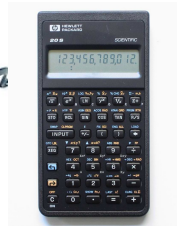

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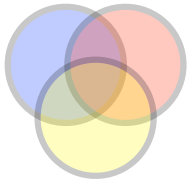

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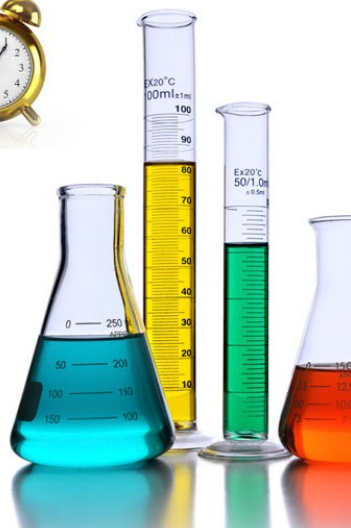
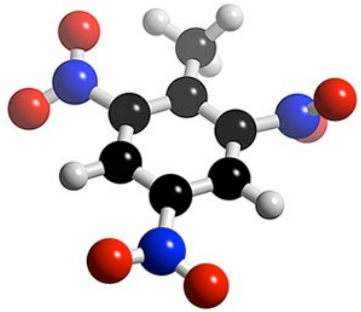


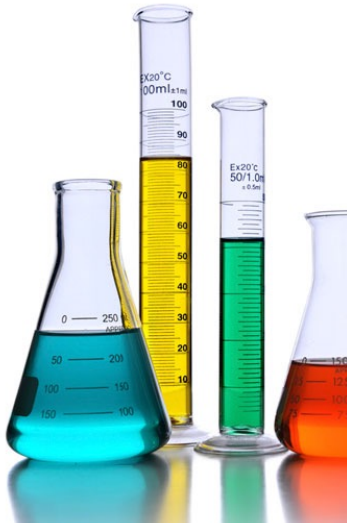
Instructor

- Prof. Nick DeMello, Ph.D. "Professor DeMello"
  - Lecture Instructor



nick@chemlectures.com

- Lecturing College Chemistry since 2007
- Created Educational Software at UCLA for McGraw Hill & the Ministry of Education of Malaysia
- Post Doctoral Research at UCLA Computational & Organic Chemistry
- Ph.D. at University of Pittsburgh (Pennsylvania) Synthetic Organic & Computational Chemistry
- B.S. at Cal Berkeley (California) Nuclear & Synthetic Organic Chemistry
- Sequoia High School Graduate … with Courses at Cañada College



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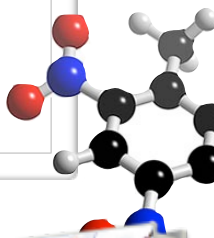

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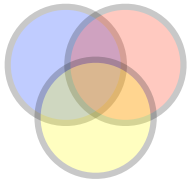

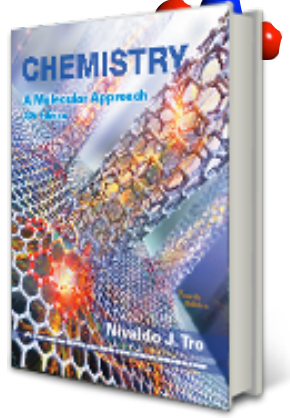

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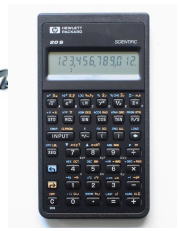
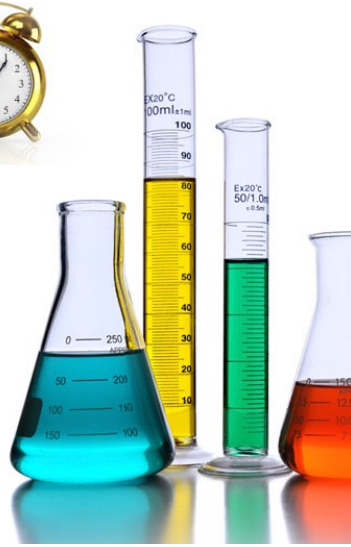


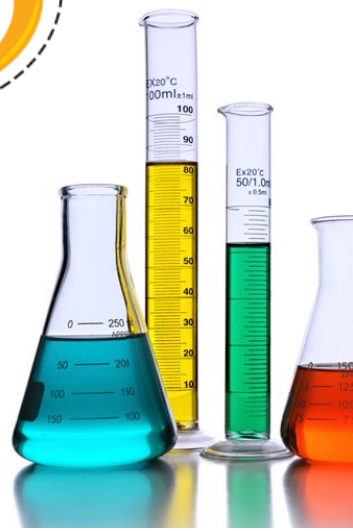


Requirements: Pre-reqs

- Math 120, 123 or equivalent proficiency in algebra.
  - Chemistry is a math intensive subject. If you don't have sufficient skills in algebra, you will not be able to understand the presentations or apply the tools.
- English 100 or equivalent.
  - Written lab reports and extensive reading is required.
- High school chemistry, Chem 192, or equivalent exposure to science is useful.
  - But not required.

- We will go from zero to quantum mechanics in 18 weeks.
- The course moves fast and the content is difficult.
- Previous exposure to these subjects will help.

- That's it.
- We're gonna start at square one.

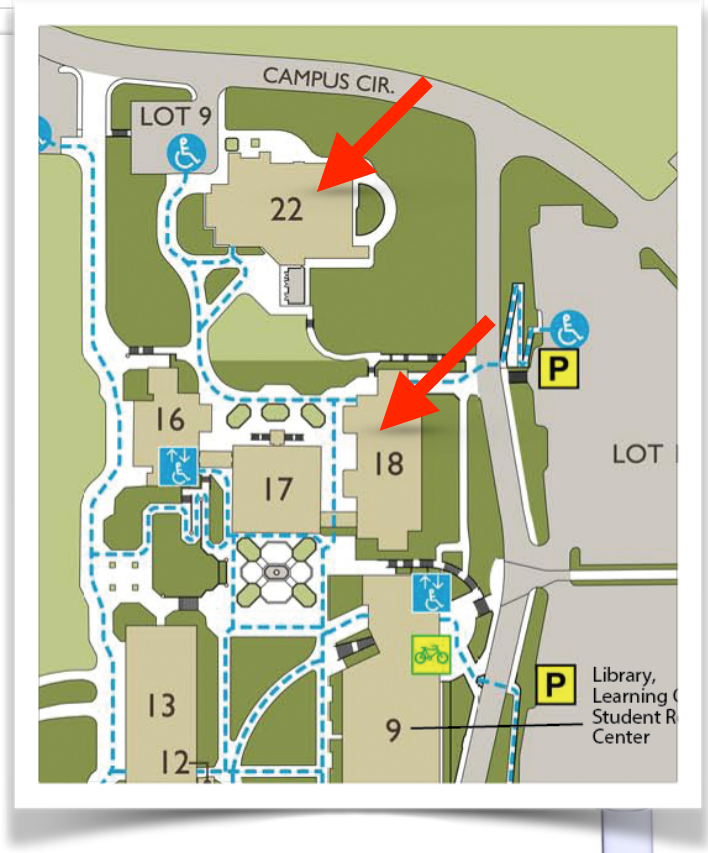


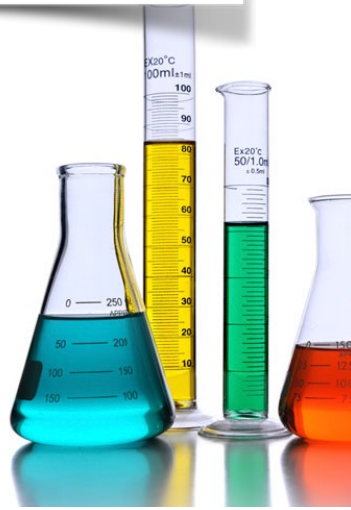
Requirements: Schedule

- This class meets: 08/16/17 - 12/06/17 M/W
- LECTURE:
  - 11:10-12:25pm (Mon/Wed)
    - Please do not be late
  - in Room 114 of Building 22
- LAB:
  - 8:10am - 11:00am (Mon/Wed) — **Section AAX**
  - 2:10pm - 5:00pm (Mon/Wed) — **Section ABX**
  - in Room 305 of Building 18

- Attendance is required.
  - Students missing more than two consecutive lectures, four or more lectures in total, or any lectures during the first two weeks of class, may be dropped from the class without notice.
  - Two or more absences from lab may result in the student being dropped.

- There will be sign in sheet at each lecture and lab, you must sign the the sheet to have your attendance recorded.
- **Not signing the sheet is the same as being absent**.



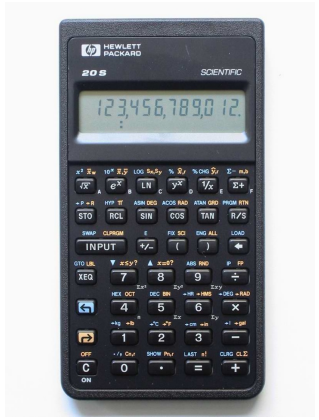


Requirements: Class Materials

- Textbook:

  Nivaldo Tro Chemistry: A Molecular Approach, 4th Edition, Pearson, copyright 2016

Digital Copy available in Canvas



- Mastering Chemistry License

  (accessible through Canvas)

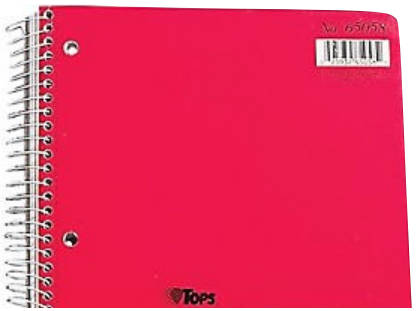
- Laboratory Safety Goggles

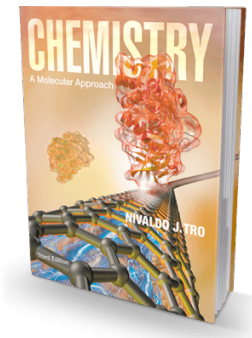
  (will talk more about these in lab)

- Simple Scientific Calculator

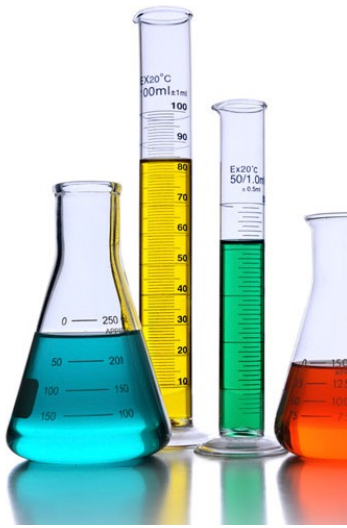
  The calculator needs to do scientific notation (eg. 2.5×10^5) and simple arithmetic (add, subtract, divide, and multiply).

- Spiral Bound Notebook & Pencils (2) — bring to every class!



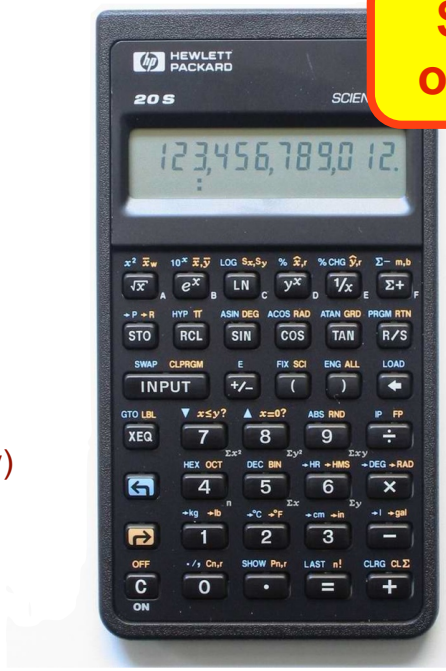


Older editions will probably have much of the same information, but you are responsible finding information if older books presents it in a different chapter.



A simple scientific calculator is best.

Must do scientific notation.
(must have an EE or E or Exp key)



$15-35 on eBay

$9-15 on Amazon

Graphing calculators are bad — they are expensive, hard to use and will trip you up on an exam.

Don't buy one. If you already have one and *know how to use it well*, it's acceptable.

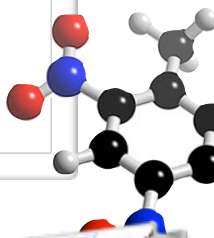
Cell phones/PDAs are not acceptable.

Best choice:
a simple calculator with
log and scientific notation keys
- HP 20s (27s or 42s also good)
- Texas Inst TI-30Xa (least expensive)

CAUTION:
Chem lab calculators are like boxers, they don't stay pretty for long.

Do not spend big money on any calculator, it might take an acid bath tomorrow!

Class Introduction



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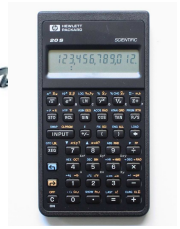

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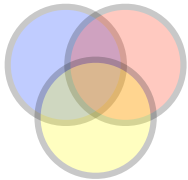

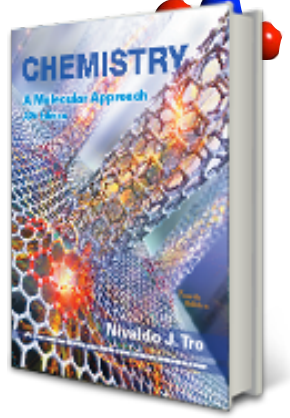

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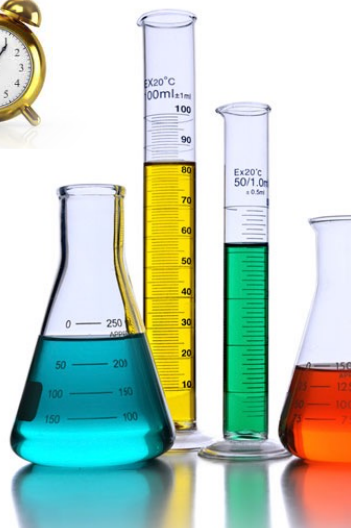


Evaluation

- There will be about 1,000 points available during the semester.
  - There will be four midterm exams (100 pts each), given during lab section (see schedule for dates).
  - The final exam will be worth 160 pts, according to the college final exam schedule.
  - There are about 12 homework assignments (16-20 pts each)
    - most will be done using mastering chemistry online.
  - Experiments will be hands on explorations in lab section:
    - Each experiment will have a pre-lab and a report (14 pts combined).
      - Includes pre-lab quizzes or required at home preparation & reports
      - These points are for participation, if you miss the lab you cannot submit a report for it.
    - Best 14 scores will be counted
      - The last lab counts for double, it won't be dropped.
  - A lab safety quiz is required by the department (8 pts).

Exam #1

Exam #2

Exam #3

Exam #4

Final Exam

We will provide more details in Lab

- <u>There are no makeup exams.</u> (You cannot take exams early)
- <u>There are no makeup labs.</u> (You cannot do lab experiments early)

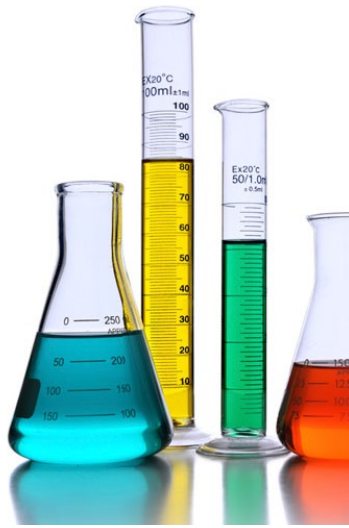
Evaluation

- Grades are a straight percentage of the points you score to the points available.
  - There is no curve.
  - There is no extra credit.
- There are no minus grades.
- If you are in the top half of either the B or C range you will get a plus prefix.

  (when campus policy allows)
- Student progress reports will be provided after each exam (and are available on request).

400 pts	Midterm Exams (4 exams; 100 pts each)	40%	
160 pts	Final Exam (comprehensive; 160 pts)	16%	Exams 60%
36 pts	Workshop/Practice Exams (9 pe's; 5 pts each)	3½%	
200 pts	Homework (11 chapters; 16-20 pts each)	20%	
196 pts	Lab Experiments (best 14 scores; 14 pts each) (includes 4 pt pre-lab quizzes & 10 pt reports)	19½%	Projects 40%
8 pts	Lab Safety	1%	
1,000 pts		100%	

A	90 - 100 %
B	80 - 89 %
C	70 - 79 %
D	55 - 69 %



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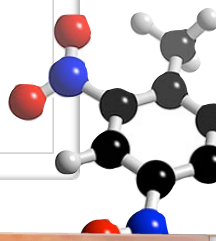

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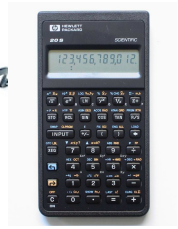

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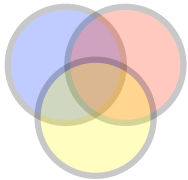

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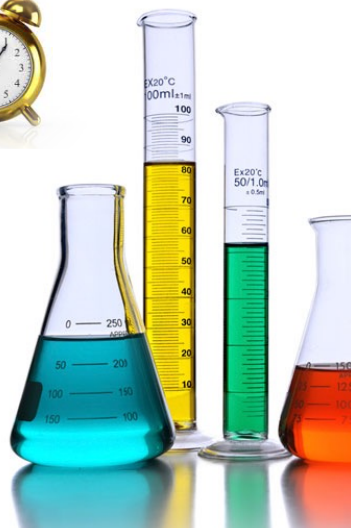
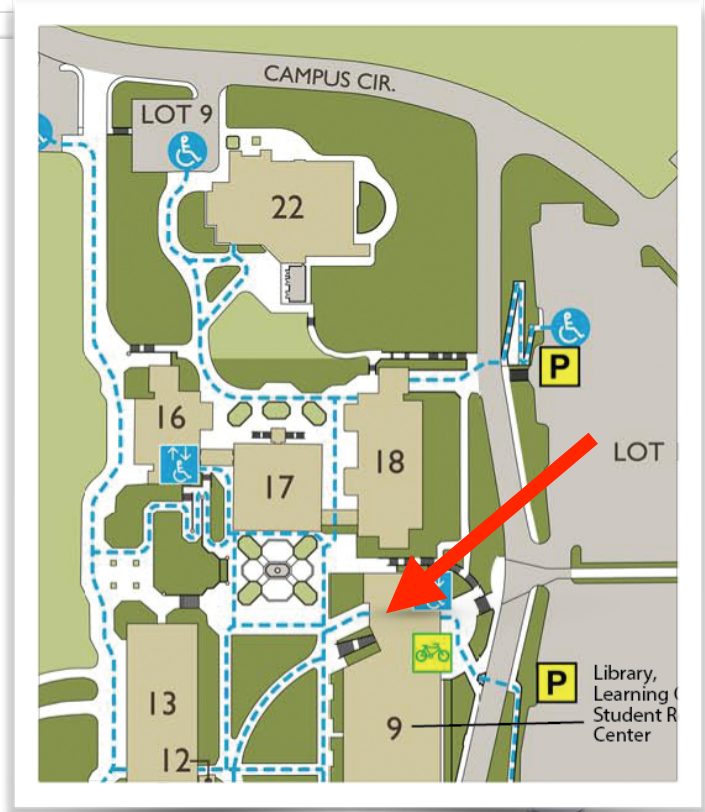
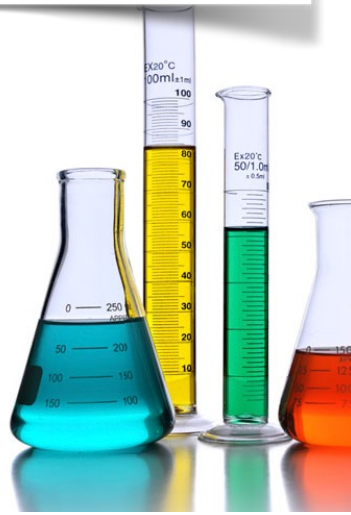


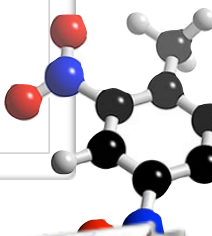
Additional Resources

- Cañada Learning Center
  - Located in Building 9, Room 105
    - Second Floor, in the Back!
    - This is where I'll have office hours
  - Free Tutoring with MESA or STEM
  - Quiet & Well Lit Environment
    - Perfect for studying & Study Groups
  - Computers, Printers, Photocopying
- Chem 210 Website
  - http://chem.ws/210





Class Introduction



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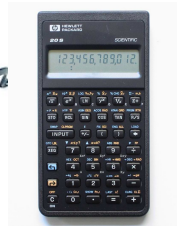

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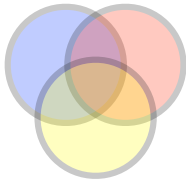
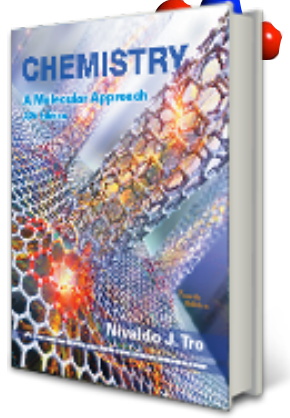
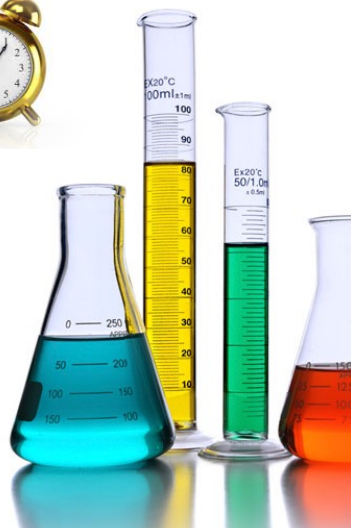
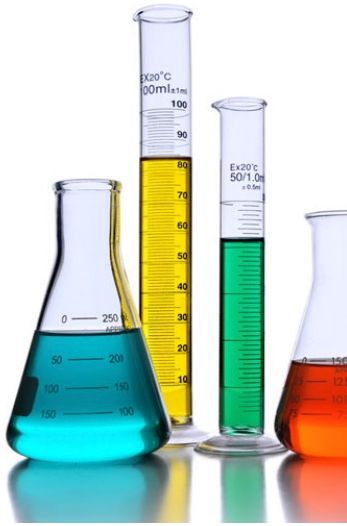






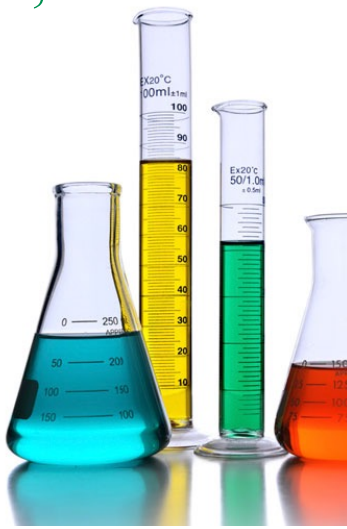
Imagination is the beginning …



“Imagination will often carry us to worlds that never were.
But without it we go nowhere.”
Carl Sagan

“Imagination is the beginning of creation.
You imagine what you desire, you will what you imagine
and at last you create what you will.”
George Bernard Shaw

Imagination is more important than knowledge.
For knowledge is limited to all we now know and understand,
while imagination embraces the entire world,
and all there ever will be to know and understand.
Albert Einstein



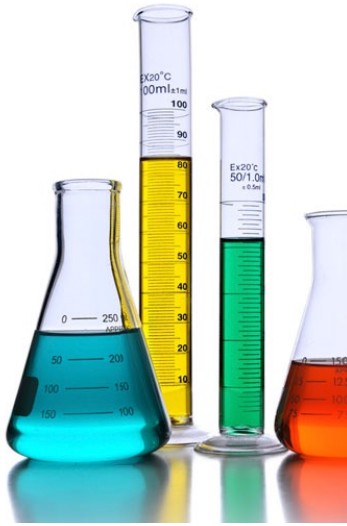
What we can imagine…

- Imagination has no limits. It's not even limited by reality.

- But everything imagined can be put into two piles.
  - The things that are consistent with reality.
  - The things that are not.
- It's useful to sort these things.
  - Reality has consequences.
    - True things can have an impact on us.

- True walls can stop us.
- True pits can trap us.
- True bridges can be relied on.
- False one's distract us, slow us and can be dangerous to rely on.

- For many things, it matters whether they're true or false.

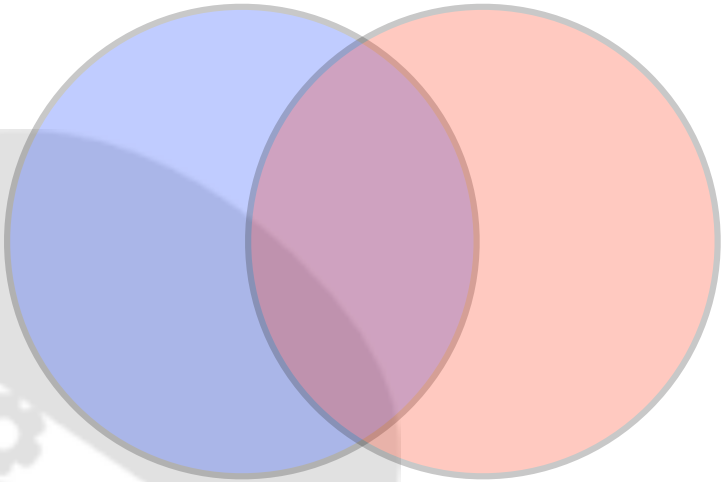


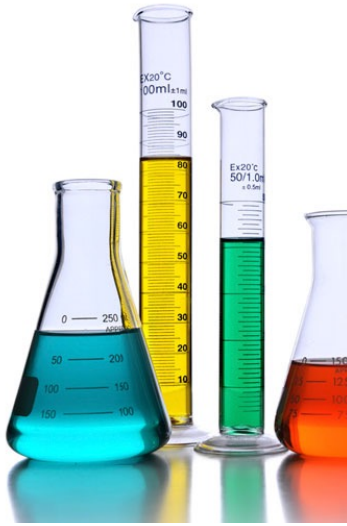
What we can imagine…

- True means consistent with reality.
- False means different than reality.

- It's useful to be confident in things that are true,
  and to understand when they are false.
- Believing in something means having confidence it is true.

- Belief is certainty.
  - Not everything we believe in is true.
  - Not everything that is true is believed.
  - Not every belief has consequences.
    - It doesn't always matter if a belief is true or false.
    - But it often does.



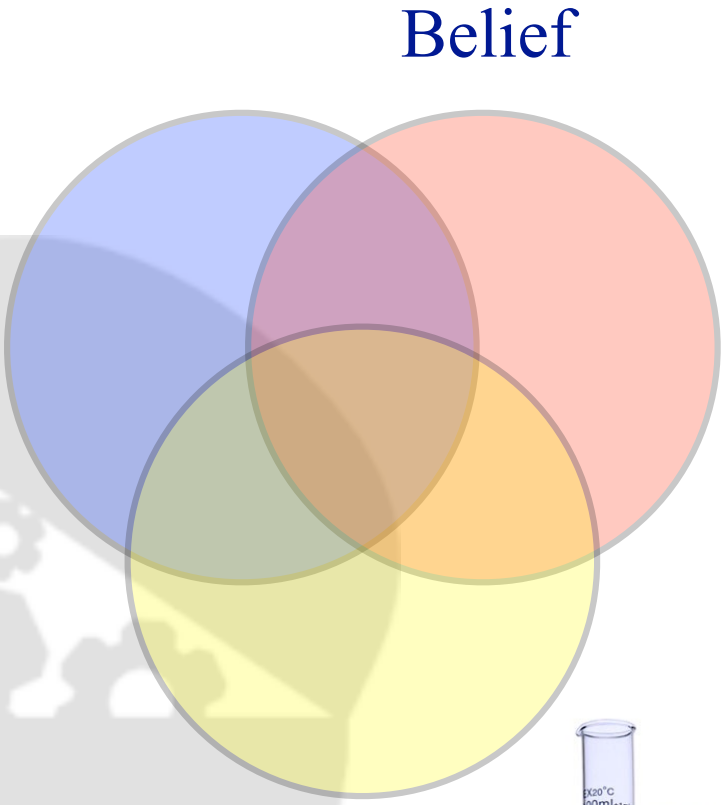


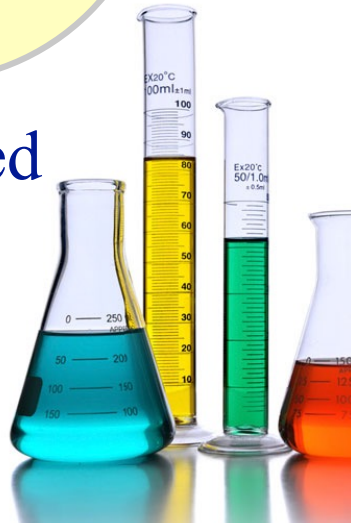
What we can imagine…

- It's hard to know what's true.
- It's easier to know if something is false.
- It only takes observing one exception from reality to know a statement is false.

- Justifications help us find truths.
- Justifications are reasons to believe in something.

- Things that are false are harder to justify.
  - Justified beliefs are **more likely** to be true.
    - Not guaranteed, just more likely.
  - Justifications reduce the chance we'll trick ourselves into being certain about something, that is not true.
  - Justifications give us confidence that things are true, they build certainty (belief).

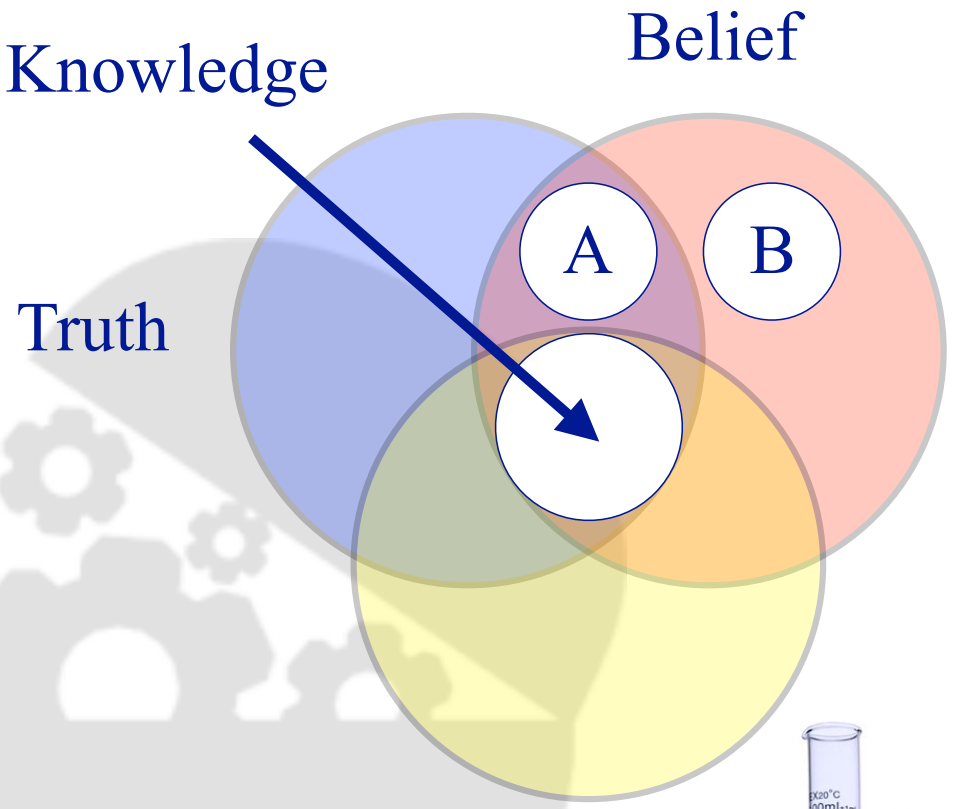


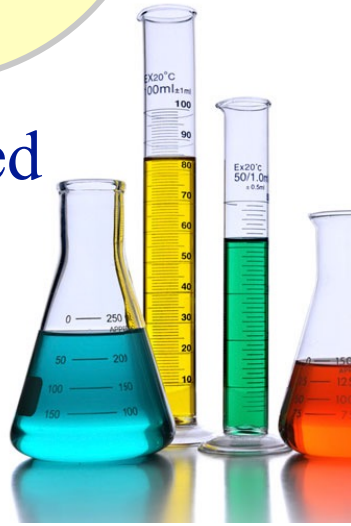


What we can imagine…

- Knowledge is a justified true belief.
- Knowing something means believing it, and having justifications for it's truth.

- Knowledge isn't just an answer.
- You can always guess for an answer.
  - The guess could be true (A)
  - The guess could be false (B)
  - A guess still isn't knowledge.
    - Even if it's a lucky guess (A)



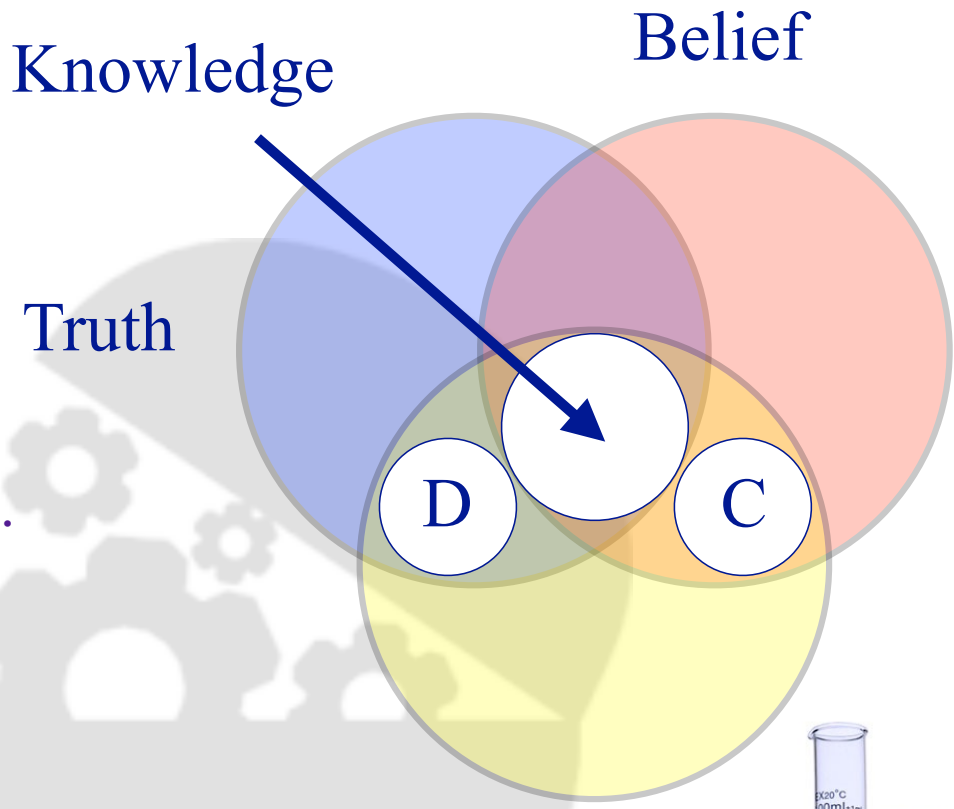


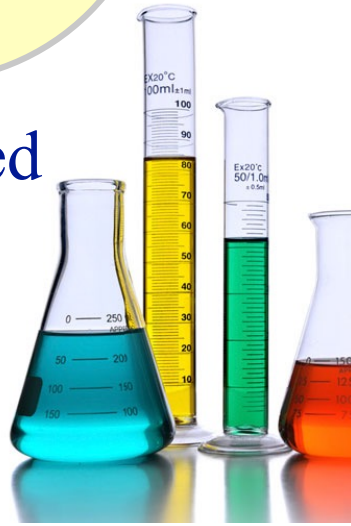
What we can imagine…

- Knowledge is a justified true belief.
- Knowing something means believing it, and having justifications for it's truth.

- Not all justifications are reliable.
  - A false justification (an error), can lead us to a false conclusion (C)
- Tested justifications can direct our beliefs.
  - They can lead us to unknown truths (D).
  - Things that don't seem true at first, but we come to believe.
    - Like quantum mechanics.
  - They can help us grow our knowledge.

- Science is one process for identifying and building justified true beliefs.
- Science is a method for producing knowledge.





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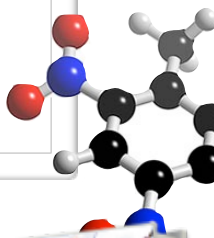

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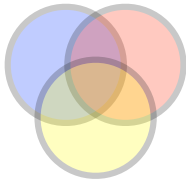
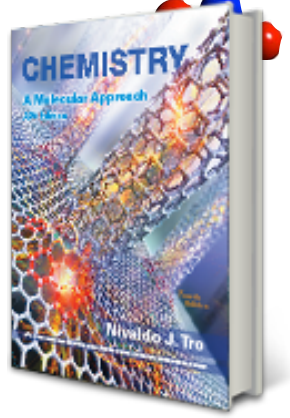
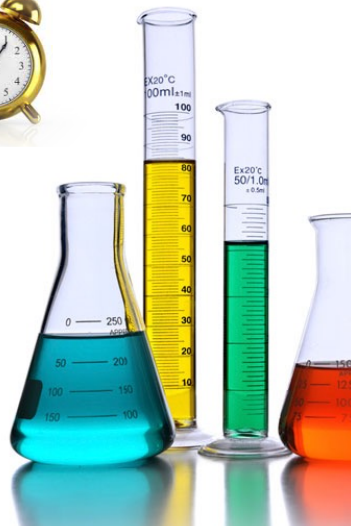
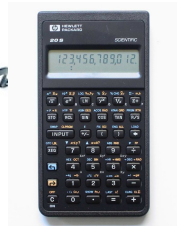
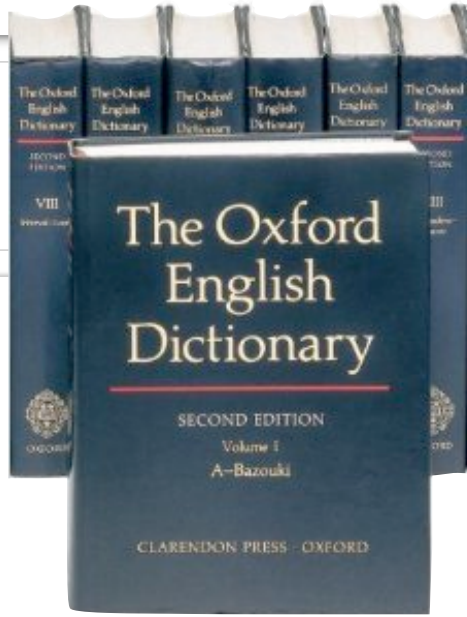








What is science?

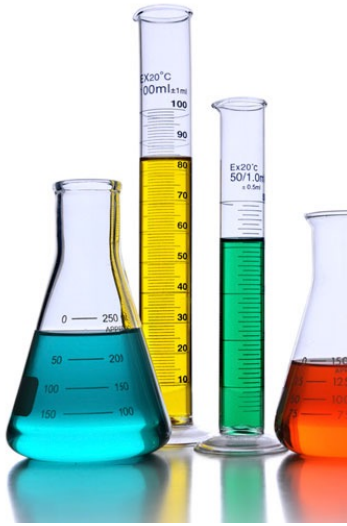


Science

noun /sīəns/

: the systematic study of the structure and behavior of the physical and natural world through observation and experiment.

— Oxford



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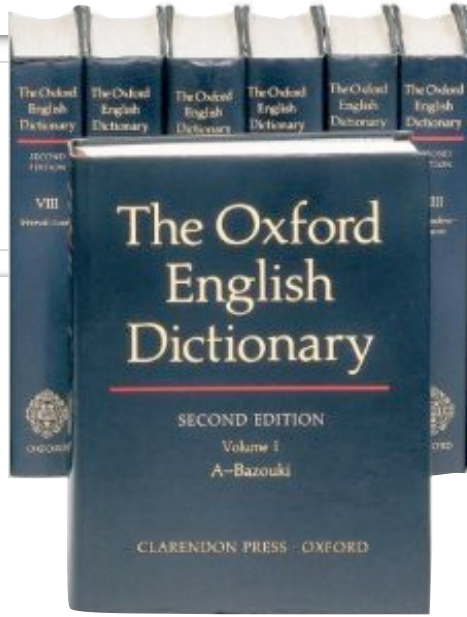

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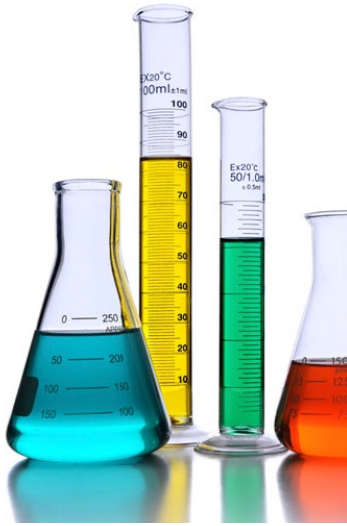

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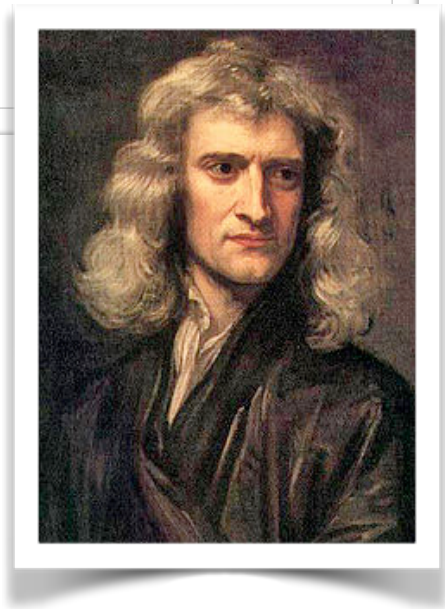
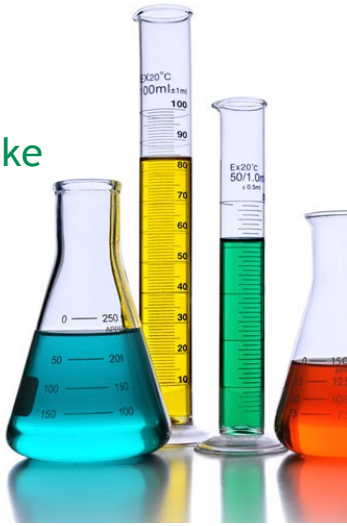


- Knowledge is a justified true belief.
  - There are different ways to justify beliefs.
- Study means a process (method) for gaining knowledge.
- Science is one method of justifying beliefs.
  - There are other methods.
- Science is an empirical method.
- Empirical means observable or experienceable.
  That which can be experienced by others.
- If our justifications are empirical, we can share them.
- Other people can observe what we observed and we can share justified beliefs.
  - That means the knowledge we acquire can grow beyond just us.
    - It means Einstein could start with the knowledge of Newton and build off of it.
    - It means their knowledge can belong to *and be expanded by* new generations, like yourself.

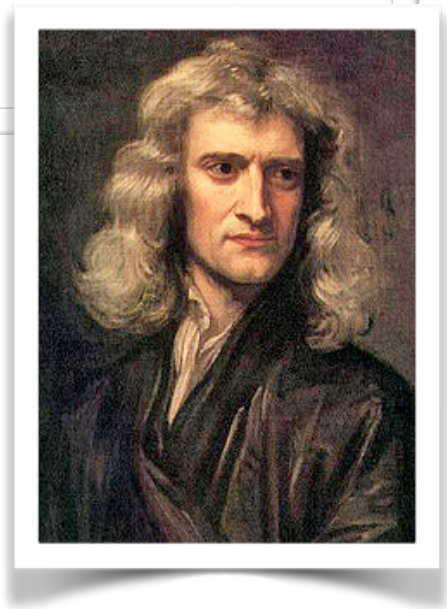
"If I have seen further it is by standing on the shoulders of giants."

— Sir Isaac Newton



What is science?

- Science prioritizes physical and natural phenomena.
- Scientific knowledge can be characterized as …
  - Reproducible
    - If we can't reproduce our observations, that experience is hard to share. That knowledge may end with us.
  - Testable
    - If we can interact with those observations, we can refine them and gain greater clarity of that knowledge.
  - Tentative
    - Gaining knowledge is about stepping into unknown areas. It's necessary to make our assertions tentative, the same way you would step carefully into a dark room.
  - Predictive
    - The best knowledge creates models that we can use to predict future events — reliably.
  - Explanatory
    - Knowing why something will happen gives us greater insight that whether it will happen. If we can explain natural phenomena, we can often direct or cause it.



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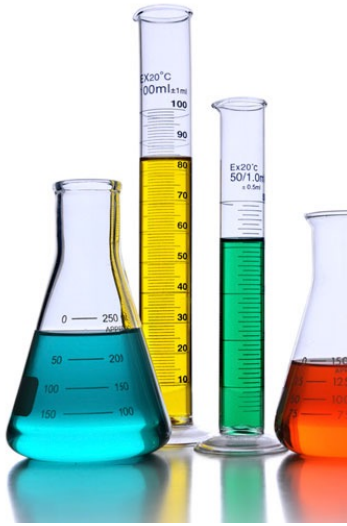

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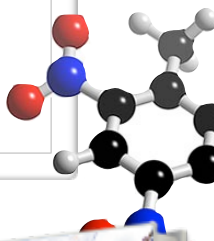

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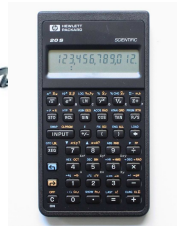

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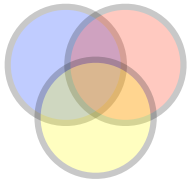

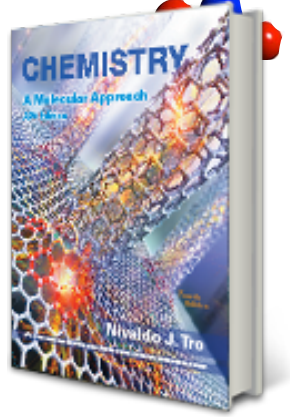

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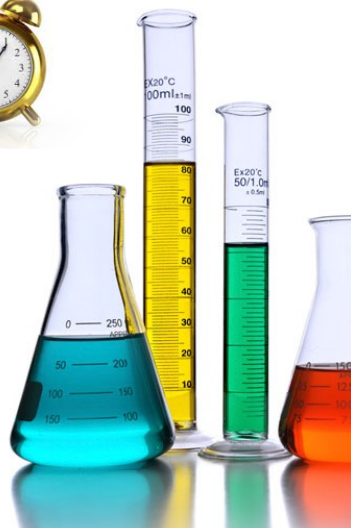
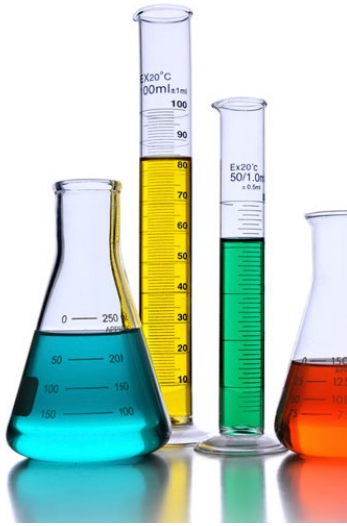


Observation

- Scientists start by collecting observations.
- Reproducible data, that documents how we experience the world.
- Observations are not just what you see, it's any experience we can reproduce and that others can confirm.
  - The taste of honey.
  - The color of the sky.

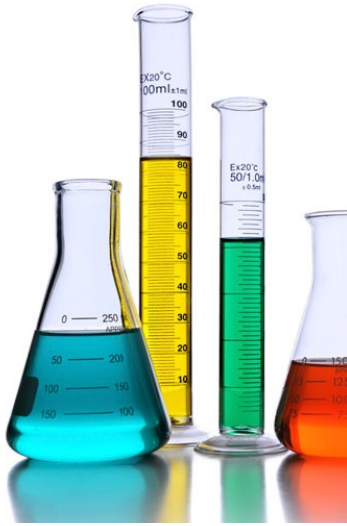
- Observations can be both qualitative an quantitative.
- Measurements are quantitative observations.
  - We'll talk more about measurements in a bit.



Observation

- It's important to keep our observations and our interpretations of those observations separate.

- Observations are truths.
  - If you saw water on your car this morning, it's true you saw water.
- Interpretations are not necessarily true.
  - If you saw water on your car this morning, it's not necessarily true it rained last night.
- But those interpretations, those possible explanations, are valuable.
    - They may be the reason for our observations.
- Hypothesis are tentative explanations of our observations.



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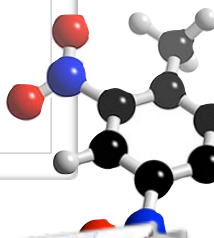

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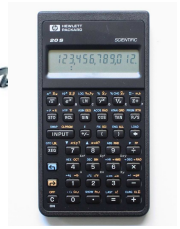

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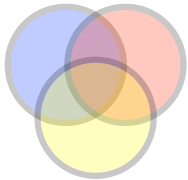

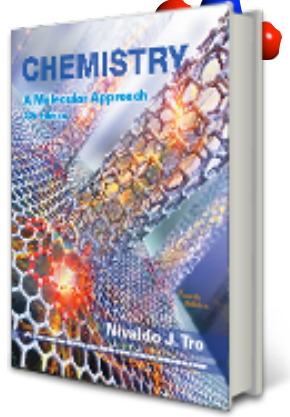

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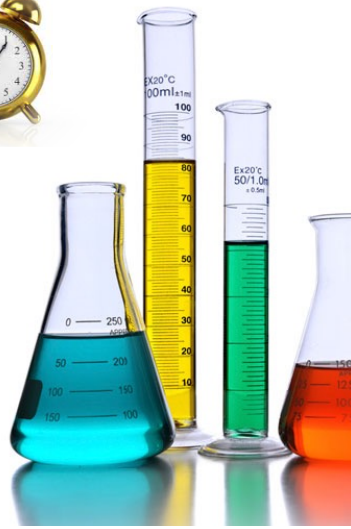


Theories & Laws

- Scientists express much of the knowledge they collect as models.
  - The same way you might draw a map to share your knowledge of a city.
    - … or a globe to predict the distance it takes to drive to another city.
    - … or folded paper to explain how a plane flies.

- These models are laws and theories:
  - Law
    - A statement of natural phenomena to which no exceptions are known. A law is not an explanation.
      (A summary of many consistent observations, without explanation.)

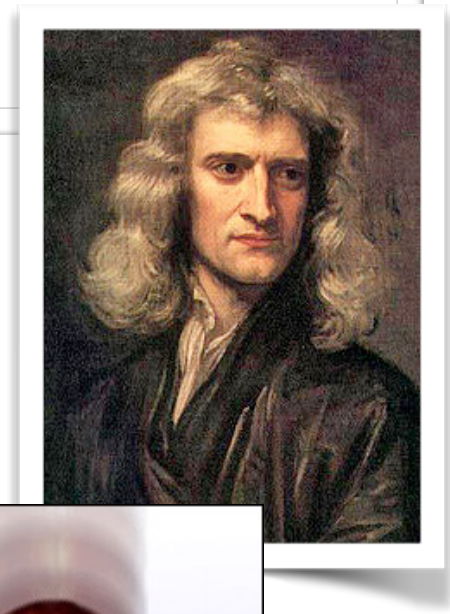
    The law of gravity is that two objects pull on each by a force equal to the sum of their masses and divided by the distance between them squared.

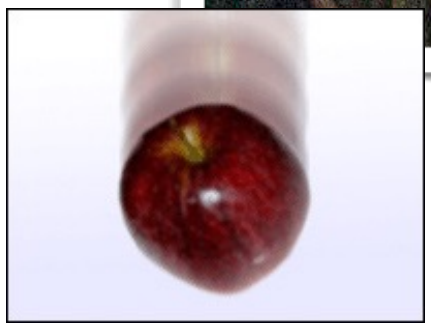
  - Theory
    - An explanation of nature with considerable evidence or facts (observations) to support it.

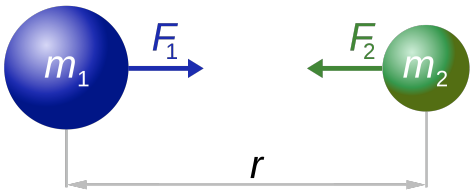
    Tectonic theory states that continents can move because the surface of the earth is composed of plates floating on a liquid molten core.

Scientific Laws

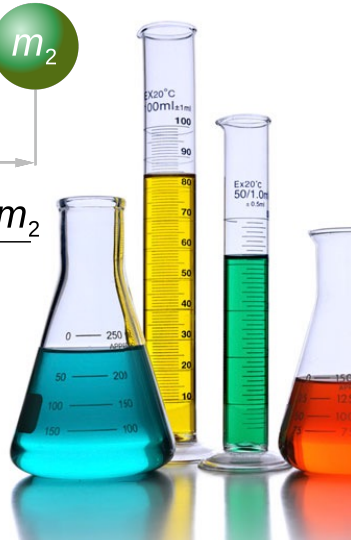
- Laws are easy to understand.
  - Laws are truths.
  - Laws are a statement of our collective observations.
    - Something is a law if it truthfully describes every observation mankind has every made of that phenomena.
  - Gravity is a law, we have never observed an exception to it.
    - The law of gravity is consistent with reality.
  - Laws don't explain why something happened.
    - We don't have a single, reliable explanation as to how gravity works.
    - We only know what to expect because we always see the same thing happen.
      - That pattern can be used to predict future behavior.
      - It justifies our belief that if we drop an apple, it will fall towards the earth.
- Laws tell us what **has** happened.
- Laws are a reasonable way to predict what **will** happen.
  - But laws do not promise.
  - It's always possible a future observation will differ.
  - … at which point that model will no longer be a law.







$$F_1 = F_2 = G\frac{m_1 \times m_2}{r^2}$$

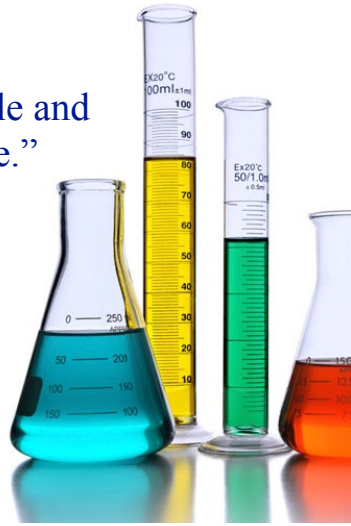


Scientific Theories

- Theories are not truths.
- Theories are an imperfect attempt to represent truths.
  - The truths theories reveal to us are often more valuable than scientific laws—because they explain why.
  - As we make observations we attempt to see the truth of why behind those observations.
  - We model the 'why' of it with a theory.
  - Theories, although always imperfect, can be useful representations of the real world.
  - They can point to and help us predict truths not yet revealed or observed.
- Like a sculptor has a perfect image in his mind
  - … and then tries to represent that image by taking away everything from a block of marble that is inconsistent with the image.
  - … and like sculptors, scientists are imperfect so a little inconsistency (some falsehoods) always remain.

"I saw the angel in the marble and carved until I set him free."

— Michelangelo



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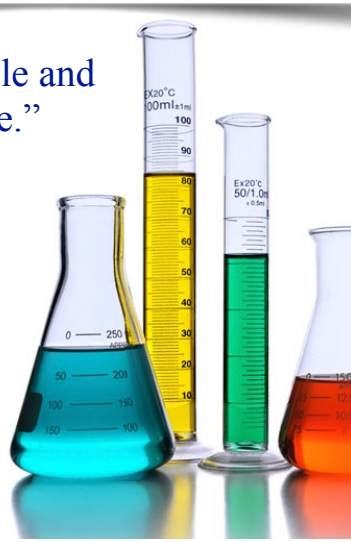

Scientific Theories

- We chip away at theories to improve them, by experiencing that phenomena from different angles and making new observations.
  - We try to improve the explanation by finding where it's inconsistent with reality, and removing that part.
    - To leave the theory as close to truth as possible.
- Experiments are reproducible, designed experiences that provides an opportunity to make further observations and disprove hypothesis.
  (or gain support and confidence in our hypothesis.)

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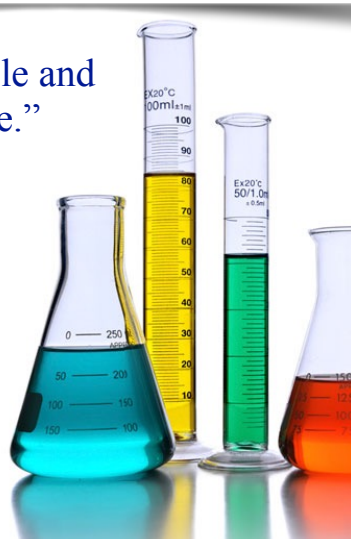


Scientific Method

- Observation: The details of an experience that can be reproduced and confirmed by others.
  (Data, Facts)
- Hypothesis: A tentative explanation of observations that provides a basis for further experimentation.
  (Hypothesis must be disprovable to have value.)
- Experiment: A reproducible, designed experience that provides an opportunity to make further observations and disprove hypothesis.
  (or gain support and confidence in our hypothesis.)
- Theory: "Well-established hypothesis." An explanation of nature with considerable evidence or facts (observations) to support it.
- Law: Statement of natural phenomena to which no exceptions are known. A law is not an explanation.
  (A summary of many consistent observations, without explanation.)

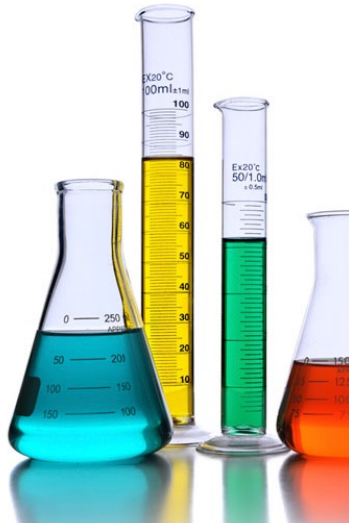
Observation

Hypothesis

Law

Theory

Experiment



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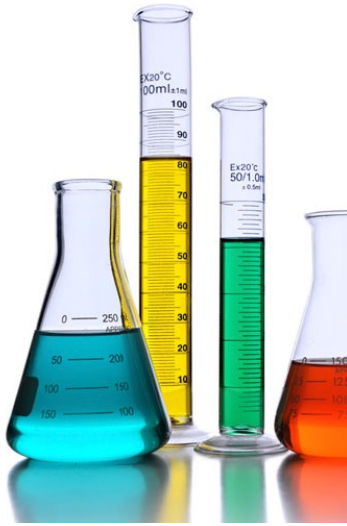
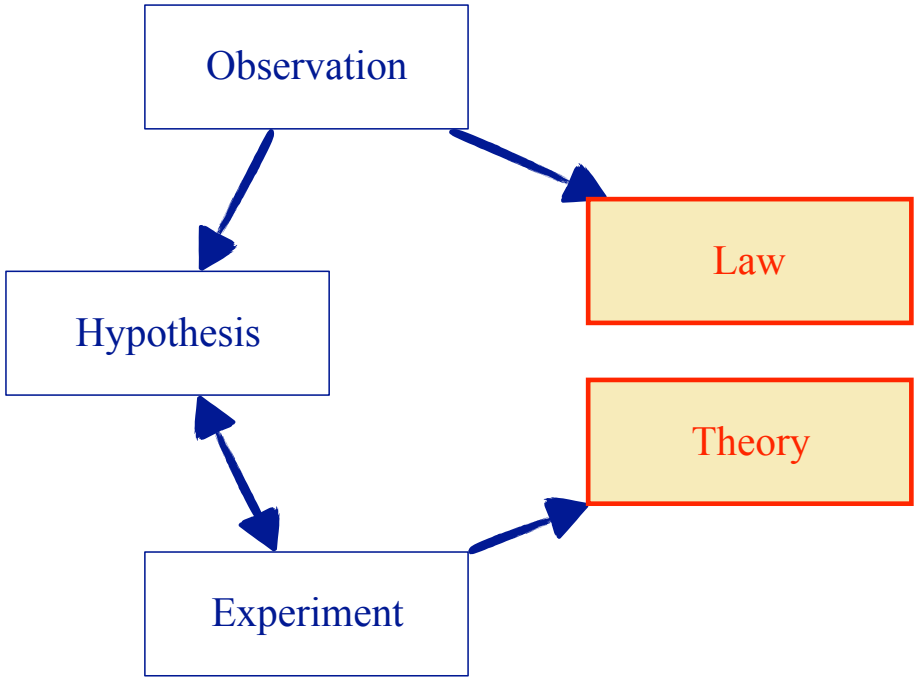


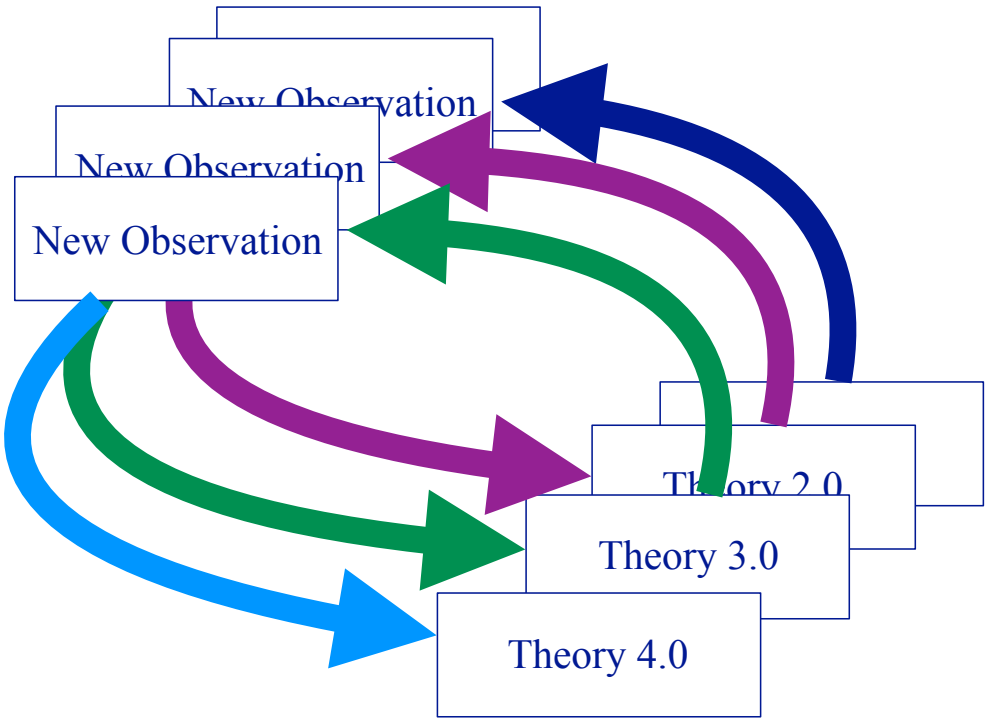
Scientific Method is a process.

- You always start with observations.
  - What do you know is true (real).
  - What you see, touch, hear, smell…
  - No interpretations, just observations.
- Only when you have enough data, enough observations, do you offer a tentative explanation, a hypothesis.
  - It's like a connect the dot game, let yourself see enough connections before you guess what the picture might be.
  - A hypothesis is a model for how things *might* work.
- Then you experiment.
  - You try and test that model, stretch it, break it, find it's limits so you know how much you can trust it.
    - When it holds, you test it more.
    - When it breaks, you fix it. You patch it up and offer a slightly better hypothesis.
- When you start to trust that explanation you call it a theory.
  - Theories are well established explanations.
  - Theories are reliable models.
  - Theories let us predict the future, successfully and with confidence.
- When we can't explain something, but it's showing to be true by many observations, we all it a law.
  - Laws let us predict the future, without knowing why.
  - Laws are patterns that seem to have no exceptions.
- Scientists don't make science, we use scientific theory to produce laws and theories.
  - Science is what we do.
  - Laws and theories are what we produce.

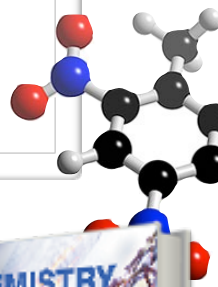


Science is never perfect or complete.

- Science is iterative.
  - It goes in cycles, bringing us closer to the truth each time, but never claiming to be the truth.
- It's never complete.
  - Science never claims to have all the answers.
  - All we try and do is produce useful models, reliable explanations.
    - Tools for predicting results.
  - We never prove theories.
    - We only disprove them
      … so we can improve them.
- We make leaps and reach plateaus in knowledge.
  - Theories that gave us the steam engine, put us on the moon, the electric motor, the internet…
  - Science has produced great theories and important laws on which marvelous technologies are built.
    - But no theory is ever the end of the story.
    - We assume every theory has room to grow.
    - Each theory leads us to new observations, new hypothesis, new theories.
    - The more you learn, the more you realize there is out there to know.
  - Science requires the arrogance to believe you can know anything, and the humility to accept you will never know everything.



Class Introduction



- Are you in the right room?
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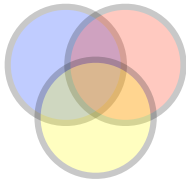

- Knowledge
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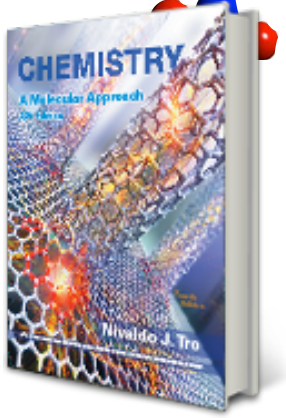

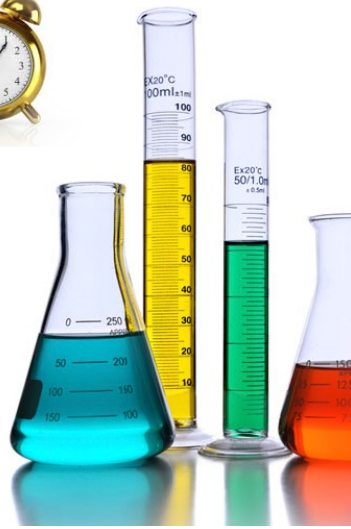

Getting Started

"The science of the composition, structure, properties and reactions of matter, especially of atomic and molecular systems."

— Webster

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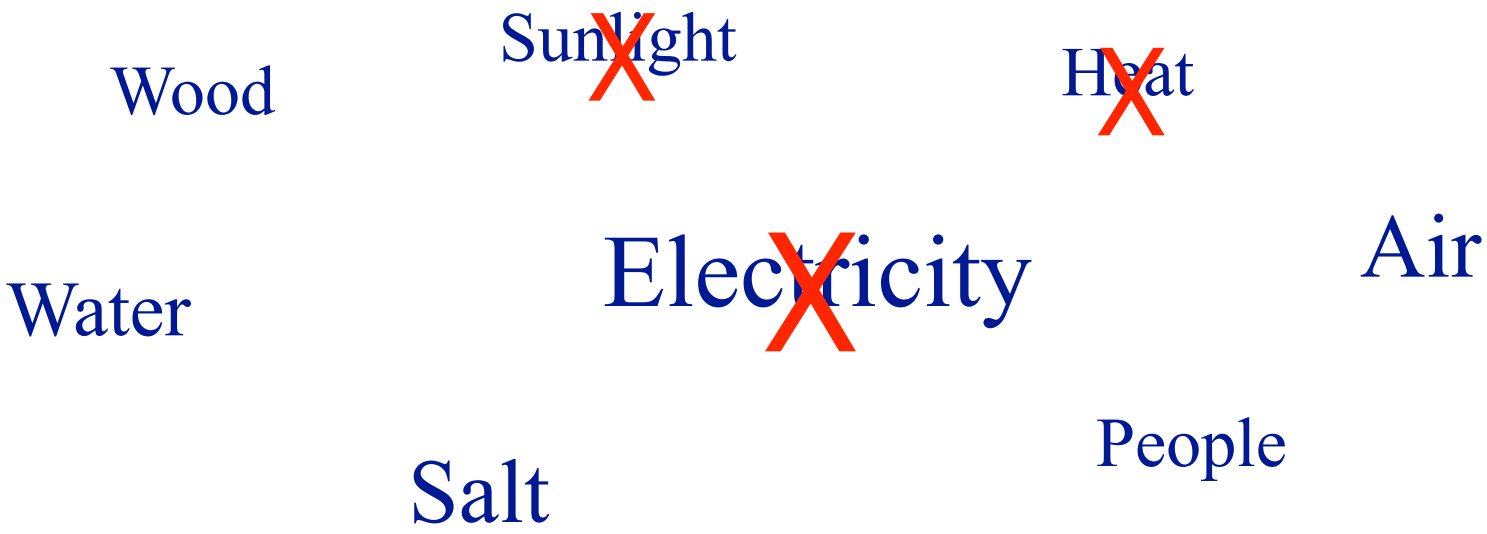
Chemistry Defined

The science of matter.

What is Matter?

Matter is anything that has mass and occupies space.



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Chemistry Defined

What is it made of?

How do the pieces fit together?

"The science of the composition, structure, properties and reactions of matter, especially of atomic and molecular systems."

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What makes it unique?

How do you change it?

How do we answer these questions?

How do clocks work?

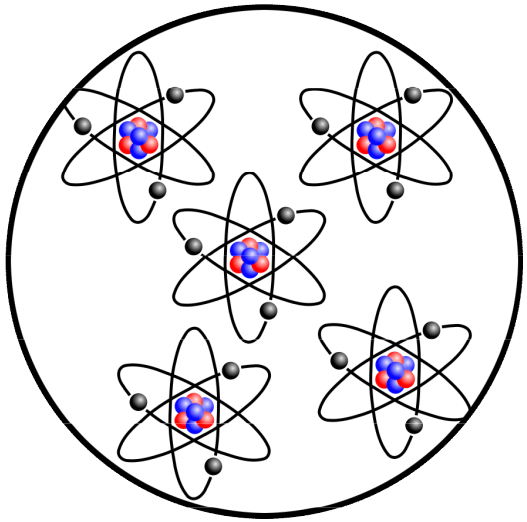
What is it made of?

How do the pieces fit together?

What makes it unique?

How do you change it?

How do rocks work?



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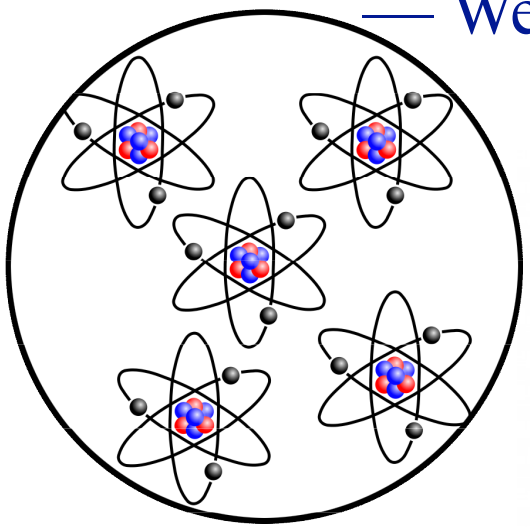
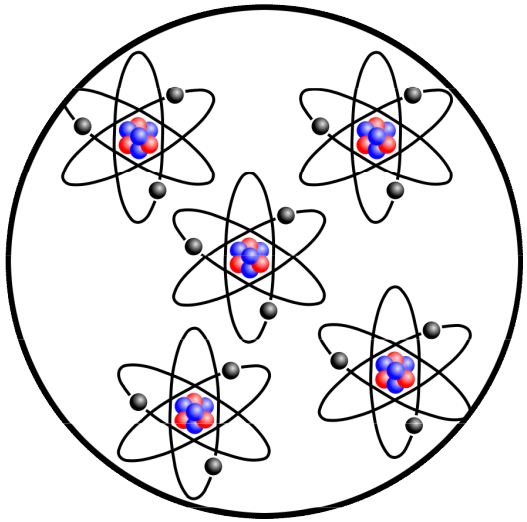


Chemistry predicts & explains matter.

- You can divide all substances into smaller pieces of matter.
- The smallest pieces of a substance, that are still that substance, are atoms and molecules. (We'll just call them particles for now.)
  - **This is atomic theory. The first theory of chemistry.**
  - Chemists explore these small particles and through observation and experiment, offer reliable explanations for the reactivity and properties of the substances they compose.
- This semester, we will help you use scientific method to deduce the composition and understand the structure of the particles that make up all matter in the universe.
- Once you know a substances composition and structure, we will show you how to predict and explain many of the properties and reactivity of those substances.
  - Given similar white powders, you will be able to predict which:
    - Dissolves in water.
    - Floats in water.
    - Turns pink in water.
    - Burns in water.
    - Freezes water.
    - Changes into water.
- This is chemistry, the science of matter.



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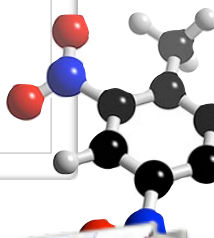

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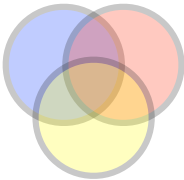

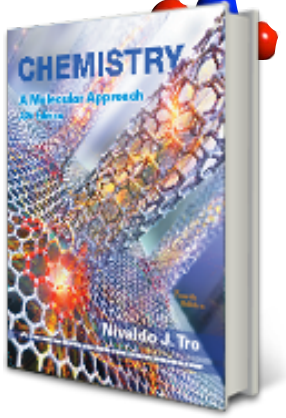

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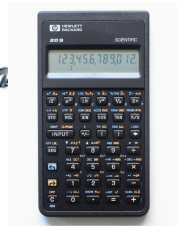

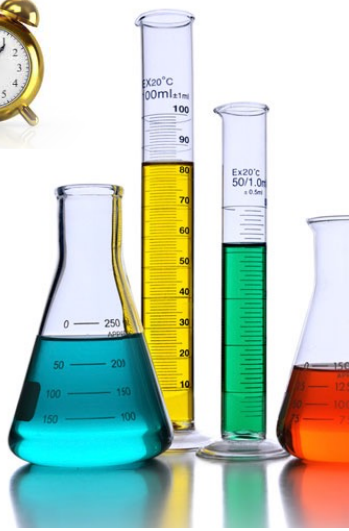

This semester we will discuss...

1. Chemistry defined
   — basic tools & questions.
2. Atoms & the Elements
   — flavors of the atom.

Exam #1

3. Chemical Formulas & Equations
   — the language of chemistry.
4. Solutions & Chemical Reactions
   — transmutation.

Exam #2

5. Chemistry in the Gas State
   — the balloonists.
6. Thermochemistry
   — energy in chemical reactions.

Exam #3

7. Quantum Mechanics
   — taking apart the atom.
8. Periodicity & Configuration
   — programming the atom.

Exam #4

9. Chemical Bonding
   — executing atomic programs.
10. Molecular Shape
    — definitions and basic questions.
11. Intermolecular Forces
    — what holds matter together.

Final Exam

The final is cumulative!

Questions?