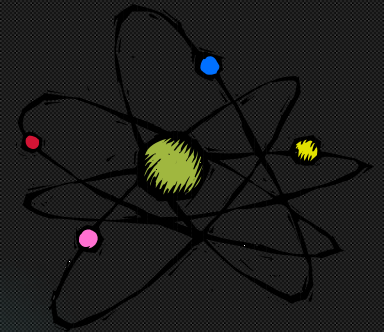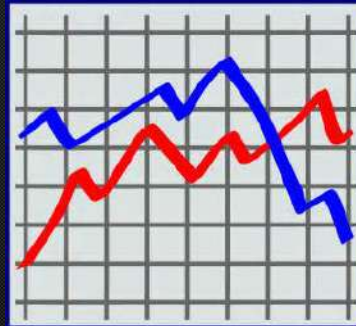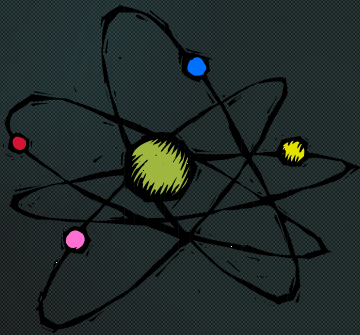# ACT Preparation for Science Reasoning

## C. RAY- ACT PREP

# Science Reasoning

Don't let it SCARE you.....

You don't need to know very much information about the topics which includes Biology, Chemistry, Physics, Meteorology, Geology, and Astronomy.

You need to FOCUS on reading Carefully and Thinking Logically.

Everything you need to know in order to answer the questions will be given to you in the passages.

# Science Reasoning

► Is **not** testing knowledge of scientific facts

► Is testing your ability to solve puzzles, read graphs and charts, draw conclusions and inferences by working with facts, evidence, and data.
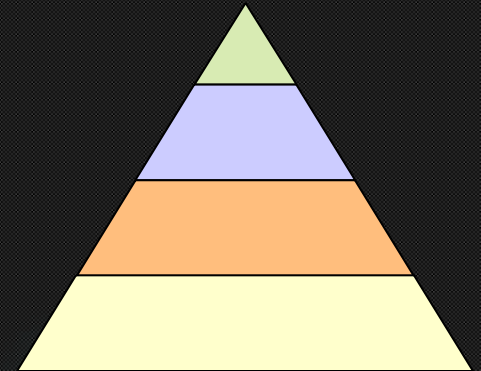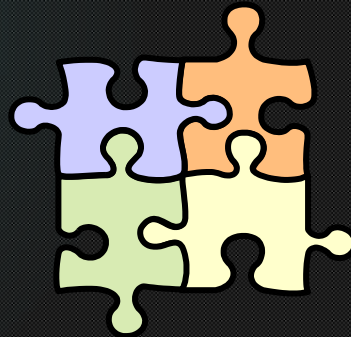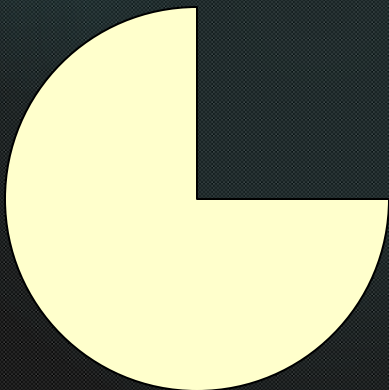
# Science Reasoning

40
Multiple Choice Questions divided Into 7 passages

2 or 3
Data Representation

3 or 4
Research Summaries

1
Conflicting Viewpoint

# Science Reasoning

Three types of questions:
- **Understanding**: tests your ability to know what the passage is saying
- **Analysis**: asks you to find the deeper meanings in the passage
- **Generalization**: Inferences

# Science Reasoning

|  | Data representation | Research Summaries | Conflicting Hypotheses |
|---|---|---|---|
| Understanding (about 2 questions) | Knowing the variables and their values | Identify the problem and the data | Knowing the points at issue |
| Analysis (about 3 questions) | How they relate and what is implied by relationship | Conclude from data compared to controls | Does arguments agree with facts |
| Generalization | Suggests further study from data | How results impact society | What study implies for others not in study |

# You have 35 minutes

- To read 7 passages, look at charts and graphs, and answer 40 questions…..

- That is 5 minutes per passage and obviously less than a minute per question..

HOW??

# Test Taking Strategies

1. **Start by scanning the passage.** This should take no more than 20 seconds. Just get a "rough" idea of what it is about. Do not study DETAILS. Look for the MAIN message of the graph/ chart.

2. **Read the passage again in order to really understand it.** Underline any key words.

# Test Taking Strategies

3. Answer the first question in the group. It is an understanding question (the simplest of the 3 types).

If you can't answer it, you'll probably miss the rest too. Look back in the passage to find the answer.

If you still can't answer it, skip to the next passage and come back to this

one later.

# Test Taking Strategies
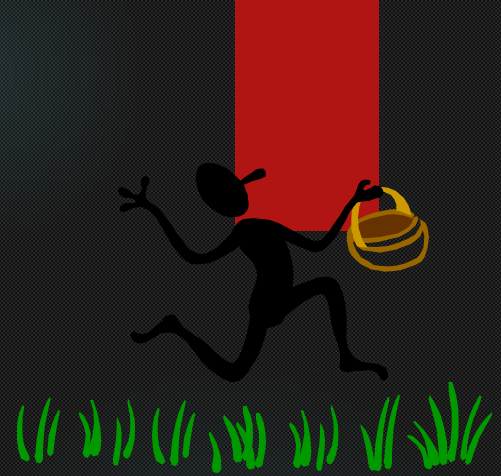
**4.     Skip the hard questions.**

After you have answered the first question.

Do not spend more than 30 seconds on any question.

Every question is worth the same number of points….go for the easy ones first…

BUT…never leave a question blank even if you take a guess

# Test Taking Strategies

## 5. Read all the choices.

Choosing the right answer is eliminating the three wrong answers..

Process of elimination (P.O.E.)- cross off incorrect answers as you go; this will decrease the number of choices when you aren't sure of the answer

# Test Taking Strategies

**6. Use Estimation when asked to calculate. You can also use process of elimination.**
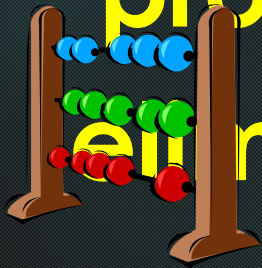
# Test Taking Strategies

## 7. Pace yourself.

35 minutes for

7 passages

5 minutes per passage

You have about 30 seconds for each question.

# Test Taking Strategies

## 8.  Answer every question.

When you answer the easy questions, try the hard ones again without spending too much time.

When your time is running out with only a 30 seconds or so left, take a random guess on the answer sheet.

# Difficulty of the questions

For each passage, after you have scanned and then read it….answer the first one. If it is too hard even after looking for the answer, skip to the next passage.

When you answer the first question, read through all of the questions answering the easiest "understanding" questions first.

# Difficulty of the questions

- **Never** leave a question **blank** before you move on to the next passage

- **There is no penalty for guessing**

- It is difficult to come back to a question once you start a new passage because you'll need to reacquaint yourself with the passage. It is better to at least take a guess the first time through.

# Data Representation

▶ **Includes information (data) presented on some sort of chart or graph**

▶ **You will analyze the data**

**in order to answer the questions.**

▶ **You must understand what the variables are.**

▶ **Pay attention to chart notes, which will provide essential information that you need to interpret the data in the chart or graph.**
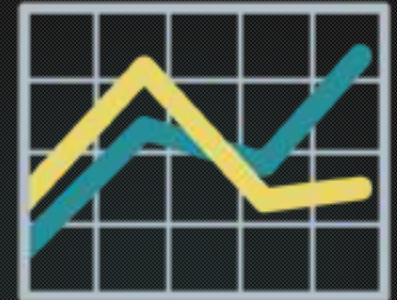
# Data Representation

A little background knowledge

will be helpful here.
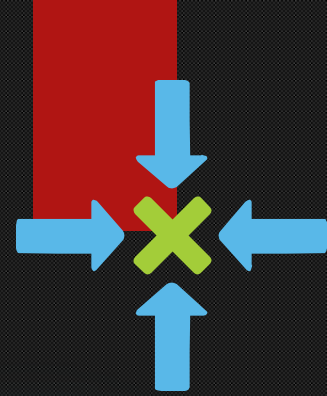
**Variable** – what changes in an experiment

**Independent variable** – what the experiment is changing

**Dependent variable** – the change being measured as the independent variable changes

# Data Representation

Line graphs show how something changes (usually over time)

Useful for identifying increases or decreases in data

Look for main
 message of graph

Watch for changes
 over time.

Be aware of the relationship between the variables.

## Number of Common Dolphins seen in Santa Barbara Channel from 1996-2001

A line graph plotting Number of Individuals against Year. Values approximately: 1996 ~1700, 1997 ~7400, 1998 ~4600, 1999 ~6300, 2000 ~4900, 2001 ~7600.
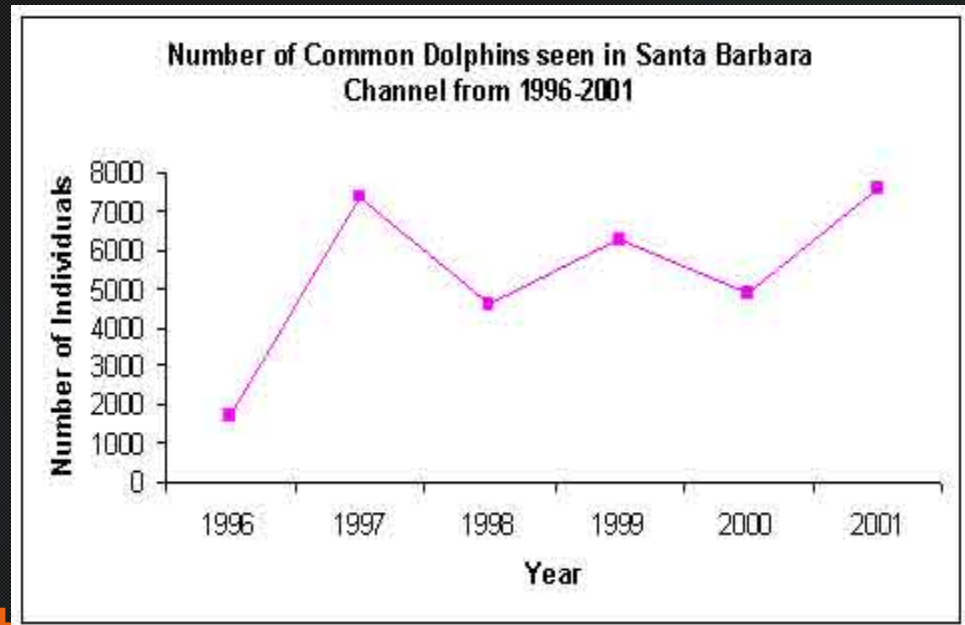
# Data Representation

**Bar graphs** – **used to show similarities and differences between data sets.**

**Can be set up horizontally or vertically**

**A scale is used to show comparisons**

**Look for main message**

**through the trend**

**in the graph**

# Data Representation

Tables – show exact values

Can be used to show quantitative(numbers) data
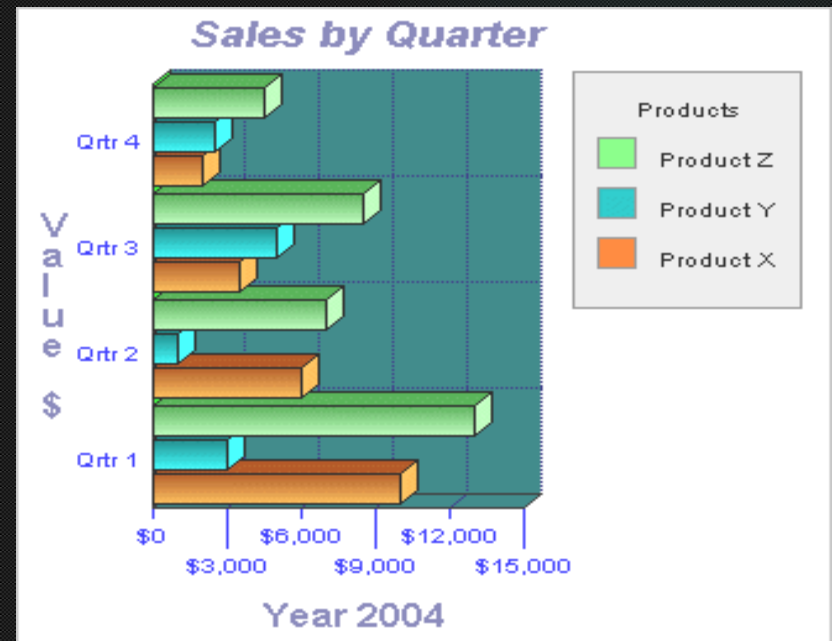
And Qualitative data such as characteristics

| Name | Thread pitch (mm) | Minor diameter tolerance | Nominal diameter (mm) | Head shape | Price for 50 screws | Available at factory outlet? | Number in stock | Flat or Phillips head? |
|------|------|------|------|------|------|------|------|------|
| M4 | 0.7 | 4g | 4 | Pan | $10.08 | Yes | 276 | Flat |
| M5 | 0.8 | 4g | 5 | Round | $13.89 | Yes | 183 | Both |
| M6 | 1 | 5g | 6 | Button | $10.42 | Yes | 1043 | Flat |
| M8 | 1.25 | 5g | 8 | Pan | $11.98 | No | 298 | Phillips |
| M10 | 1.5 | 6g | 10 | Round | $16.74 | Yes | 488 | Phillips |
| M12 | 1.75 | 7g | 12 | Pan | $18.26 | No | 998 | Flat |
| M14 | 2 | 7g | 14 | Round | $21.19 | No | 235 | Phillips |
| M16 | 2 | 8g | 16 | Button | $23.57 | Yes | 292 | Both |
| M18 | 2.1 | 8g | 18 | Button | $25.87 | No | 664 | Both |
| M20 | 2.4 | 8g | 20 | Pan | $29.09 | Yes | 486 | Both |
| M24 | 2.55 | 9g | 24 | Round | $33.01 | Yes | 982 | Phillips |
| M28 | 2.7 | 10g | 28 | Button | $35.66 | No | 1067 | Phillips |
| M36 | 3.2 | 12g | 36 | Pan | $41.32 | No | 434 | Both |
| M50 | 4.5 | 15g | 50 | Pan | $44.72 | No | 740 | Flat |

# Data Representation

Ask yourself these four questions:
1. What are the units of measure?
2. What are the values of the variables?
3. Are there any trends?
4. Are there any correlations?

# Data Representation

► Do you remember the metric system?

Kilo, hecta, Deka, base unit, deci, centi, milli

► Make sure you know what measurement the chart or graph is using…question may require you to convert.

► On a graph the x axis is usually the independent variable and the y axis is the dependent variable.

► Direct and indirect correlation?

► Inversely proportionate?

# Research Summaries

**Thinking like a scientist:**

Requires following a pattern of thinking called the scientific method. If you understand this method, you will have more success on the research summaries portion of the test.

There are no test questions **specific to the scientific method**, but having an understanding of the process will help you answer the questions correctly.
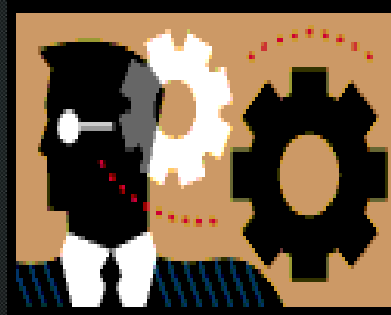
# Research Summaries

1. State the problem

2. Research (gather information)

3. Form a hypothesis (an educated guess)

4. Perform an experiment. (control and variable set up)

5. Record and analyze Data

6. State a conclusion. – does not always agree with hypothesis

7. Repeat the process.

# Research Summaries

▶ **Form a hypothesis** (an educated guess)
made before experiment is performed

▶ **Experiment** – must be at least 2 set ups:

Control – does not include what is being tested

Experimental – includes variable that is being tested

# Research Summaries

The results obtained from the experiment must prove or disprove the hypothesis.

**Rules for most experiments:**

1. Most experiments require a **control** group

2. An experiment should not test more than one **variable** at a time.

3. An experiment should be unbiased.

4. Only the data from the experiment should be used to make the conclusion.

# Research Summaries

What is a **control**?

Why must there be a control group?

What is a **variable**?

How many variables can be tested in an experiment?

# Research Summaries

What is a control? An individual or a group participating in an experiment under the same conditions as another group except for the exclusion of one factor

## Why must there be a control group?

To serve as the standard; to have something to compare the experimental group

# Research Summaries

What is a <u>variable</u>? The changes in an experiment; what is being tested.

<u>Independent</u> – causes another value or characteristic to change when it is changed

<u>Dependent</u> – the value that changes due to a change in the independent variable

How many variables can be tested in an experiment? One

# Research Summaries

**Hypothesis: Plants grow better in the dark.**

Control group:  plant in normal light conditions

Experimental group: everything about this setup the same as control except it is placed in the dark.

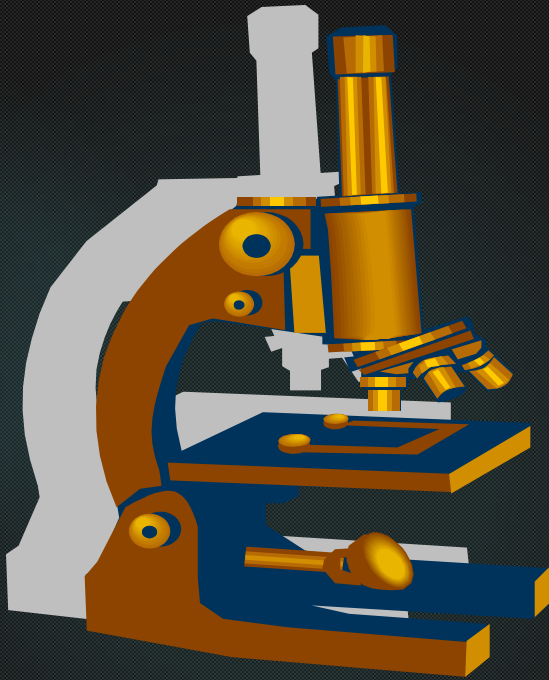The control group is needed to make the comparison.

What is the independent variable?

What is the dependent variable?

# Research Summaries

Let's practice determining independent and dependent variables.

# Research Summaries
# Understand the problem

Each description starts with a statement of what the experiment is designed to explore.

READ THIS STATEMENT CAREFULLY; Make sure you understand this statement.

# Research Summaries
# Understand the design

Study the design of the experiment.

Underline key words in the description.  If there isn't a diagram, sketch yourself one.

**Two experimental designs:**

1. **Research of some aspect of natural world – making measurements of some kind; relationship between variables; You should identify the variables.**

Example: global warming and effect on polar ice

(temperature vs

rate of melting)
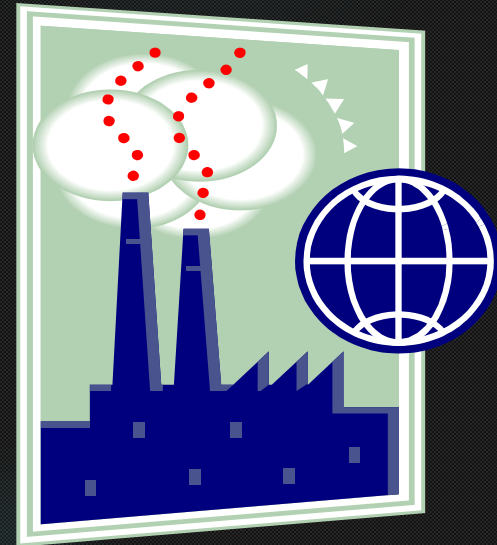
**2.** **Experiments in which the independent variable is being controlled or adjusted, which will make the dependent variable change.**

**You must**

**understand the variables.**

# Research Summaries

Understand the controls:

Precautions taken to eliminate all variables except the independent variable….

Plants must have identical soil, air, water…..

Must be genetically identical, etc

# Research Summaries

**Study the results-**

**May be presented in words, a diagram, or in some form of a data table (independent variable on left, dependent variable on right)**
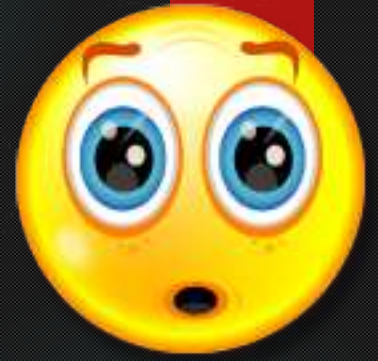
**Look for trends....**

# Research Summaries

Look for flaws such as:

Are the controls adequate?

Is the conclusion obvious by looking at the data?

Are there errors in the experiment?

# 35
# MINUTES
## which is 5 minutes per passage
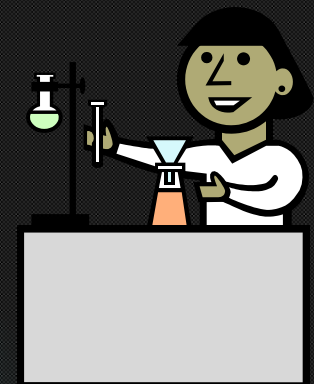
# Conflicting Viewpoints

Science ideas and theories are incomplete and are constantly being modified…..

Therefore, there are

disagreements, which lead to

**Research, investigations, and experimentation**.

Eventually, a consensus will be reached

due to the **data and evidence**
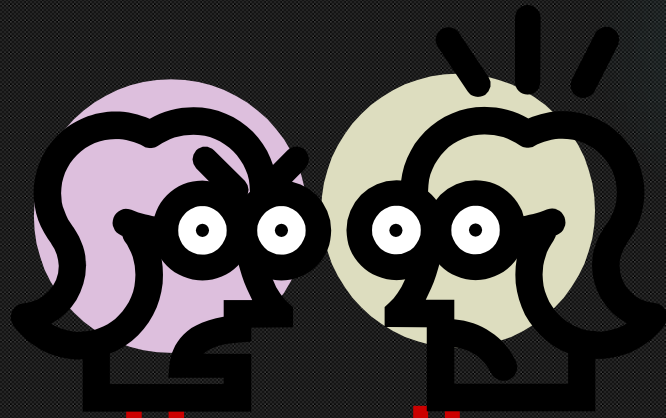
obtained through experimentation.

# **Conflicting Hypotheses**

This type of passage gives:

- ▶  a brief summary or description of the problem

- ▶ Explanations of the two conflicting viewpoints of the scientist

# Conflicting Hypotheses

This passage takes more time and should be **saved for last**.

Is usually the most difficult!

# Conflicting Hypotheses

Asks you to compare varied opinions about a scientific topic and to evaluate different hypotheses based on scientific data.

**Trying to decide which hypothesis is correct is a <span style="color:green">waste of time</span>.**

**The test does not ask you to choose the right one.**

# Conflicting Hypotheses

This passage discusses a scientific topic which is explained by more than one hypothesis.

The 2 hypotheses directly contradict each other.  However, they may have some similarities.

Never mix up the hypotheses.

They may have same assumptions and use the same data to support their claims.

# Conflicting Hypotheses

- Think like a scientist
- Must have a thorough understanding of the **scientific method**
- Avoid making unnecessary assumptions
- Read quickly and effectively as you go through the passage
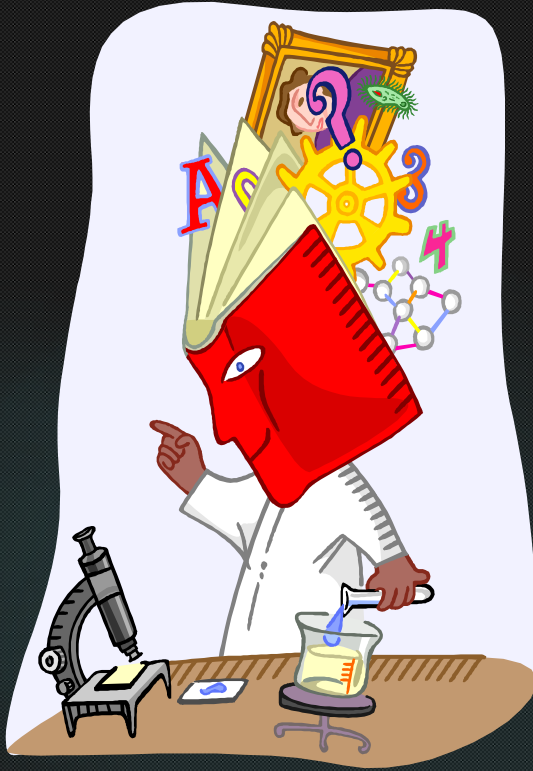
# Conflicting Hypotheses



▶ **Read the passage quickly**

▶ **Identify the basic disagreement.**

▶ **Think about these 6 questions:**
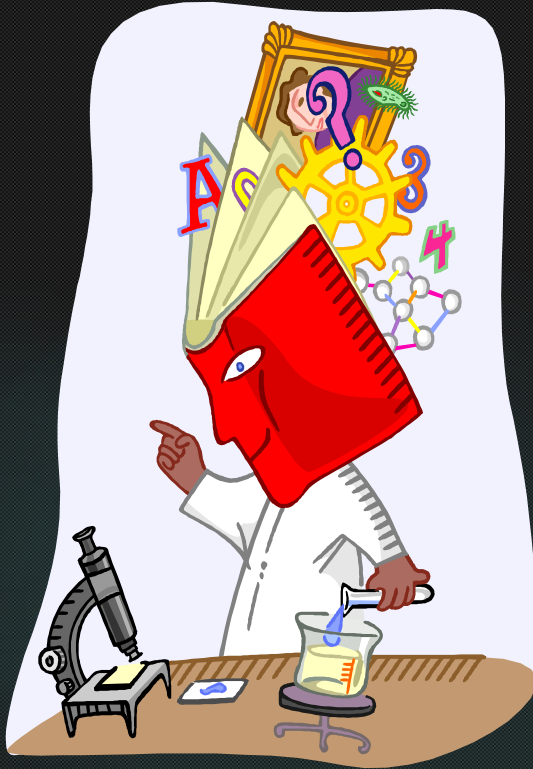
# Conflicting Hypotheses

▶ What is the **basic question** that is argued?

▶ What is the **position of each scientist**?

▶ What is the **evidence** of Scientist I?

▶ What is the **evidence** of Scientist 2?

▶ What **flaws** does Scientist 2

▶ find with Scientist 1?

▶ What **flaws** does Scientist 1

▶ find with Scientist 2?

# Conflicting Hypotheses

Usually 7 questions:

▶ Find similarities and differences

▶ What observations would support or refute each hypothesis

▶ You must understand what each hypothesis claims

# Conflicting Hypotheses

General guidelines:

- ► Identify the points where hypotheses agree and disagree
- ► Look for evidence that supports each hypothesis
- ► Think about what sort of new evidence would support or refute each hypothesis

## ►Save it for last.

# Conflicting Hypotheses
# Save it for last.

If you are running out of **time**, look for the questions about only one of the passages.

Such as:

"The position taken by Scientist 1 involves the assumption that:"

► **Make sure when you practice you read the directions carefully. The directions will not change on test day.**

► **Pace yourself.**

► **Know which technique works best for you…are charts easier than graphs?**

# Conflicting Scientists

- **ACT Science Mini Lesson #11-Conflicting Scientists Practice**

- *A greenish, potato-sized meteorite discovered in Antarctica is believed to have originated on Mars. Investigations of the meteorite have revealed a number of unusual features. Some scientists believe that these features are evidence of primitive life on Mars, while other scientists believe that they are more probably the result of nonbiological (nonliving) processes, such as hydrothermal synthesis.*

- **Hydrothermal Synthesis Hypothesis**

- This hypothesis states that the meteorite crystallized slowly from magma (molten rock) on Mars 4.5 million years ago. About half a million years later, the rock became fractured. This was a time when Mars was much warmer and had abundant water. Deep inside the planet, in a process called hydrothermal synthesis, hot water and carbon seeped into the fractured rock and formed new complex organic compounds called polycyclic aromatic hydrocarbons (PAHs). (Organic compounds, or those that contain carbon, are formed from life processes, such as bacterial decay, as well as processes that are not associated with life, including hydrothermal synthesis and star formation.)

- As the chemical environment of the planet changed over time, crystals of magnetite, iron sulfides, and carbonate formed in the rock. The crystallization of the carbonate resulted in the formation of unusual elongated and egg-shaped structures within the crystals.

- **Main Argument of Hypothesis #1** *Hot water and carbon seeped into the fractured rock and formed new organic compounds called (PAHs).*

- **Primitive Life Hypothesis**

- Proponents of this theory argue that the meteorite crystallized slowly from magma (molten rock) on Mars 4.5 million years ago. About half a million years later, the rock became fractured. At this time abundant water and a warm climate created the right conditions for life. The rock was immersed in water rich in carbon dioxide, which allowed carbon to collect inside the fractured rock, along with primitive bacteria. The bacteria began to manufacture magnetite and iron sulfide crystals, just as bacteria on Earth do. As generations of bacteria died and decayed, they created PAHs inside of the meteorite's carbon molecules. Finally, some of bacteria themselves were preserved as elongated egg-shaped fossils inside the rock.

- **Main Argument of Hypothesis #2** *The rock was immersed in water rich in carbon dioxide, which allowed carbon to collect inside the fractured rock. As generations of bacteria died and decayed, they created PAHs inside of the meteorite's carbon molecules.*

# KEY POINTS

▶ **Key Points From the Passages on the Previous Slide**

▶ **What is the issue being argued about?** *The issue being argued about is whether the features of the meteorite are evidence of primitive life on Mars, or if they are more probably the result of nonbiological (nonliving) processes, such as hydrothermal synthesis.*

▶ **Main Point of Agreement** *The meteorite crystallized slowly from magma (molten rock) on Mars 4.5 million years ago. About half a million years later, the rock became fractured.*

▶ **Main Point of Disagreement**

▶ *Hydrothermal synthesis vs. primitive life*

# Good Luck!!