Ch01

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

Introduction

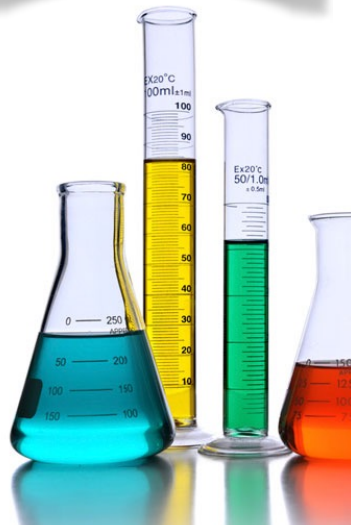
section 01
CRN 42682

section 02
CRN 42690

Welcome to Chem 30A

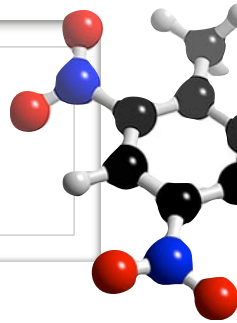
Intro to Gen, Organic, & Bio Chemistry part 1

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

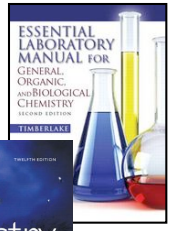


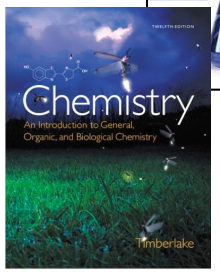
version 1.5

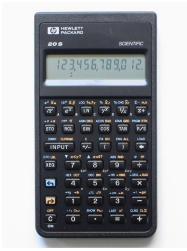
Class Introduction



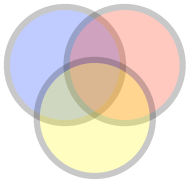
- Are you in the right room?
  - Instructor
  - Requirements
    - Pre-req's
    - Schedule
      - Dates & Times
    - Materials
  - Evaluation (Grades)
    - Point Break Down
    - Grade Reports
      - Knowing how you're doing.
  - Other Resources

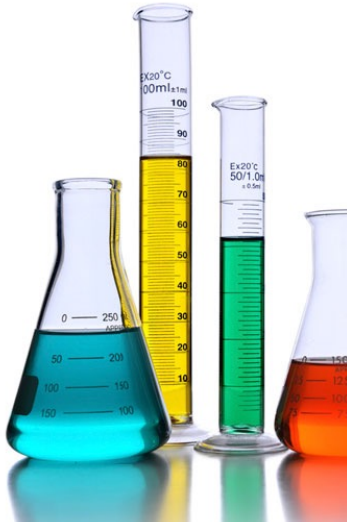






- Knowledge
  - Imagination
  - Truth & Belief
  - Justification
- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation
- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.



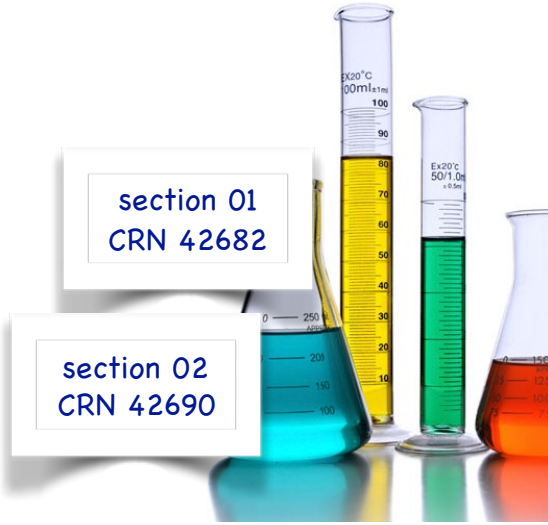


Are you in the right room?

- This is Chem 30A: **Intro to General, Organic, & Bio Chemistry part 1**
  - section 01 - CRN 42682
  - section 02 - CRN 42690

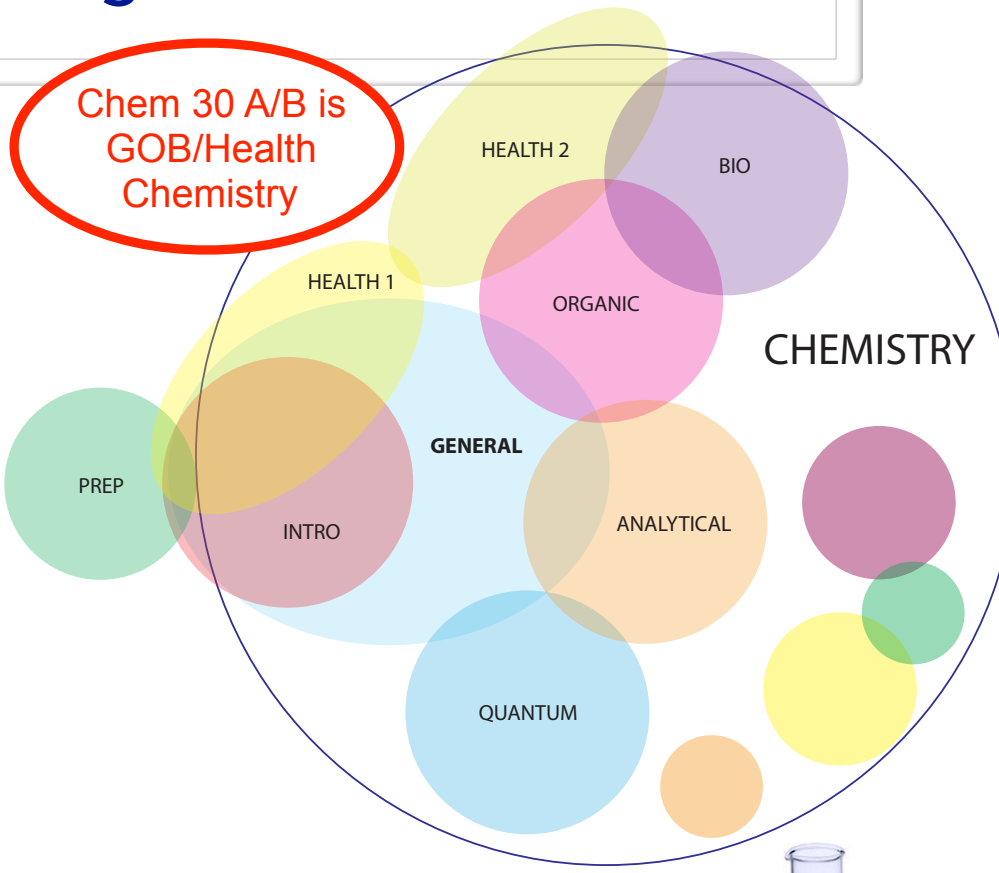
- This class has a lab and lecture component, you can't take one without the other.
- Intro GOB Chemistry is
  - A university level entry course into chemistry.
    - You are not required to have any previous chemistry experience.
    - This class is transferable to UC and CSU programs.
  - A two quarter series.
    - We will discuss general chemistry topics this semester, organic and biochemistry topics come in the second half (Chem 30B).
    - Some programs and certificates only require the first half (this class), not the whole series.
      - Talk to your counselor if you are unsure whether that applies to the schools you are targeting.

If you are enrolled
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!



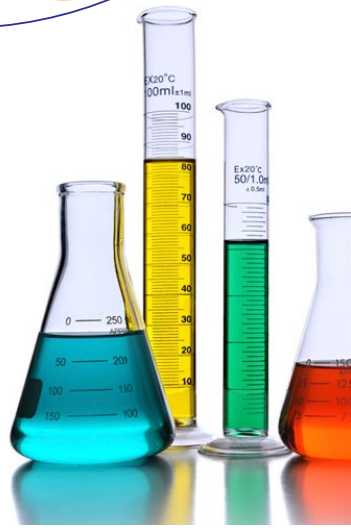
Are you taking the right course?

- Chemistry is big subject. There is more than one entry course for college chemistry. Most of them cover many of the same topics, but the context and depth in which we go over those topics is very different.
- The big three "first" chemistry courses are:
  - General Chemistry (Chem 1A/1B/1C)
    - 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.
  - Intro Chemistry (Chem 10)
    - 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 store in General Chemistry you may want Intro Chemistry.
      - Some nursing programs (not many) will accept this course, check with your counselor.
  - GOB Chemistry (Chem 30A/B)
    - Intro to General, Organic & Biochemistry (also called GOB or Health Chem) is a two quarter series that won't get into the full depth of topics it shares with General Chemistry.
    - It will include topics in Organic and Biochemistry (in the second quarter).
    - GOB Chem is optimized for students in the health care industry, it's ideal for students seeking entry into many nursing programs.
    - It's also meets the requirements of <u>some</u> certificate programs.

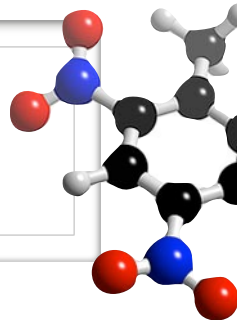


Note: Prep Chemistry (Chem 25, used to be called Chem 50) offers foundation skills that we will only briefly review in this class.

Prep Chemistry is primarily designed to assist students taking on the challenge of General Chemistry, but can be useful to students taking any of these three paths.

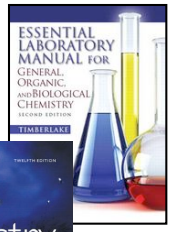


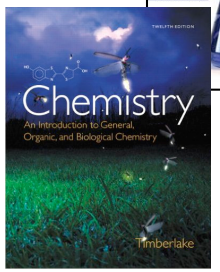
Class Introduction



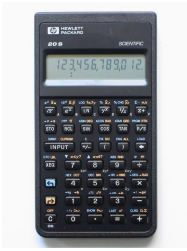
- Are you in the right room?
- Instructor

- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials

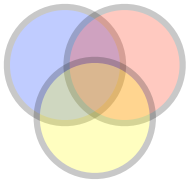




- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources

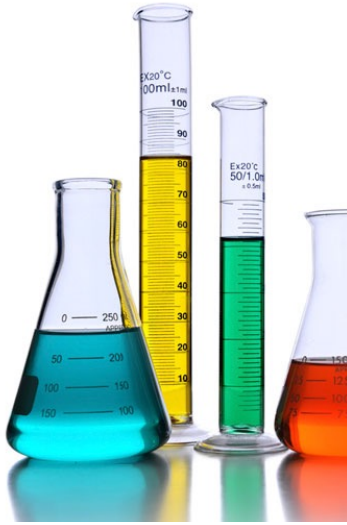


- Knowledge
  - Imagination
  - Truth & Belief
  - Justification



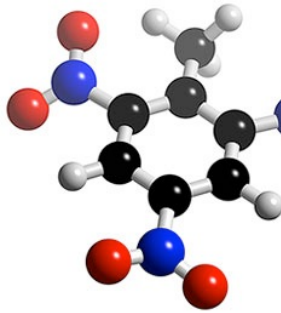
- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation

- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.



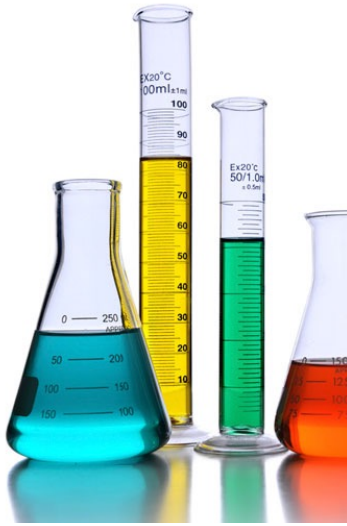
Instructor

- Prof. Nick De Mello, Ph.D. "Professor De Mello"
  - Lecturer & Lab Instructor (both sections)

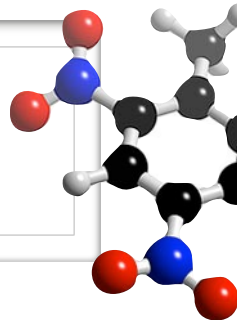


nick@chemlectures.com

- 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

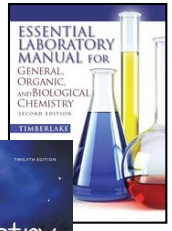


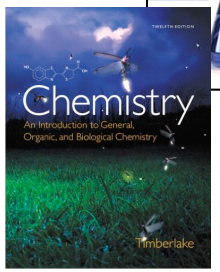
Class Introduction



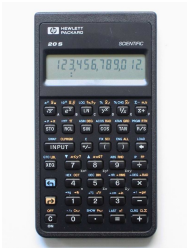
- Are you in the right room?
- Instructor

- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials

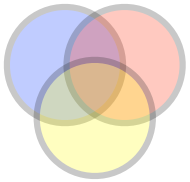




- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources

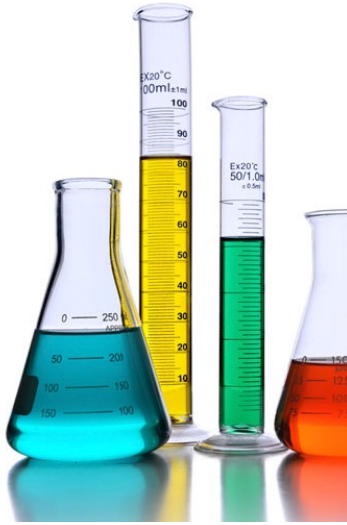


- Knowledge
  - Imagination
  - Truth & Belief
  - Justification



- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation

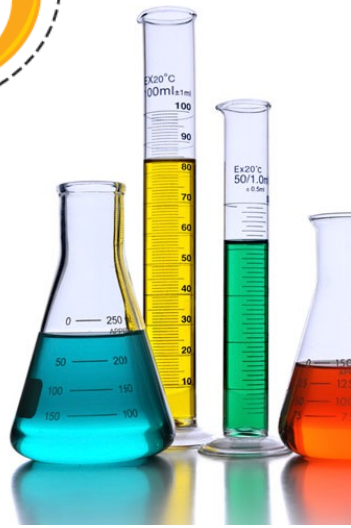
- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.



Requirements: Pre-reqs

- Math 114 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 Writing 211 & Reading 211 or ESL 272 & 273 or equivalent.
  - Written lab reports and extensive reading are required.
- Previous science or chemistry courses will help, but is not required.
  - We will go from zero to quantum in 12 weeks.
  - The course moves fast and the content is extremely compressed.
  - Previous exposure to these subjects is valuable.

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



Requirements: Schedule

- This class meets: 03/04/16 - 06/24/16 M/W
- LECTURE (both sections):
  - 8:30am - 10:20pm Mon & Wed
    - Please do not be late
  - in Room 1102 of Building SC1
- LAB:
  - SECTION 01: 11:30am - 2:20pm Mon
  - SECTION 02: 11:30am - 2:20pm Wed
  - in Room SC2 of Building 2204 (top floor)
- OFFICE HOURS
  - 10:30 - 11:20pm Mon & Wed
  - in Room S43 of building S4 (the student success center)

You cannot make up a missed lab by going to the other lab section. There are no make-up labs.

- Lecture and Lab attendance is required.
  - Students missing more than two consecutive lectures, more than four 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.
    - Missing two or more labs may mean you don't have enough lab hours to qualify for your program.
- 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

Older editions of the textbook will most likely work fine, check with me if you have a different edition.

- Available from the De Anza Book Store:
  - Textbook:

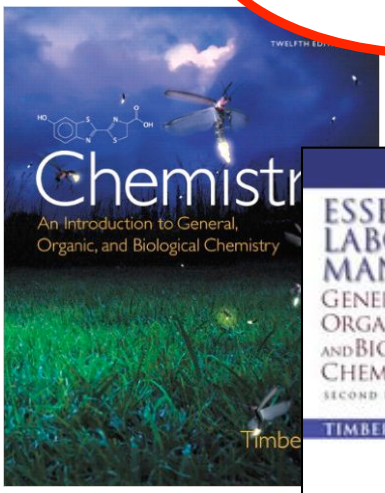
    Timberlake Chemistry: A Molecular Approach, 12th Edition, Pearson, copyright 2015
  - Lab Manual:

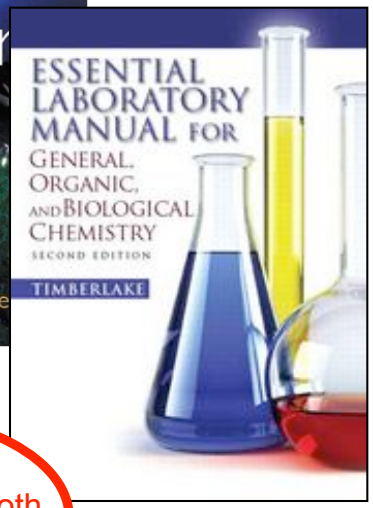
    Catalyst: Introduction to General, Organic and Biochemistry, Pearson, copyright 2015
  - Mastering Chemistry License

    (can be purchased with text book or separately)
  - Laboratory Safety Goggles

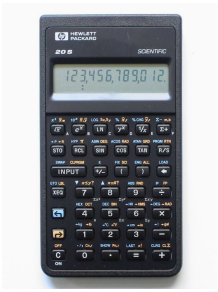
    (goggles must tightly grip your forehead, we will discuss this further in lab)
  - Simple Scientific Calculator

    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!

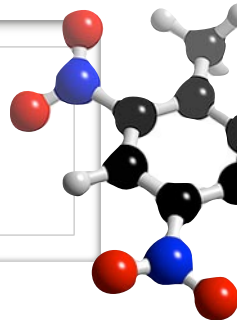




Same books are currently used for both Chem 30A and 30B (at De Anza)

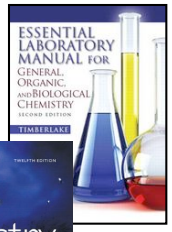


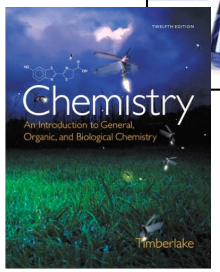
Class Introduction



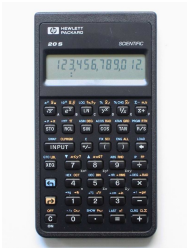
- Are you in the right room?
- Instructor

- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials

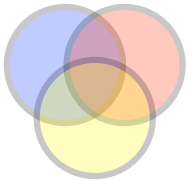




- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources

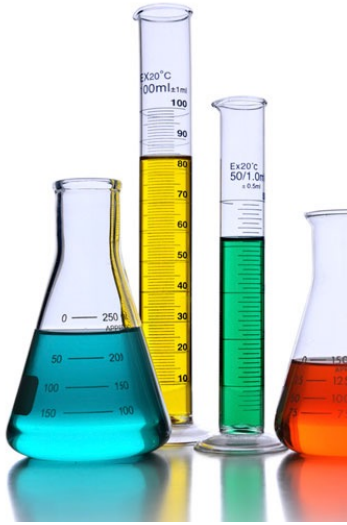


- Knowledge
  - Imagination
  - Truth & Belief
  - Justification



- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation

- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.



Evaluation

- There will be about 700 points available during the semester.
  - There will be three midterm exams (80 pts each), given during the first hour of lecture (see schedule for dates).
  - The final exam will be worth 120 pts, according to the college final exam schedule.
  - There are about 10 homework assignments (17-20 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 quiz and a report (15 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.
  - A lab safety quiz is required by the department (10 pts).

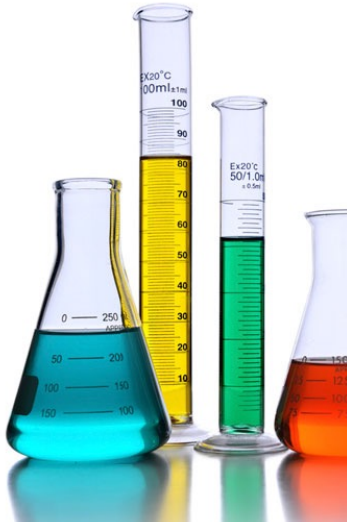
Exam #1

Exam #2

Exam #3

Final Exam

- <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)



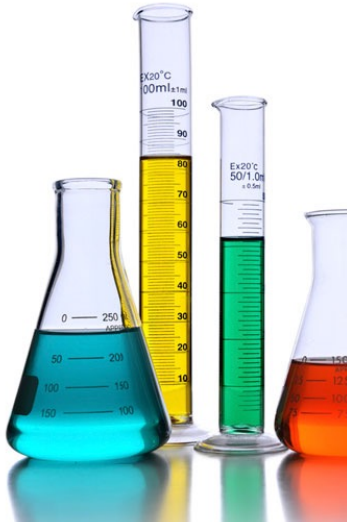
Evaluation

- 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).

180 pts	Homework (10 assignments; 17-22 pts each)	26%	Lecture 3/4
240 pts	Midterm Exams (3 exams; 80 pts each)	34%	
120 pts	Final Exam (comprehensive; 120 pts)	17%	
80 pts	Lab Reports (8 scores; 10 pts each)	11%	Lab 1/4
40 pts	Lab Quizes (8 quizes; 5 pts)	6%	
30 pts	Lab Practical (30 pts)	4%	
10 pts	Lab Safety	1%	
700 pts		100%	

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



Evaluation

Chem 210 — Midterm Progress Report

Full Name	Student, Alan
Status	Registered
GNumber	G 00123456
Major	Chemistry

Points to date	917.2
Possible to date	1005
Percent to date	91%

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

FName	Alan
LName	Student
Phone	650-555-1234
eMail	a.student@my.smccd.edu

Section	AC
Bench	E
Locker	62
Locker Combo	01-20-03

Class Grade

A

Exams

Exam01	82.3	82%
Exam02	87.3	87%
Exam03	85.0	85%
Exam04	92.0	92%
Final	146.0	91%

Workshop Practice Exams

PE 01	4.0	80%
PE 02	4.5	56%
PE 03	0	
PE 04	4.5	90%
PE 05	3.2	64%
PE 06	4.5	90%
PE 07	5	100%
PE 08	5	100%

Combined: Reports + Pre-Lab

SftyQz	8.0	100%
Lab01	16.0	100%
Lab02	15.0	94%
Lab03	14.0	88%
Lab04	16.0	100%
Lab05	14.0	88%
Lab06	14.5	91%
Lab07	14.0	88%
Lab08	13.0	81%
Lab09	14.5	91%
Lab10	15.0	94%
Lab11	0.0	
Lab12	14.0	88%
Lab13	16.0	100%
Lab14	16.0	100%

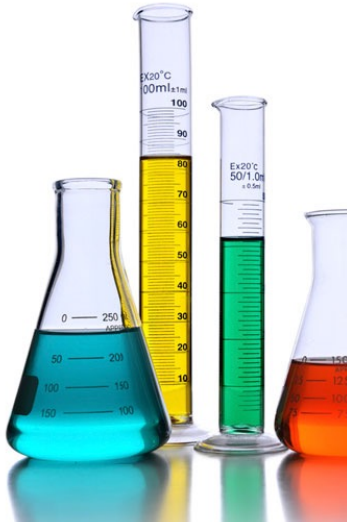
Safety Issues

Homework

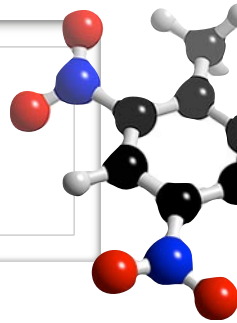
Ch01	16.8	99%
Ch02	18.0	100%
Ch03	18.0	100%
Ch04	17.6	98%
Ch05	15.5	97%
Ch06	17.7	99%
Ch07	16.2	102%
Ch08	19.3	102%
Ch09	10.8	60%
Ch10	17.0	100%
Ch11	18.8	99%
Intro	8.0	100%

- 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.

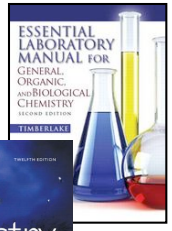
  (when campus policy allows)
- Student progress reports will be provided after each exam (and are available on request).

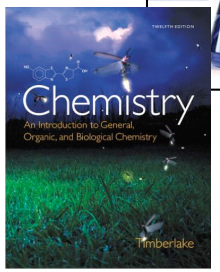


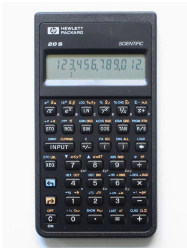
Class Introduction



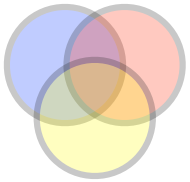
- Are you in the right room?
- Instructor
- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials
- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources

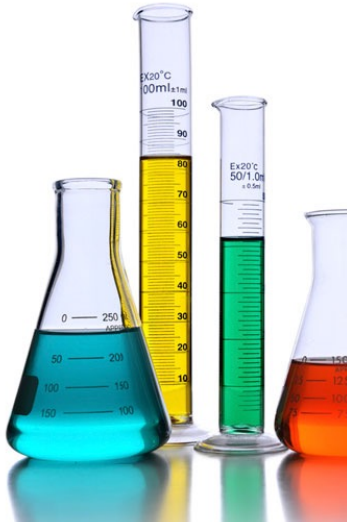






- Knowledge
  - Imagination
  - Truth & Belief
  - Justification
- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation
- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.





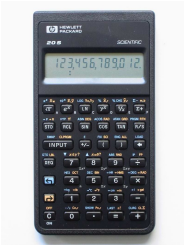
Additional Resources

- De Anza STEM Student Success Center
  - Located in Building 9, Room 105
    - I sit in the back at the round tables
    - This is where I'll have office hours
  - Free Tutoring
  - Casual & Well Lit Environment
    - Perfect for studying & Study Groups
- Chem 30A Website
  - http://chem.ws/30a

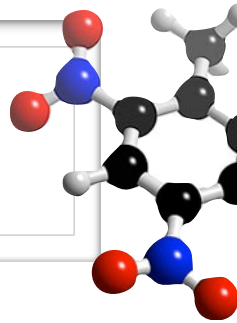
Class Introduction

- Are you in the right room?
- Instructor
- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials
- Evaluation (Grades)
  - How do I get an "A"?
  - Grade Reports
    - Knowing how you're doing.
- Other Resources

- Introduction to Content
  - Getting started
    - Knowledge
    - Science
    - Chemistry
  - Overview of Topics
    - What this class offers.

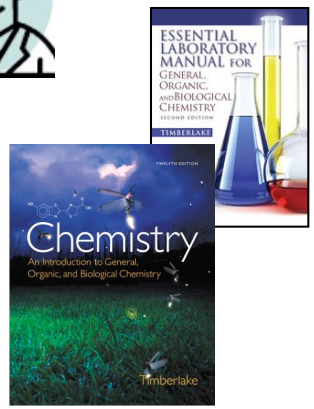


Class Introduction

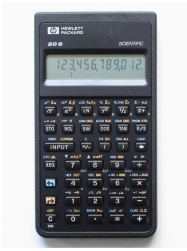


- Are you in the right room?
- Instructor

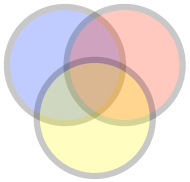
- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials



- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources

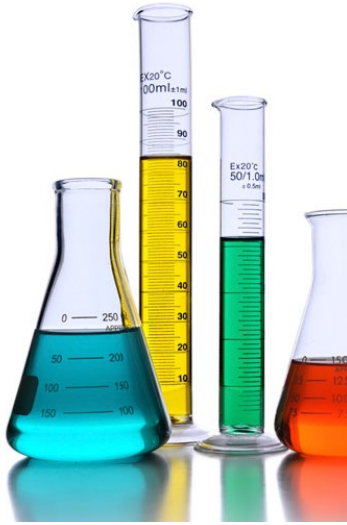


- Knowledge
  - Imagination
  - Truth & Belief
  - Justification



- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation

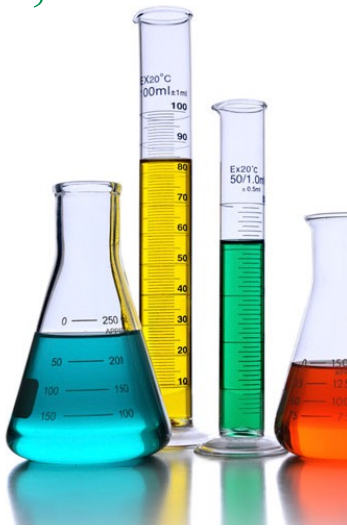
- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.



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

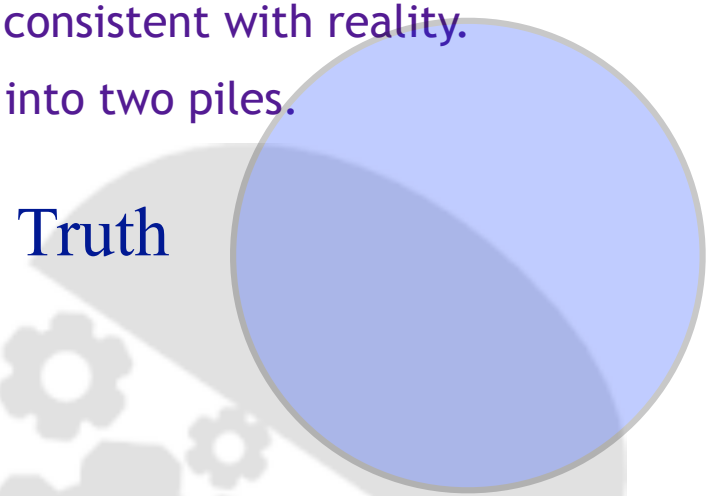
"Imagination is the beginning of creation.
You imagine what you desire, you will what you imagine
and at last you create what you will."
George Bernard Shaw

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



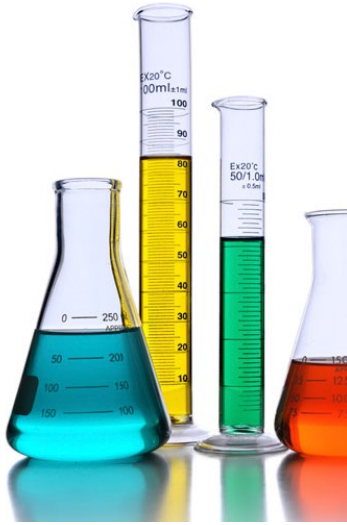
What we can imagine…

- Imagination has no limits. It's not even limited by reality.
- Some things that exist in our minds aren't consistent with reality.
- But everything we can imagine 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 just distract us.

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

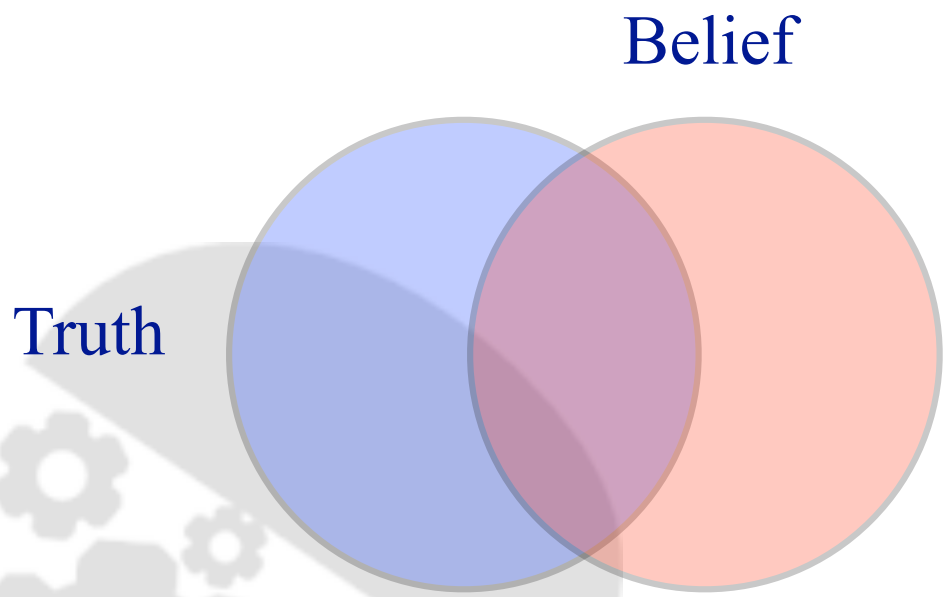


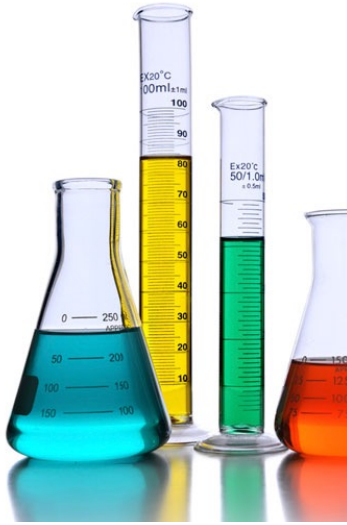
What we can imagine…

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

- It's useful to believe in things that true, and to understand when they're not.
- 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 not.
    - But it often does.



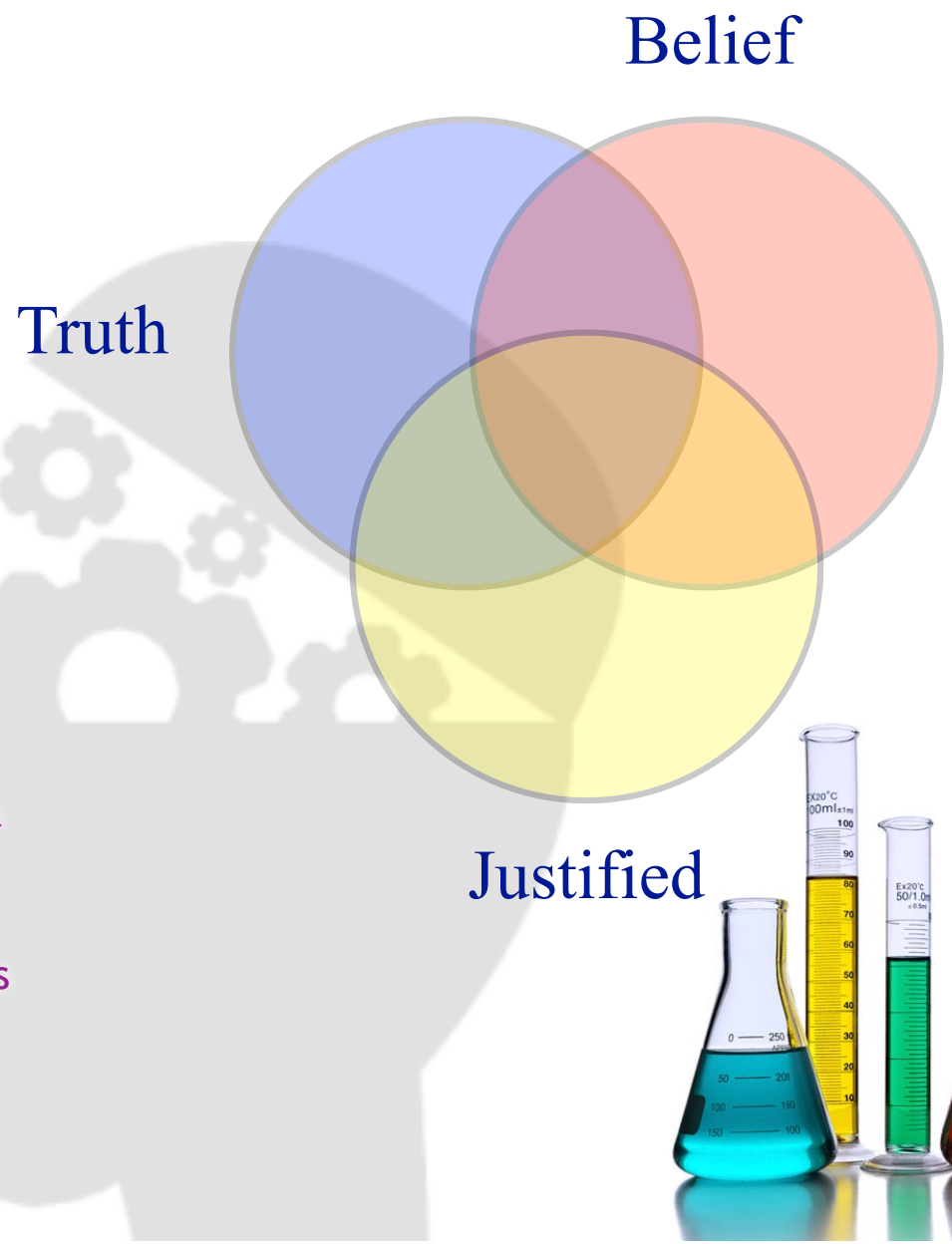


What we can imagine…

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

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

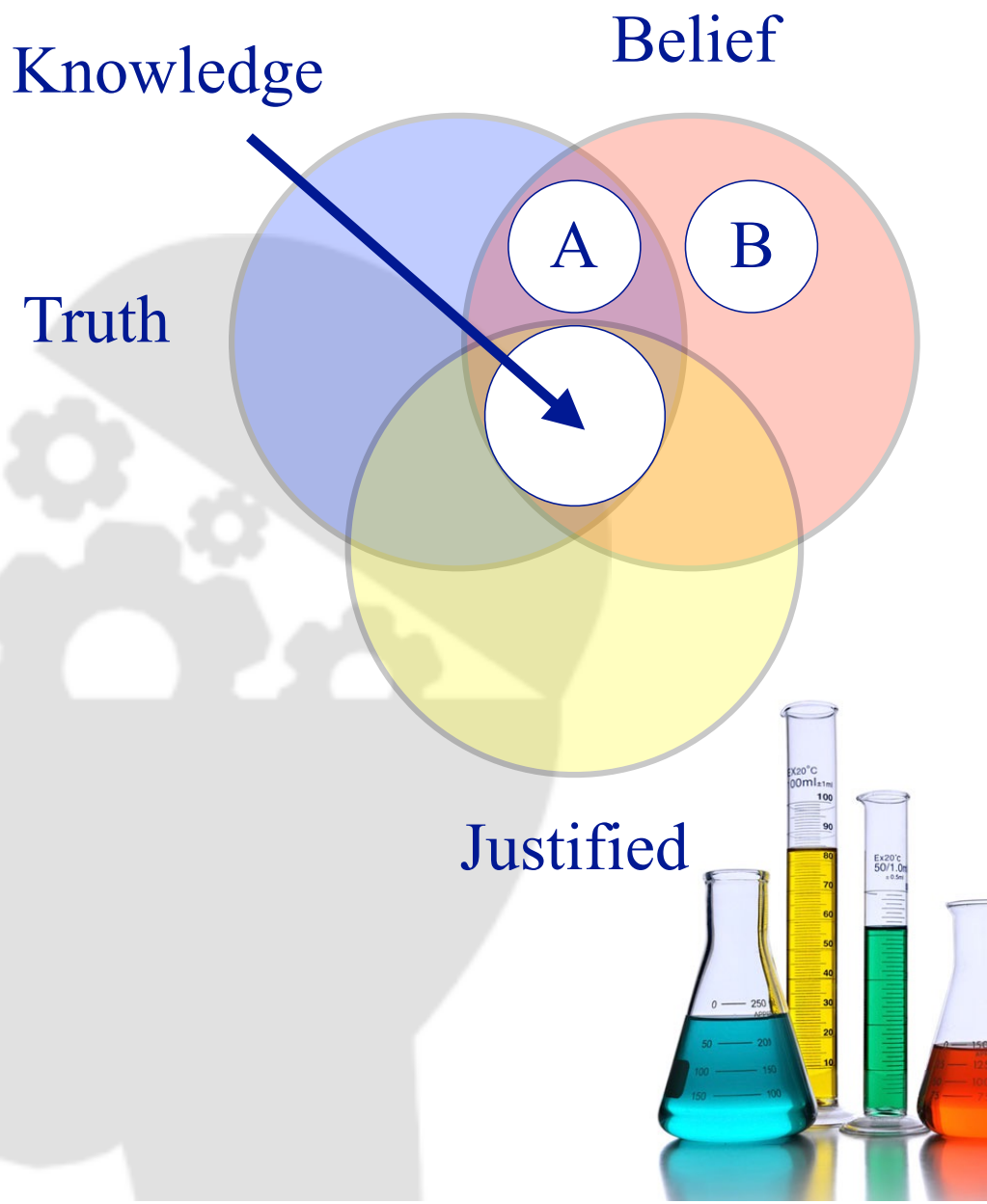
- Things that are false are harder to justify.
  - Justified beliefs are more likely to be true.
  - Justifications reduce the chance we'll trick ourselves into being certain about something, that is not true.
  - Justifications give us confidence that things are true.



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 true (A)
  - The guess could be false (B)
  - A guess still isn't knowledge.
    - Even if it's a lucky guess (A)

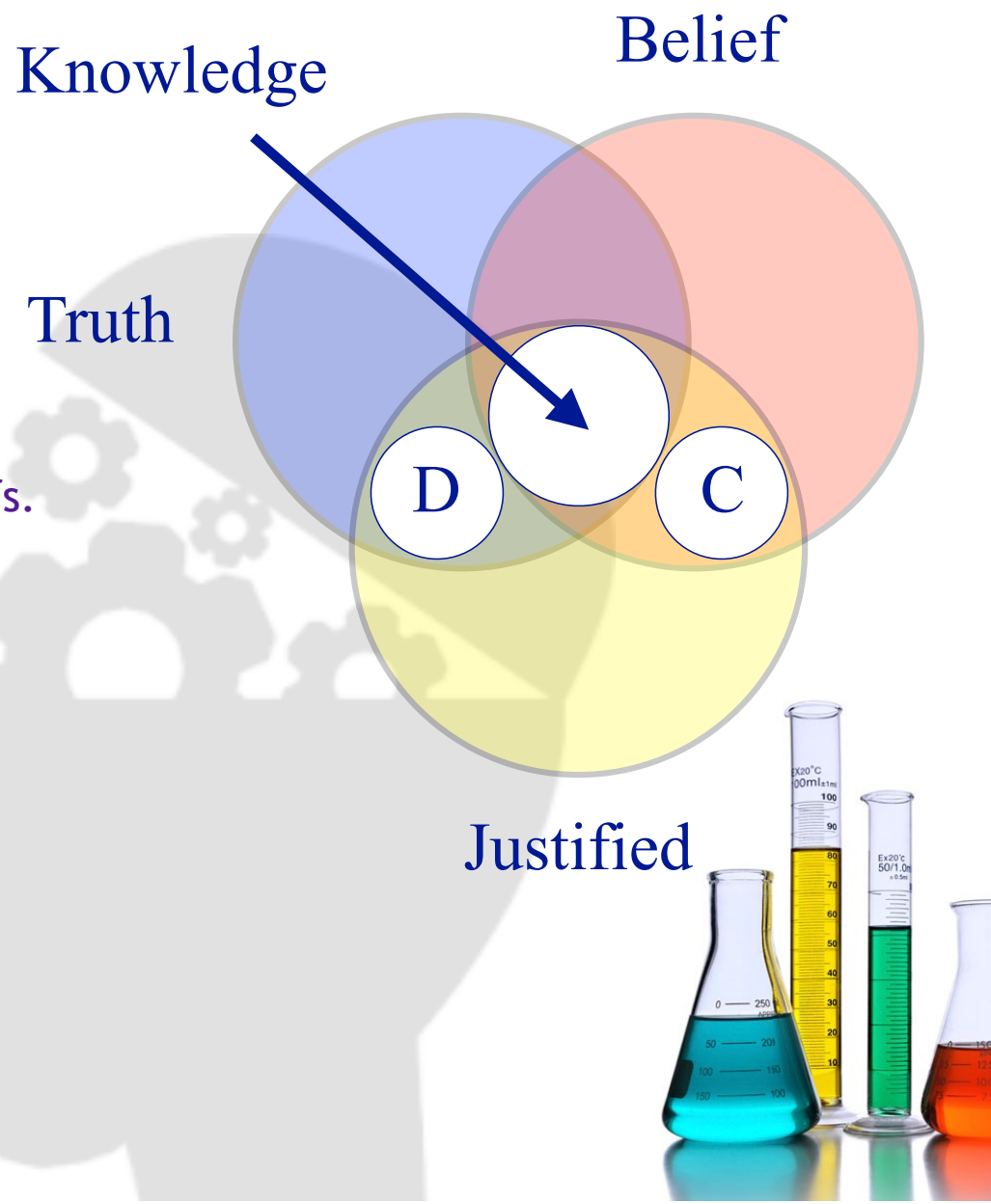


What we can imagine…

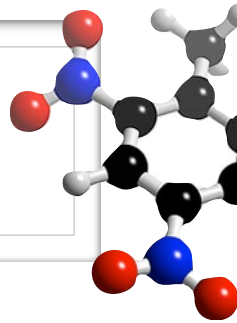
- Knowledge is a justified true belief.
- Knowing something means believing it, and having justifications for it's truth.

- Not all justifications are reliable.
  - A false justification (an error), can lead us to a false conclusion (C)
- Careful justifications can direct our beliefs.
  - They can lead us to new 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 justified true beliefs.
- Science can produce knowledge.

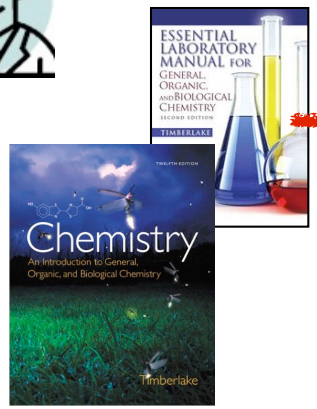


Class Introduction

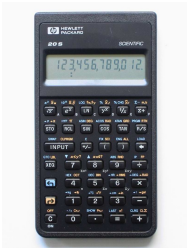


- Are you in the right room?
- Instructor

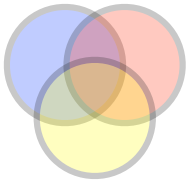
- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials



- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources

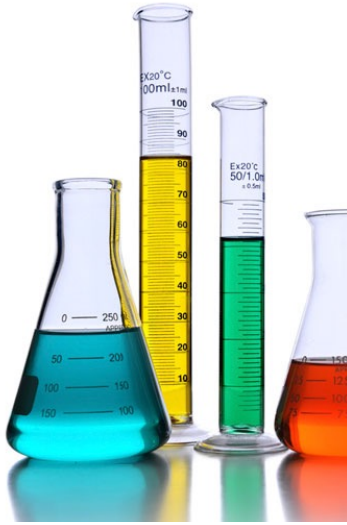


- Knowledge
  - Imagination
  - Truth & Belief
  - Justification



- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation

- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.



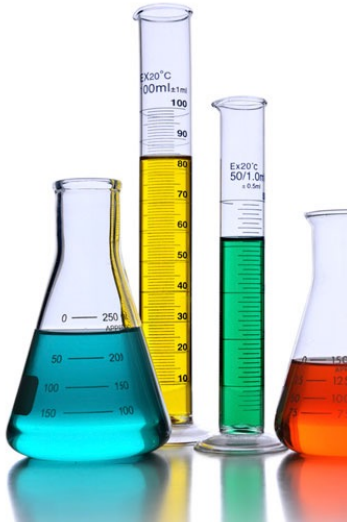
What is science?

Science

noun /sīəns/

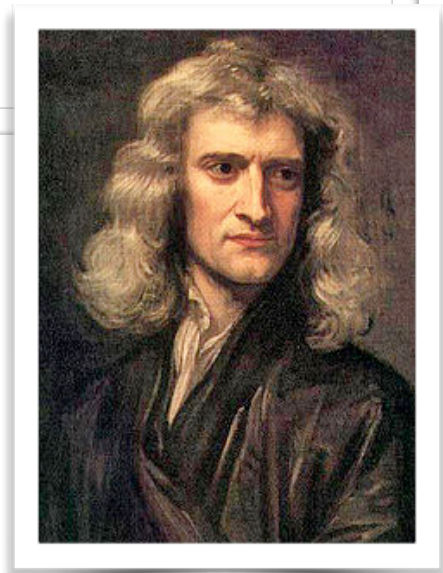
: the systematic study of the structure and behavior of the physical and natural world through observation and experiment.

— Oxford



What is science?

- Knowledge is a justified true belief.
  - There are different ways to justify beliefs.
- Science is one method of justifying beliefs.
- 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. By you.

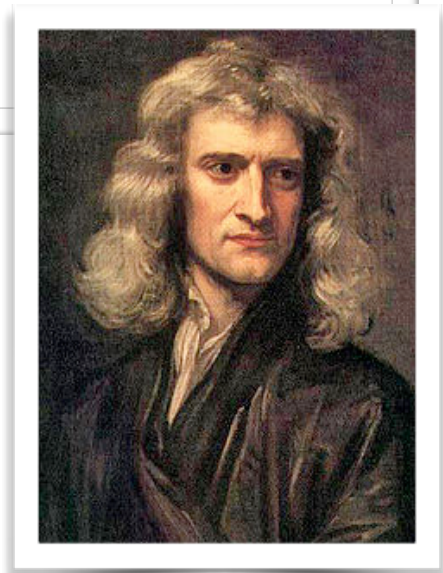


"If I have seen further it is by standing on the shoulders of giants."

— Sir Isaac Newton

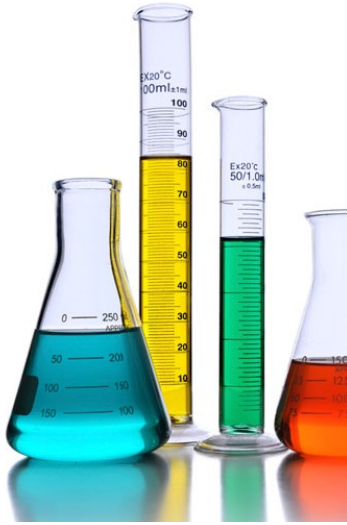
What is science?

- 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.

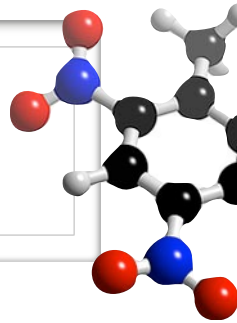


"If I have seen further it is by standing on the shoulders of giants."

— Sir Isaac Newton

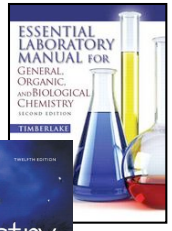


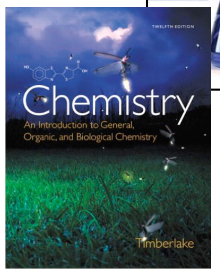
Class Introduction



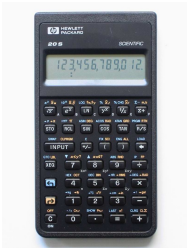
- Are you in the right room?
- Instructor

- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials

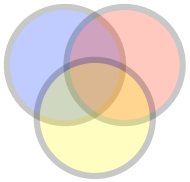




- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources



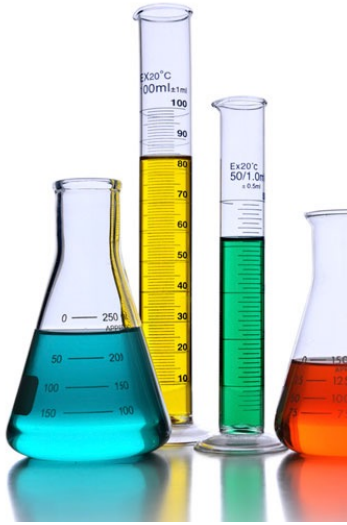
- Knowledge



  - Imagination
  - Truth & Belief
  - Justification

- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation

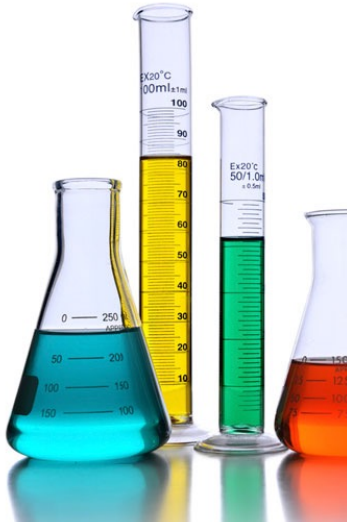
- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.



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.

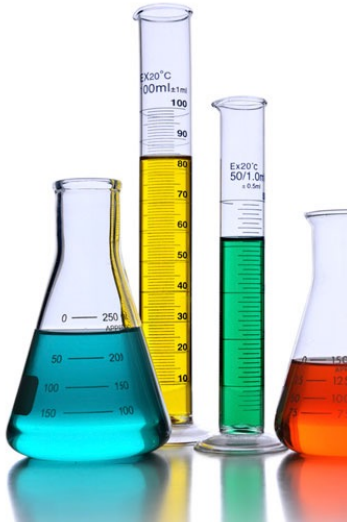
- Observations can be both qualitative an quantitative.
- Measurements are quantitative observations.
  - We'll talk more about measurements in a bit.



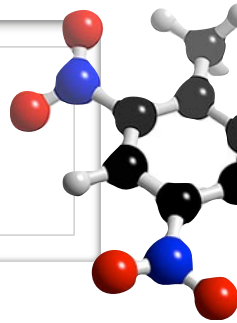
Observation

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

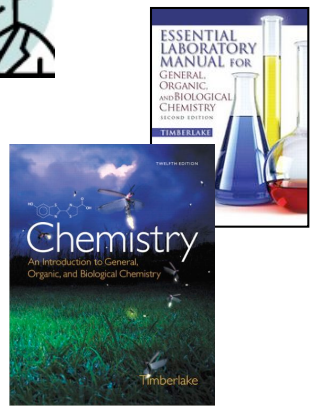
- Observations are truths.
  - If you saw water on your car this morning, it's true you saw water.
- Interpretations are not necessarily true.
  - If you saw water on your car this morning, it's not necessarily true it rained last night.
- But those interpretations, those possible explanations, are valuable.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

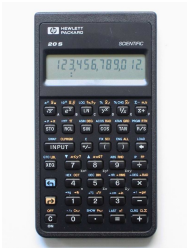


Class Introduction

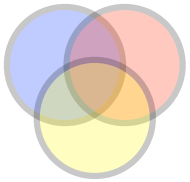


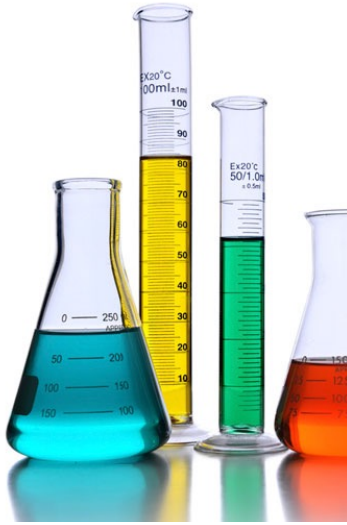
- Are you in the right room?
- Instructor
- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials
- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources





- Knowledge
  - Imagination
  - Truth & Belief
  - Justification
- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation
- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.





Theories & Laws

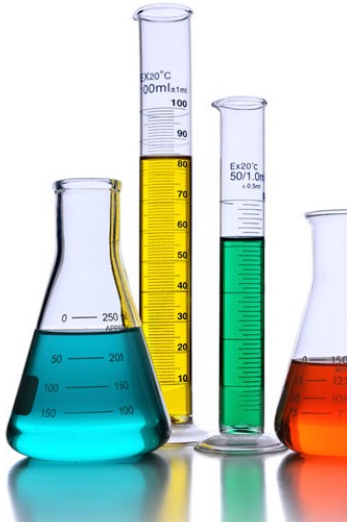
- Scientists express much of the knowledge they collect as models.
  - The same way you might draw a map to share your knowledge of a city.
  - The same way you might use a paper airplane to explain how an airplane flies.

- 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.)

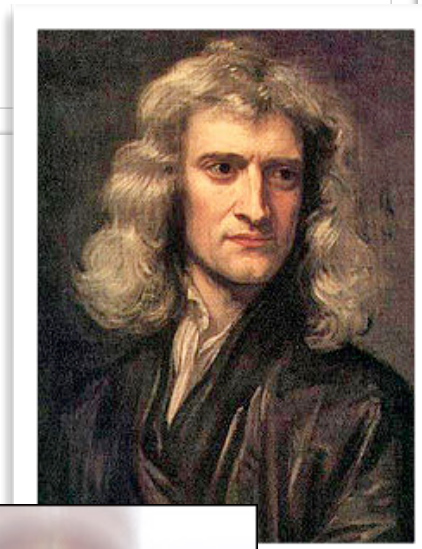
    The law of gravity is that two objects pull on each by a force equal to the sum of their masses and divided by the distance between them squared.

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

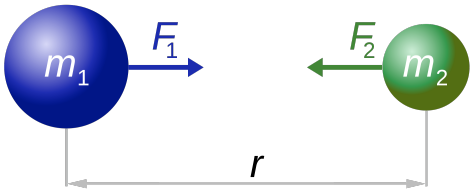
    Tectonic theory states that continents can move because the surface of the earth is composed of plates floating on a liquid molten core.



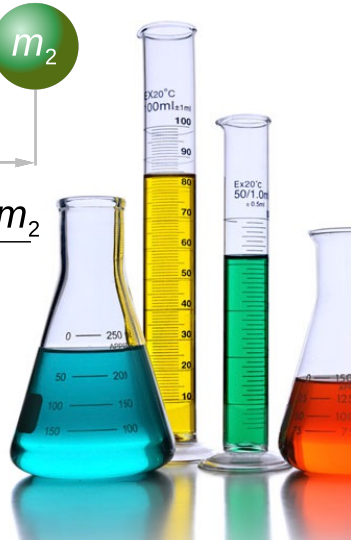
Scientific Laws



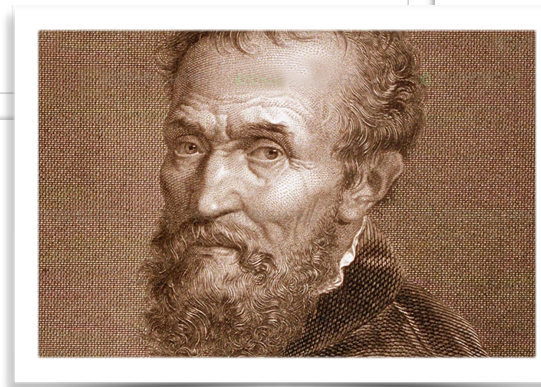
- Laws are easy to understand.
  - Laws are truths.
  - Laws are a statement of our collective observations.
    - Something is a law if it truthfully describes every observation mankind has every made of that phenomena.
  - Gravity is a law, because we have never observed an exception to it.
  - Laws 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 a promise.
  - It's always possible a future observation will differ.
  - … at which point that model will no longer be a law.



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



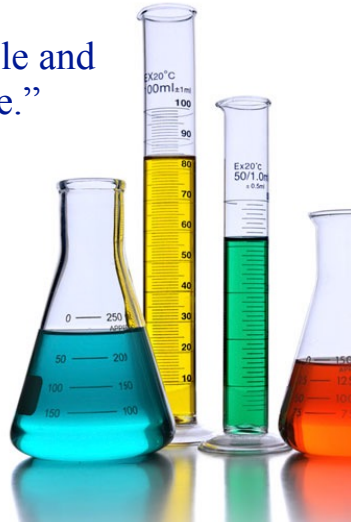
Scientific Theories



- Theories are not truths.
- Theories are an attempt to represent truths.
  - The truths theories offer 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, and then we model it with a theory.
- 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 almost always remains.

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

— Michelangelo

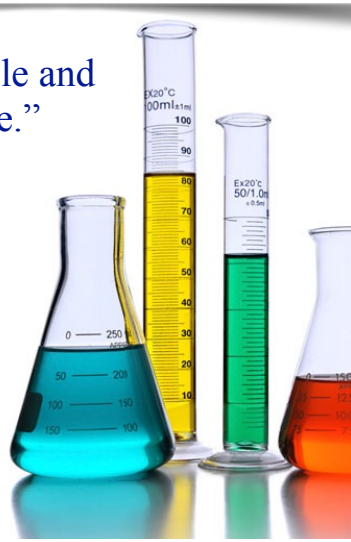


Scientific Theories

- Theories are not truths.
- Theories are an attempt to represent truths.
  - The truths theories offer 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, and then we model it with a theory.
- 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 almost always remains.

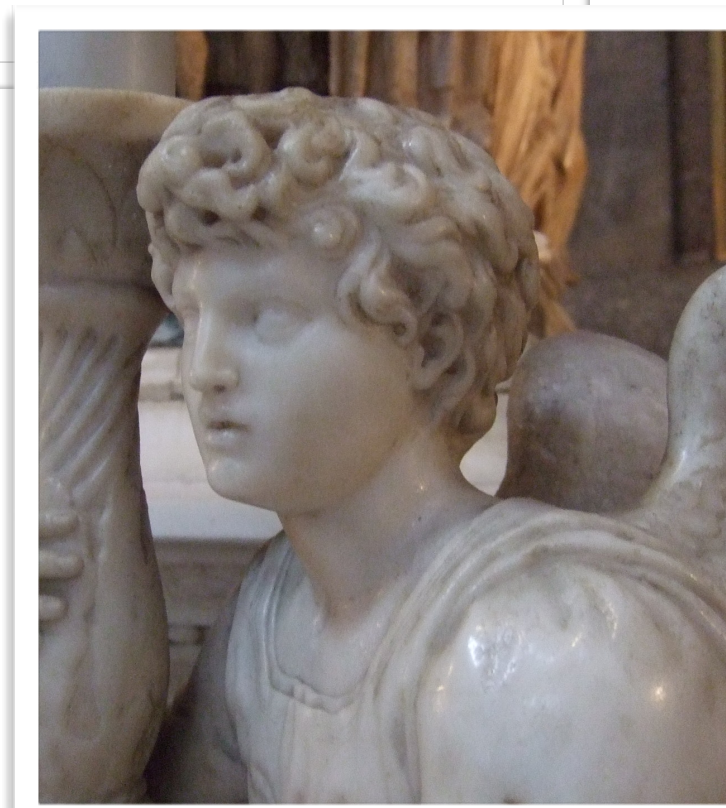
"I saw the angel in the marble and carved until I set him free."

— Michelangelo



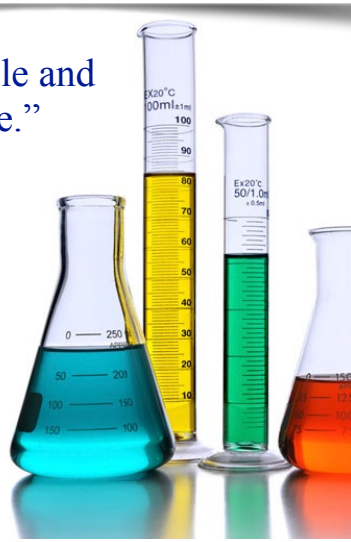
Scientific Theories

- 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.)



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

— Michelangelo



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.)

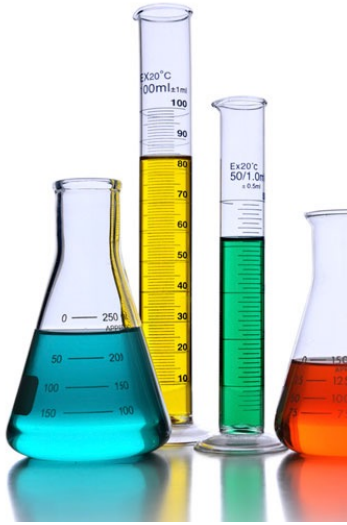
Observation

Hypothesis

Experiment

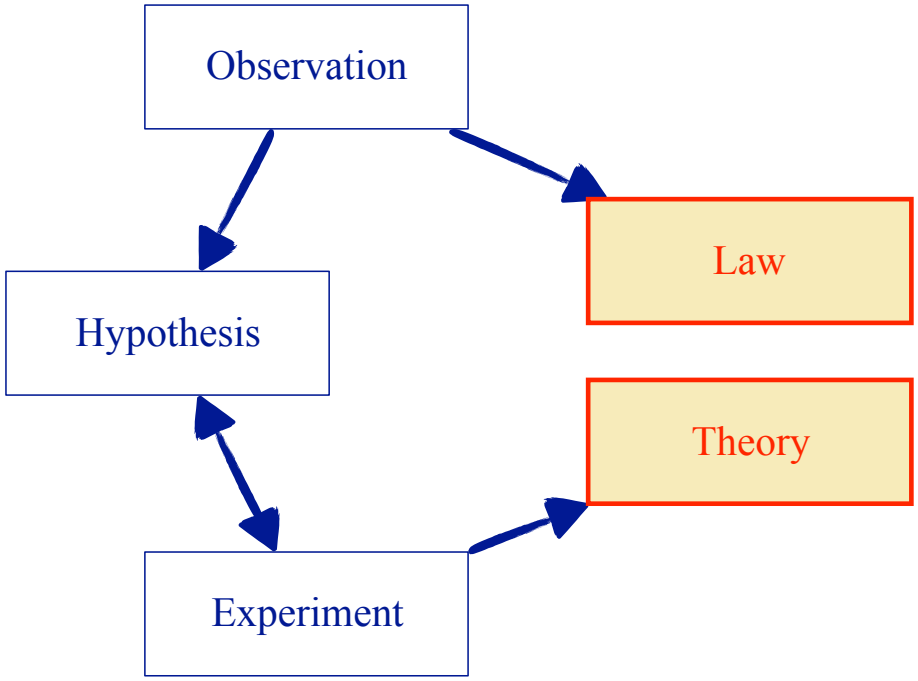
Law

Theory



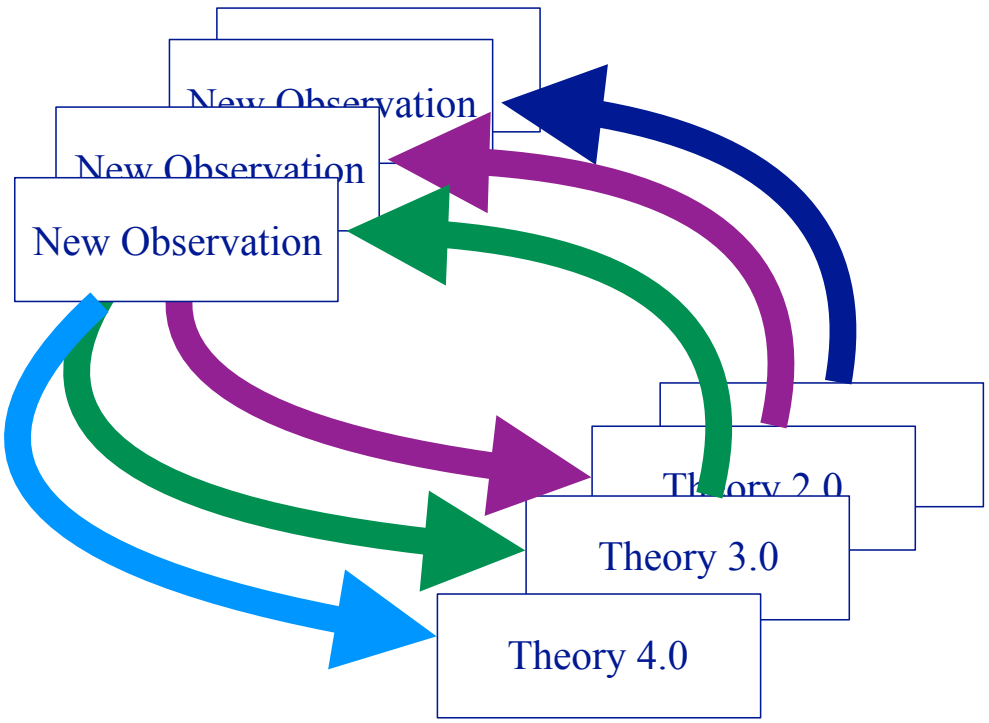
Scientific Method is a process.

- 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.



True or False?

What's the difference between a hypothesis and a theory?

Trust. A theory is a hypothesis we've decided to trust.

What's the difference between an observation and a law?

Frequency. An observation is something we've seen once, a law summarizes all the observations that have ever occurred.

What's the difference between an observation and and a hypothesis?

What's the difference between a law and a theory?

Explanation. Hypothesis and theories attempt to tell us why, laws and observations just say what we've seen.

True and False:

Observations are facts/truths. ✓

Interpreted observation are hypothesis. ✓

A hypothesis is a fact/truth. ✗

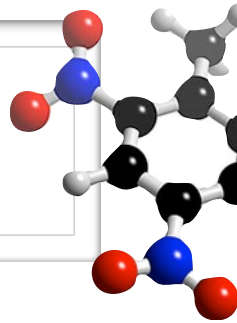
A proven hypothesis is a theory. ✗

An established theory is a fact/truth. ✗

A proven theory is a law. ✗

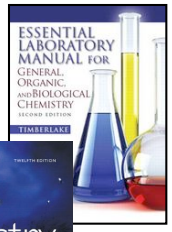
A law is a fact/truth. ✓

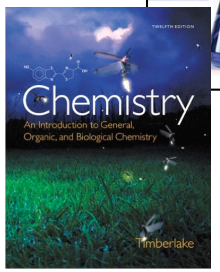
Class Introduction



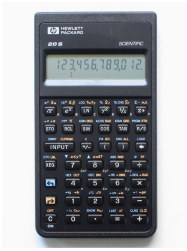
- Are you in the right room?
- Instructor

- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials

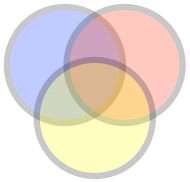




- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources



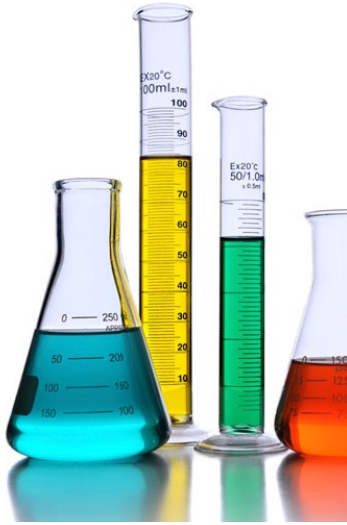
- Knowledge



  - Imagination
  - Truth & Belief
  - Justification

- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation

- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.



Getting Started

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

— Webster

Getting Started

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

— Webster

Chemistry Defined

The science of matter.

What is Matter?

Matter is anything that has mass and occupies space.

Wood

Sunlight

Heat

Air

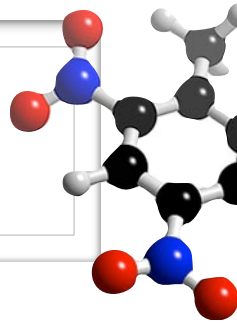
Water

Electricity

People

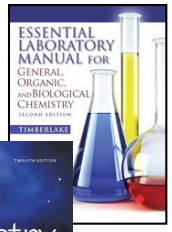
Salt

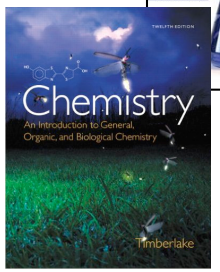
Class Introduction



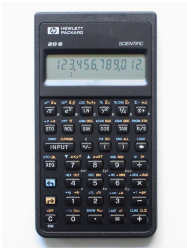
- Are you in the right room?
- Instructor

- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials

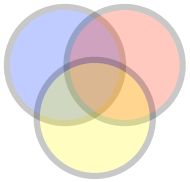




- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources

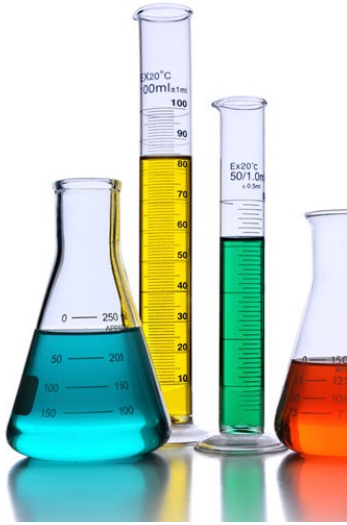


- Knowledge
  - Imagination
  - Truth & Belief
  - Justification



- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation

- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.



Chemistry Defined

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

— Webster

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."

— Webster

What makes it unique?

How do you change it?

How do we answer these questions?

How do clocks work?

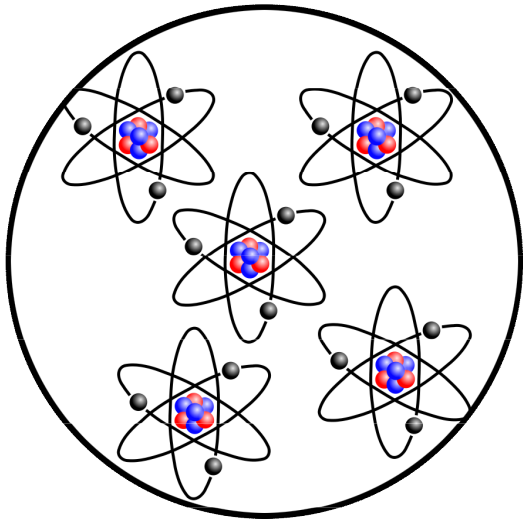
What is it made of?

How do the pieces fit together?

What makes it unique?

How do you change it?

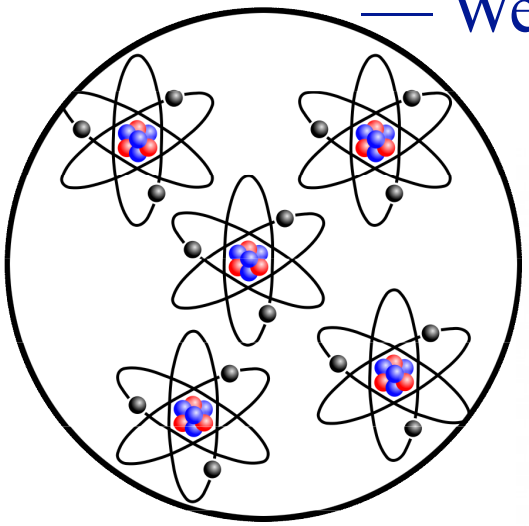
How do rocks work?



Chemistry Defined

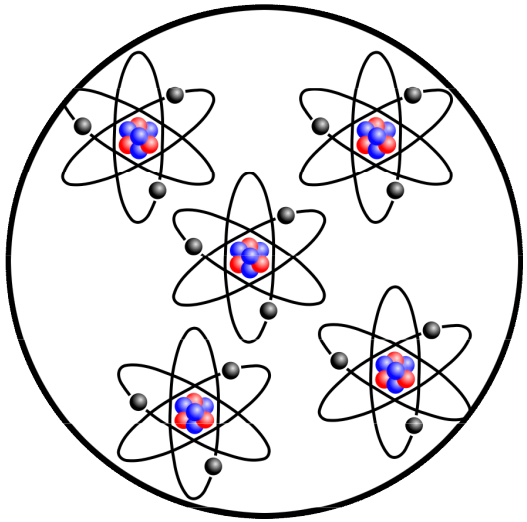
"The science of the composition, structure, properties and reactions of matter, especially of atomic and molecular systems."

— Webster

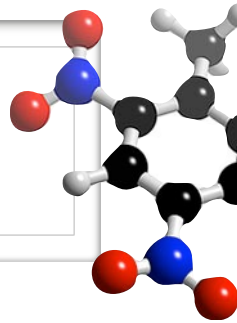


Chemistry predicts & explains matter.

- 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.

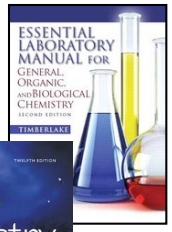


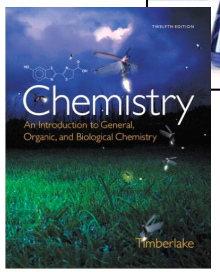
Class Introduction



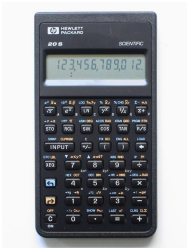
- Are you in the right room?
- Instructor

- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials

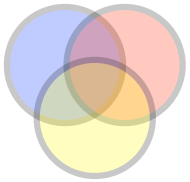




- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources



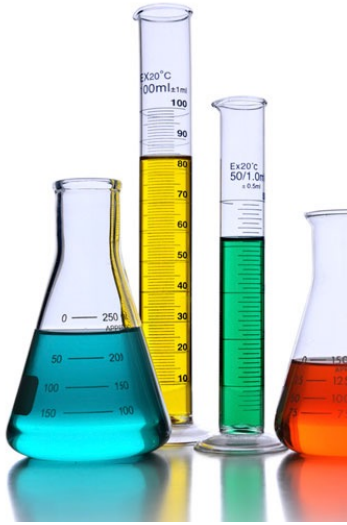
- Knowledge



  - Imagination
  - Truth & Belief
  - Justification

- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation

- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.



This semester we will discuss...

1. Chemistry Defined
   — the science of matter.
2. Measurement
   — the edge of knowledge.
3. Matter & Energy
   — differences in substances.

Exam #1

4. Atoms & the Elements
   — flavors of the atom.
6. Compounds & Molecules
   — complex particles.

Exam #2

7. Reactivity & Stoichiometry
   — transmutation & "how much".
8. Chemistry in the Gas State
   — chemistry taught man to fly.
9. Solutions
   — electrolytes & concentration.

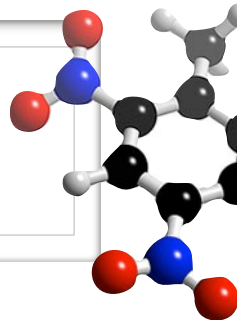
Exam #3

10. Acids & Bases
    — moving raw protons.
5. Radioactivity
   — radiation & nuclear reactions.

Final Exam

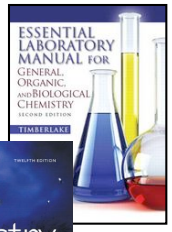
The final is cumulative!

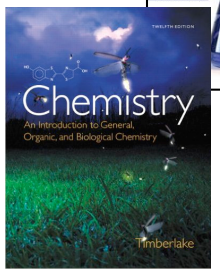
Class Introduction



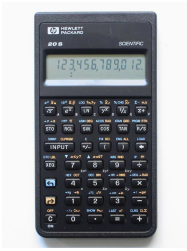
- Are you in the right room?
- Instructor

- Requirements
  - Pre-req's
  - Schedule
    - Dates & Times
  - Materials

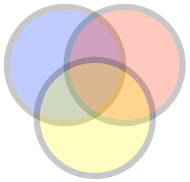




- Evaluation (Grades)
  - Point Break Down
  - Grade Reports
    - Knowing how you're doing.
- Other Resources

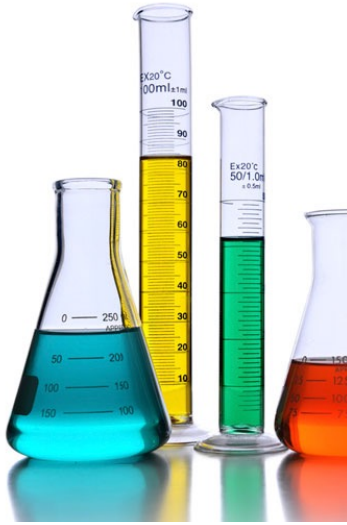


- Knowledge
  - Imagination
  - Truth & Belief
  - Justification



- Science
  - Purpose
  - Method
    - Observation & Hypothesis
    - Models
      - Theories & Laws
    - Experimentation

- Chemistry
  - The science of matter
    - Matter
  - From clocks to rocks
  - Overview of Topics
    - What this class offers.



Questions?