# Quantitative and Scientific Approaches

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# Manipulating Powers of 10

- A) (10^-4)(10^12)=
- B) 1/10^7=
- C) 1/10^-7=
- D) 10^-6 + 10^-7=
- E) 10^5 x 0.01=
- F) 10^-5 x (1000)=
- G) 10^-7 x 10^7=
- H) 10^12 x 10^20=
- I) (10^-12)(10^12)=
- J) How many milliliters are in 1000 cubic meters? Derive and explain or response is meaningless.

# Linear Dimension to Volume

How many ml. in 1000 meters$^3$

Steps:

10m x 10m x 10m =

1000 cm x 1000 cm x 1000 cm =

_____ cm x _____ cm x _____ cm =

_____ cm$^3$

# More Terms of Scientific Discourse

- Inference
- Induction
- Fact
- Law
- Theory

# Continued…

- Inference-a conclusion based on something known or assumed; no experiment performed; just observation.
- Induction-reasoning from particular facts or observations to a general conclusion.
- Fact, law, theory: Are they the same?
- Fact-refers to something observed many times then stated as being true; fact not as strong as theories.
- Law-tells what happened but not why; articulates an observation
- Theory-a formulation of underlying principles of observed phenomena which has been **verified** to some degree. Theories are more reliable and more rigorous than facts. Evolution is a theory. Theories are tested.

# Background on Redi-Spallanzani: Medieval Italy

- Limited understanding of natural world.
- Spread of disease common. Redi was a native of Tuscany.
- Redi's work questioned prevailing (medieval) notion that life could come from non-life.
- What are maggots? (_____) Life is not just from life… the process is species-specific.
- Redi do not prove or disprove but in fact refuted s.g.
- Redi-Spallanzani and Pasteur contributed to understanding life's origins.
- Pasteurization is a sterilization technique modeled after Pasteur's work. The break neck flask alone didn't refute s.g.

# 3 Goals for Redi's hypothesis:

- To understand the origin of life
- To refute s.g.
- To provide the beginning of a study of cause and effect.
- Of these three goals, which was best accomplished?
  - Refutation of s.g.

# Experimental setup and execution for Redi-Spallanzani

- Remember **positive control** tells you if system will allow a positive result.
- Remember **negative control** tells you that nothing in system is giving a false positive or "noise".
- Controls/**controlled elements** were time (duration), temp (same), and place (both jars, same type).
- Variable was the presence of a gauze cover on the jar to keep flies away (why gauze?_____)
- Relationships: This is weird logic, but the absence of a cover was essentially a **positive control situation**. This is meant to generate the original observation/recap the event. The presence of a cover was considered the **experimental situation**/new condition/designed to generate new outcome.
- Note that the covered jar could have been a negative control situation if other conditions were being tested. These considerations are **RELATIVE**.

# Findings

- This was an excellent falsification or negative experiment.  It was not a good positive experiment.
- The setup said what was not going on, but not what was going on.
- What is not going on:
  - Meat does not make flies.
- What is going on?
  - Not enough evidence to say flies make flies.

# Long term implications

- Years of work were needed to establish and refine the idea of life from life. Key factors:
  - Species specificity
  - Isolation
- Microbes are used as “model” organisms today.
- Key work led to the isolation of microbes.
- This led to the development of effective vaccines, reducing the spread of illness.
- Previously you would get sick, then die or get better.
- Now, we either prevent or treat illness, reducing mortality and morbidity.
- Immunity still plays a key role, but many years ago, immunity was the only protection against serious illness.

# Key scientists and ideas, hw errors

- Scientists: Spallanzani, Pasteur, Balard, Koch
- Idea(s): Isolation of life from life. Show **ORIGIN**.
- HW: Missing ideas about life:
  - Isolate and track origins; establish origins of life.
  - Address species specificity.
  - Pasteur experiment not enough by itself to address species specificity or precise origin (not DUST).