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# Chemistry is Hard

## Why?

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### Bloom's Taxonomy

- Psychologist who studied how people think
- Broke thinking into levels of complexity
- Each level required using the information below
- The lowest level is knowledge-memorizing textbook definitions
- Easiest but least useful

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### Bloom's Taxonomy

- Understanding- being able to put the knowledge into you own words
- Application- being able to use the information in new situations
- Analysis- breaking the information into meaningful pieces
- Synthesis- being able to put information together to generate new learning

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**Bloom's Taxonomy**

- Evaluation- using all the information, making and defending value judgments about the information.

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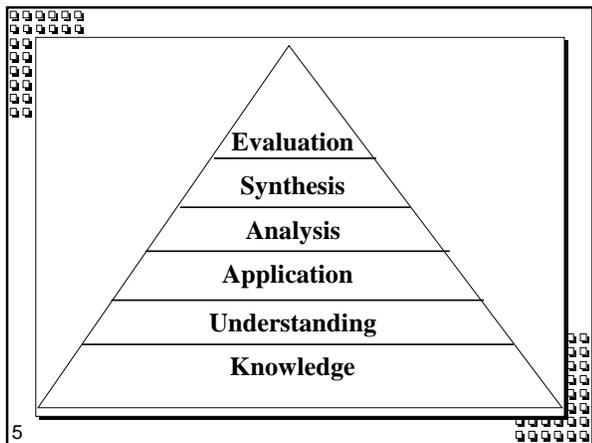
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**What does this have to do with chemistry?**

- In the past, many of your classes relied on memorization.
- Knowledge level
- Chemistry focuses on the higher levels.
- Chemistry doesn't ask you to memorize a lot of terms
- It asks you to learn processes and techniques and then apply them to novel situations

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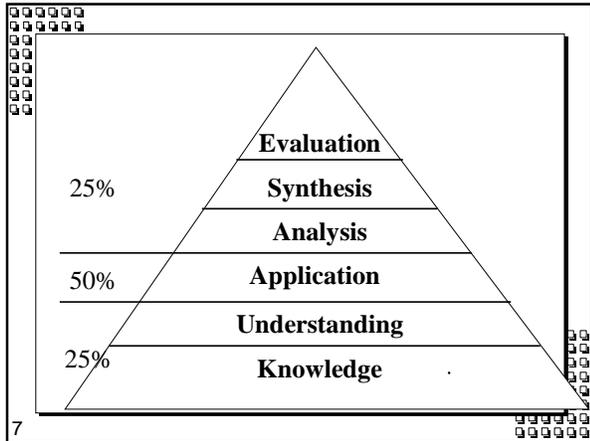
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### Word Clues

- How hard do I have to think?
- Knowledge
  - Who, what, where, when, tell, label, define, select, choose, identify, describe, recall
- Comprehension
  - Show, explain, discuss, classify, recognize, summarize, paraphrase

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### Word Clues

- Application
  - Use, solve, teach, relate, explain, predict, compute, illustrate, simulate, demonstrate
- Analysis
  - Probe, dissect, outline, compare, organize, diagram, distinguish, investigate, categorize

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**Word Clues**

- Synthesis
  - Plan, make, invent, develop, design, propose, predict, assemble, formulate, hypothesize
- Evaluation
  - Rate, judge, revise, critique, defend, justify, assess, contrast, support, recommend, conclude, interpret

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**Chapter 1**

Introduction to Chemistry

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**What is Chemistry?**

- The study of the matter, its composition, properties, and the changes it undergoes.
- Pure chemistry gathers knowledge for knowledge's sake
- Applied chemistry is the using chemistry to attain certain goals, in fields like medicine, agriculture, and manufacturing

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**Compare**

- Pure Chemistry
  - Usually comes first, applied later
  - Pure chemistry can explain behavior that has been used without knowing why
    - » i.e. Steel swords
  - Can't be good or bad
- Applied Chemistry
  - Called technology
  - Or engineering
  - Can be good or bad depending on use

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**Branches of Chemistry**

- Analytical Chemistry -studies composition of substances.
- Organic Chemistry -compounds containing carbon
- Inorganic Chemistry -substances without carbon
- Biochemistry- Chemistry of living things
- Physical Chemistry studies behavior of substances
  - rates and mechanisms of reactions
  - energy transfers

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**Why study Chemistry?**

- Explain the natural world
  - Why?
- Prepare for a career
  - Directly- in a lab
  - Indirectly- problem solving and thinking skills
- Be an informed citizen
  - Vote
  - Don't get scammed

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**Applied Chemistry**

- Material Design
  - Plastics
  - Paints
  - Nanotechnology
- Scale
  - Macroscopic- Big enough to see
  - Microscopic- Too small to see unaided
  - Nanotechnology- manipulating individual atoms and molecules

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**Applied Chemistry**

- Energy
  - Ability to do work
- Different types can be converted to each other
- Conservation
  - More efficient conversion
  - Insulation
- Production –new sources
- Storage- batteries, fuel cells

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**Applied Chemistry**

- Agriculture
  - Production- fertilizers, soil tests
  - Protection – pesticide, herbicide
- Medicine
  - Drugs
  - Materials- hips, artificial skin
  - Biotechnology- using organisms as a means of production

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**Applied Chemistry**

- Environment- Pollution
  - Eliminate sources
  - Treatment once polluted
- Astronomy
  - Remote analysis of stars from their light
  - Analysis of extraterrestrial samples

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**Alchemy**

- Forerunner of chemistry
- Mystical- search for perfection
- Practical- developed glassware and techniques used today
- Tried to change elements
- Faulty assumptions and lack of logic led them astray

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**Scientific Method**

- A way of solving problems or answering questions.
- Starts with observation- noting and recording facts
- Hypothesis- a possible explanation as to the cause of the observation, based on research and previous knowledge

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### Scientific Method

- Experiment- designed to test the hypothesis
- only two possible answers
  - hypothesis is right
  - hypothesis is wrong
- Generates data -observations from experiments.
- Modify hypothesis - repeat the cycle

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### Variables

- Controlled experiment- Only want one thing to change at a time in a laboratory.
- Manipulated variable- What you change or control directly
- Also called independent variable
- Responding variable – What changes as a result. No direct control
- Also called dependent variable

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graph TD
    A[Observations] --> B[Hypothesis]
    B --> C[Experiment]
    C --> A
  
```

- Cycle repeats many times.
- By you and by others
- The hypothesis gets more and more certain.
- Becomes a theory
- A thoroughly tested model that explains why things behave a certain way.

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- Theory can never be proven.
- It is the best explanation
- Useful because they predict behavior
- Help us form mental pictures of processes (models)

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- Another outcome is that certain behavior is repeated many times
- Scientific Law is developed
- Description of how things behave
- Measurable
- Usually an equation
- Law - how
- Theory- why

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## Communication

- Use Journals
  - Do research
  - Write article
    - » Describe procedures, methods, and findings
  - Submit for peer review
    - » Sent back for editing
  - Publish
    - » Letters to editor respond.



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## Collaboration

- Working together
- Teams
  - Different skills
  - Different specialties
- Internet and Email
- Conferences

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## Problem Solving

- Only way to get good is to practice
- Two parts
  - Developing Plan-
    - » Hard part
    - » Higher level thinking
  - Implementing Plan-
    - » Not so hard
    - » Application level

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**Solving Numeric Problems**

- Three steps-
  1. Analyze
    - A. Known
      - Numbers
      - Measurements
      - Equations
    - B. Unknown
      - What are you looking for?
      - What units?

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**Solving Numeric Problems**

- Three steps-
  1. Analyze
    - C. Plan
      - The heart of problem solving
      - Diagram
      - Look up info
        - Table
        - Graph
        - Equation

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**Solving Numeric Problems**

- Three steps-
  1. Analyze
  2. Calculate
    - » Easiest part
    - » Convert measurements
    - » Rearrange
    - » Appendix C

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**Solving Numeric Problems**

- Three steps-
  1. Analyze
  2. Calculate
  3. Evaluate
    - » Reasonable?
    - » Read the question, did you answer it?
    - » Check your work
    - » Estimate

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**Practice**

- What is the length, in centimeters, of a 10.0-inch ruler, given that there are 2.54 centimeters per inch?

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**Practice**

- A certain ball when dropped from any height, bounces one-half the original height. If the ball was dropped from a height of 60 in. and allowed to bounce freely, what is the total distance the ball has traveled when it hits the ground for the third time? Assume the ball bounces straight up and down.

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### Conceptual Problems

- Without numbers or math
- Two steps
  1. Analyze
    - » Identify known and unknown
    - » Plan
  2. Solve

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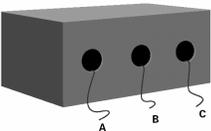
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### Practice

➤ You find a sealed box with strings protruding from three holes, as shown in the diagram.



When you tug string A, it becomes longer and string C becomes shorter. When you tug string B, it becomes longer, but strings A and C are not affected. Make a diagram showing the arrangement of the strings inside the box.

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### What is Matter?

- Matter is anything that takes up space and has mass.
- Mass is the amount of matter in an object.
- Mass is resistance to change in motion along a smooth and level surface.

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### Types of Matter

- Substance- a particular kind of matter - pure
- Mixture- more than one kind of matter

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### Properties

- Words that describe matter (adjectives)
- Physical Properties- a property that can be observed and measured without changing the substance.
- Examples?
- Chemical Properties- a property that can only be observed by changing the type of substance.
- Examples?
- Used to identify a substance

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