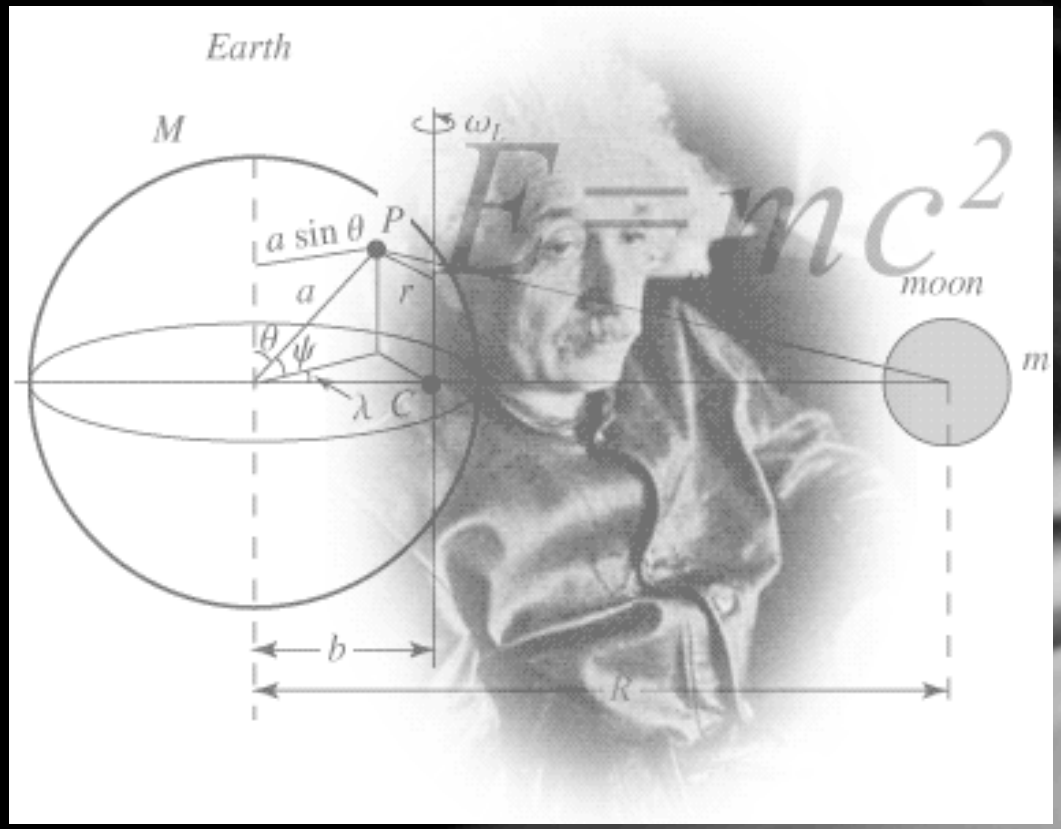


Unit 1: Section 1
Physics: The Science of Energy

We can’t control Earth’s motion, but we have learned the rules by which it moves.

The study of nature’s rules is what this course is about.

Understanding these rules will add to the way we see our world!!!

2 Ways Science Expands Knowledge:

1. Science (Research)
2. Technology / Engineering (Development)

Science (Research) is:

The search for relationships that explains and predict natural phenomena.

The Three Skills Scientists Use to Acquire Knowledge:

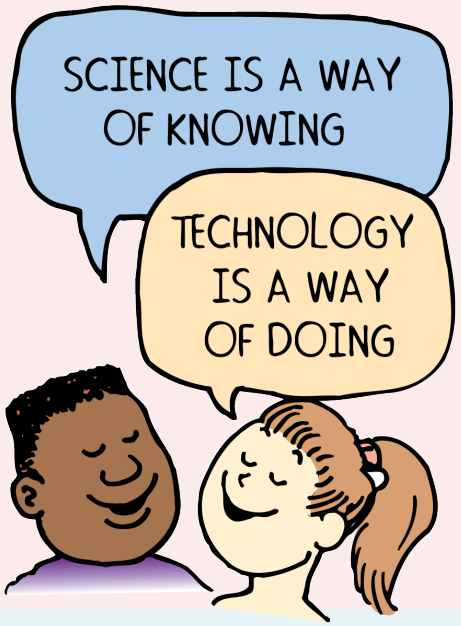
1.) Observation
2.) Measurement
3.) Experimentation

Technology/Engineering is:

The practical application and development of knowledge to everyday needs.

Examples:

1. **Computer - Records data (Electrical)**
2. **Eye glasses – Contacts (Light)**
3. **Cars / Planes (Mechanical)**
4. **Tools (Mechanical)**
5. **Thermometer (Heat)**

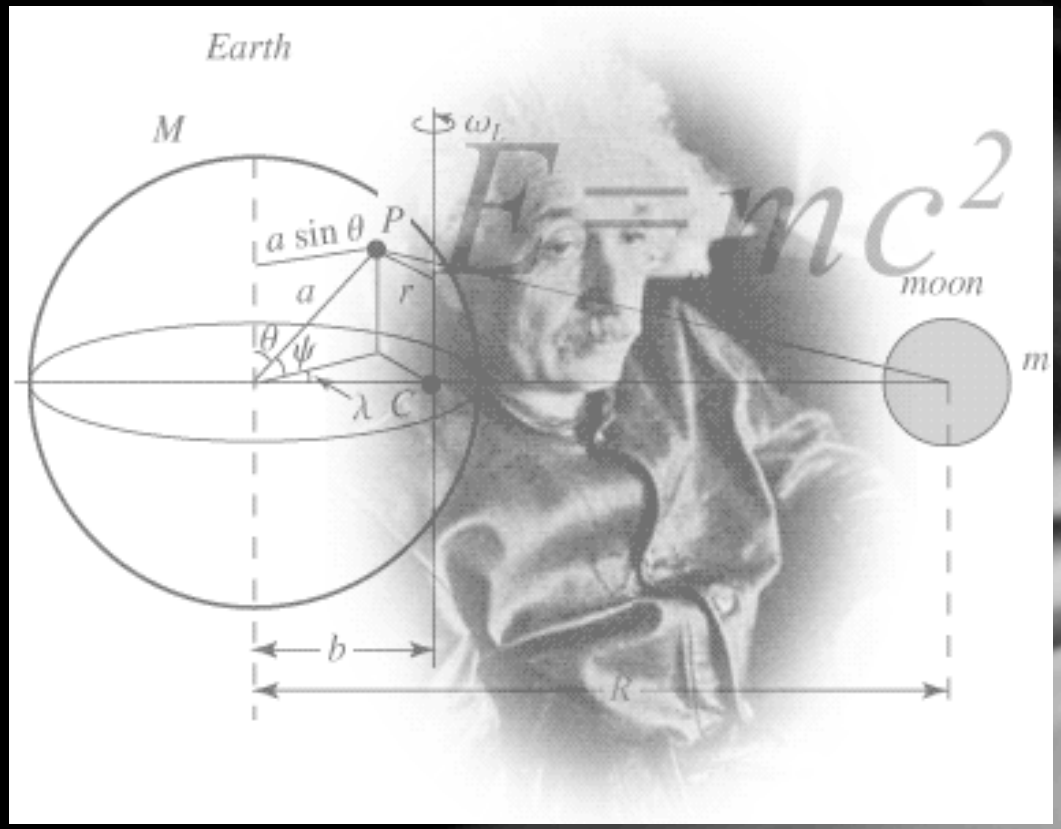


CONCEPT CHECK

What is the difference between science and technology?

Science is the search for relationships that explains and predict natural phenomena.

Technology is the practical application and development of knowledge to everyday needs.



Scientific Laws and Theories

Scientific Law (Principle):

A statement that describes the relationship between various phenomena. (Describes behavior)

1. **A scientific law may be stated in words. However, in physics a law is usually expressed by a mathematical equation**

   Examples:

   1. **Ohm's Law ($V = I \cdot R$)**
   2. **Boyle's Law ($p \cdot V = k$)**
   3. **Newton's Law of Motion**

2. **Cannot be absolutely proven but not disproven.**

Theory:

A reasonable explanation of observed events that are related.

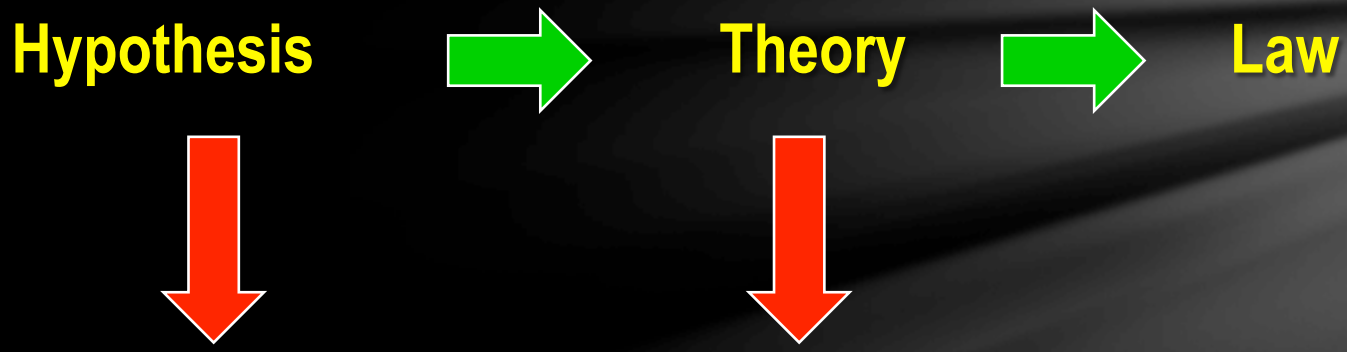
1. **Often Involves a Model**
2. **Cannot be Proven but has "Stood the Test of Time"**

Examples:

a. **Behavior of Animals**
b. **Atomic Structure**
c. **Einstein's Relativity**
d. **Newton's Gravitational Law**

Hypothesis:

An educated guess to the solution of a problem. These guesses are based on observations and can be tested.



If at anytime becomes disproven; disregard and create new hypothesis

The Scientific Method

The Scientific Method:

This is a "blueprint" of all science experiments. It is the procedure and pattern of reasoning by which we gain knowledge.

Steps to the Scientific Method:

1. State the Problem
2. Make Observations
3. Form a Hypothesis
4. Test the Hypothesis
5. Collect and Record Data
6. State a Conclusion
7. Repeat the Process

Step #1: Stating the Problem

- Identify the problem to be solved
- Start by asking a question
- Maybe the most important step

Step #2: Make Observations

- Observation: Perceiving objects or events through 1 of your 5 senses.
- Using your senses to observe: sight, sound, touch, taste, and smell.
- Observations can include taking measurements and calculations.

Observations – Sampling

- **Sampling:** Having a small group represents the whole.
- To be useful the sample must be large and random.
- What happens if the sample is too small?
- What happens if the sample is not random?

Step #3: Forming a Hypothesis

- Hypothesis: Educated guess, based on observations, can be tested.
- Prediction: Statement made in advance that states what will be obtained by testing your hypothesis.
- "If - Then" statement

Step #4: Testing the Hypothesis

A hypothesis is often tested by an **experiment**

Step #4: Testing the Hypothesis

Control Group:

The group you use as a **standard**. (You use this group to compare to the experimental group.)

Independent Variable:

The variable that causes **change** from group to group

- *Manipulated Variable (What we change)*

Dependent Variable:

The variable that changes **in response** to the independent variable

- *Responding Variable (What will change)*

Thinker!

Which of these is a scientific hypothesis and why?

a. **Atoms are the smallest particles of matter.**
b. **The universe is surrounded by a second universe, the existence of which cannot be detected by scientists.**
c. **Albert Einstein was the greatest physicist of the 1900s.**

Answer:

- ***Is scientific, because there is a test for its wrongness.***
- ***Has no test for possible wrongness and is therefore unscientific.***
- ***Is an assertion that has no test for possible wrongness.***

CONCEPT CHECK

How do you know if a hypothesis is scientific?

Step #5 - Collecting Data

- **Data**: Any information collected by **scientists**.
- Collecting and organizing data is the **longest and most tedious** phase of the scientific method.
- Charts, data tables, and graphs can help **visualize** information.

Step #6 - Stating a Conclusion

- **Modeling: Explanation** supported by data (visual, verbal, or mathematical)
- **Inference:** Conclusion based on **facts**, not direct **observation**.
- If hypothesis is **not true**, revise hypothesis and **repeat** process.

- ✓ *Was your hypothesis correct? If not, why not?*
- ✓ *What would you do differently next time?*
- ✓ *Do not worry about "negative results" or results that came out differently than you expected. Why do you think you got them?*

Step #7 - Repeat the Process

- Hypothesis must be tested **many times**.
- The experiment must be conducted in the **same way** each time.

Validity of Scientific Solutions is limited by:

1. Our knowledge and understanding
2. Our methods, techniques, procedures
3. Our apparatus and instruments

Everyday Example:

Here is another example of the Scientific Method:

Question: What is wrong; why is the Slip-n-Slide not working?
Observation: The Slip-n-Slide in the backyard is not squirting out water after someone turned on the hose.
Hypothesis: It is suspect that the spigot on the hose is not turned on or not turned on far enough to send water to the Slip-n-Slide. In previous experience, this has happened before.
Prediction: If the spigot is turned on, the water will start coming out and filling the Slip-n-Slide.
Test/Experiment: Turning on the spigot, only to find out it was already turned on as far as it would go.

Data doesn't not support the original hypothesis. Therefore there is no conclusion yet…What should they do?

Everyday Example:

Scientific Method	Car Repair
Step #1 / #2 (Problem / Observation)	Engine won't turn over.
Step #3 (Hypothesis)	Predict battery is dead. If I replace the battery, then my car will start
Step #4 (Test Hypothesis)	Replace battery.
Step #5 (Collect Data)	Engine now starts.
Revise hypothesis?	Not needed, original hypothesis confirmed
New test?	Not needed.
Step #6 (Conclusion)	Cars won't work without a fully charged battery.

1.1 Assessment

Question #1

When someone says, "That's only a theory," that person likely doesn't know that a scientific theory is a(n):

a. guess that involves a bunch of facts.
b. type of hypothesis.
c. vast synthesis of well-tested hypotheses and facts.
d. untested explanation.

1.1 Assessment

Question #2

For a hypothesis to be scientific, it must:

a. be in agreement with what we know is true.
b. have a test for proving it right.
c. have a test for proving it wrong.
d. be based on an existing scientific theory.

1.1 Assessment

Question #3

Technology is a:

a. body of scientific knowledge.
b. tool of science.
c. form of science.
d. solution to all of humankind's problems.