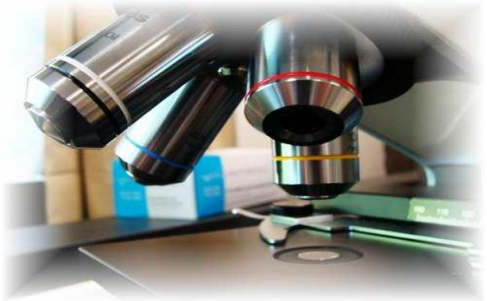

About Science Prof Online PowerPoint Resources

• Science Prof Online (SPO) is a free science education website that provides fully-developed Virtual Science Classrooms, science-related PowerPoints, articles and images. The site is designed to be a helpful resource for students, educators, and anyone interested in learning about science.

• The SPO Virtual Classrooms offer many educational resources, including practice test questions, review questions, lecture PowerPoints, video tutorials, sample assignments and course syllabi. New materials are continually being developed, so check back frequently, or follow us on Facebook (Science Prof Online) or Twitter (ScienceProfSPO) for updates.

• Many SPO PowerPoints are available in a variety of formats, such as fully editable PowerPoint files, as well as uneditable versions in smaller file sizes, such as PowerPoint Shows and Portable Document Format (.pdf), for ease of printing.

• Images used on this resource, and on the SPO website are, wherever possible, credited and linked to their source. Any words underlined and appearing in blue are links that can be clicked on for more information. PowerPoints must be viewed in *slide show mode* to use the hyperlinks directly.

• Several helpful links to fun and interactive learning tools are included throughout the PPT and on the Smart Links slide, near the end of each presentation. You must be in *slide show mode* to utilize hyperlinks and animations.

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Image: Compound microscope objectives, T. Port

Scientific Method

For additional resources on this lecture topic, see the Scientific Method Main Page on SPO.

Image: Compound microscope objectives, T. Port

What is science

?

Science is a **tool** for answering questions.

What Is Science? from Patuxent Wildlife Research Center, US Gov

What is Science?

True or False

Here are a few statements to test your current understanding of science!

(You are thinking … Wow! This instructor is HARSH! A test the first time we meet.)

What Is Science? from Patuxent Wildlife Research Center, US Gov

Science can prove anything, solve any problem or answer any question.

True or False?

False

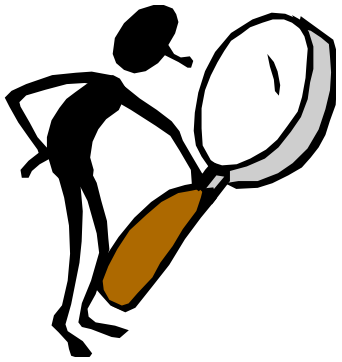
Science actually attempts to **disprove** ideas (hypotheses).

Science is limited strictly to solving problems about the physical and natural world.

Explanations based on supernatural forces, values or ethics can never be disproved and thus do not fall under the realm of science.

What Is Science? from Patuxent Wildlife Research Center, US Gov

Any study done carefully and based on observation is scientific.



False

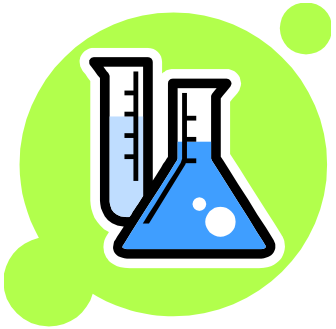
- Science must follow certain rules.
- The rules of science make the scientific process as objective as is possible.

Objective = Not influenced by feelings, interests and prejudices; UNBIASED

vs.

Subjective = Influenced by feelings, interests and prejudices; BIASED

What Is Science? from Patuxent Wildlife Research Center, US Gov

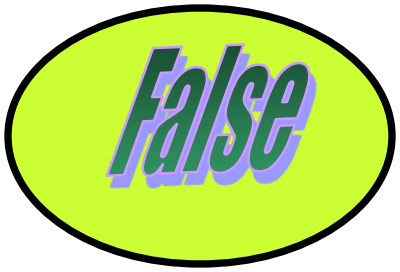


Science can be done poorly.

True

What Is Science? from Patuxent Wildlife Research Center, US Gov

Different scientists may get different solutions to the same problem.



True

What Is Science? from Patuxent Wildlife Research Center, US Gov

The Controversy Over Spontaneous Generation

John Needham & Lazzaro Spallanzani

The Question:

What causes tiny living things to appear in decaying broth?

Needham's Hypothesis: Spontaneous generation.

Spallazani's Hypothesis: Microbes come from the air. Boiling will kill them.

French chemist Louis Pasteur's design of this experiment settled the argument. **Click here** for an animation and quiz.

Needham >

Spallazani >

Image: Louis Pasteur, Pierre Lamy Petit, circa 1866; Lazzaro Spallanzani, 1729-1799

What is good science?

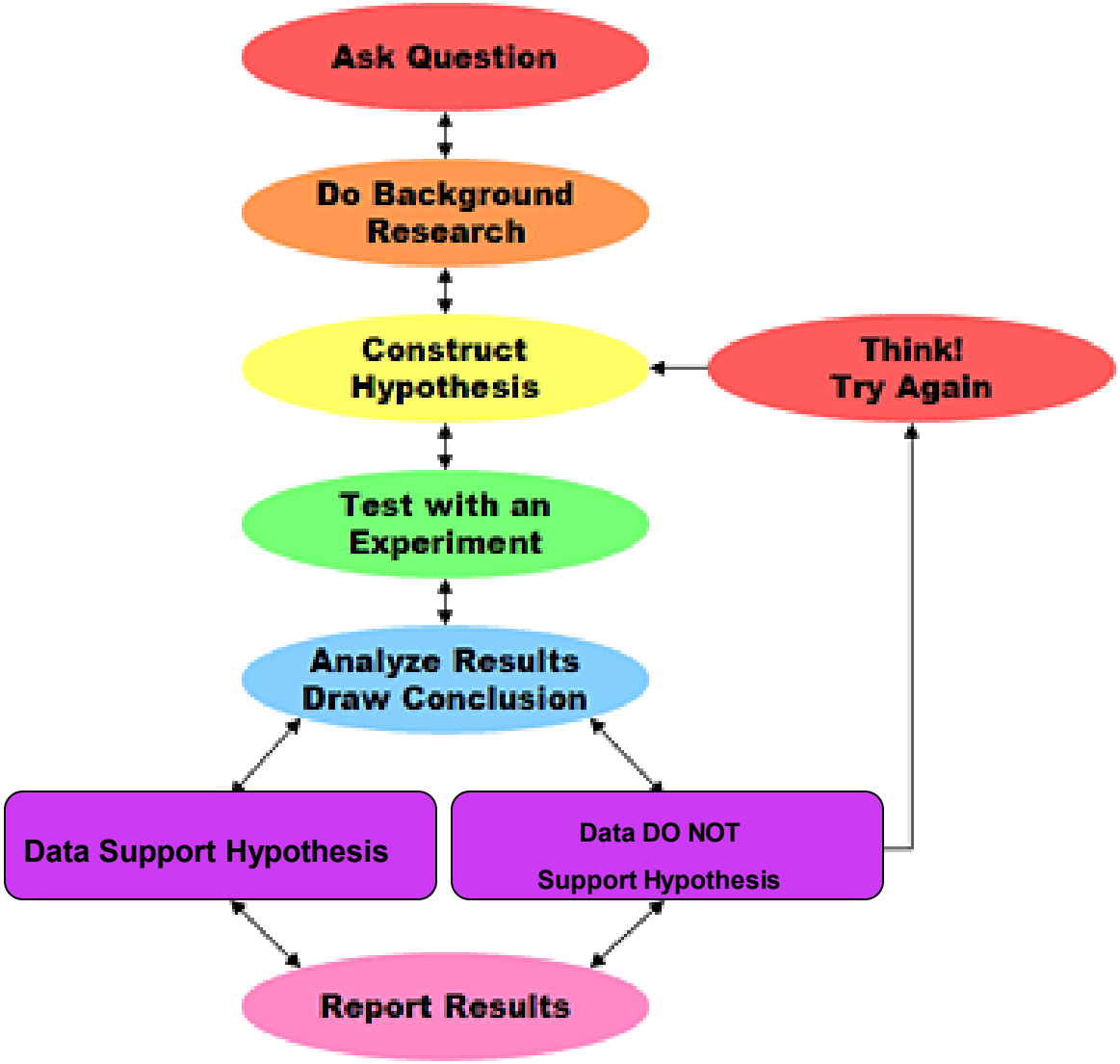
Objectivity is the key to good science.

To be objective, experiments must be designed and conducted in a way that does not introduce bias into the study.

Scientists use the

Scientific Method

Scientific Method

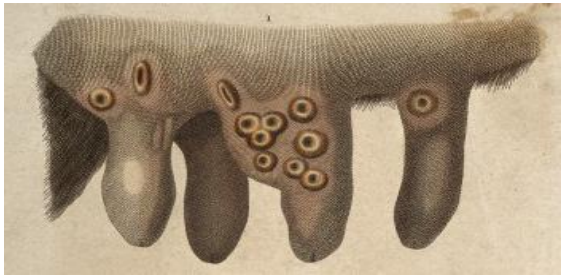


From the Virtual Cell Biology Classroom on ScienceProfOnline.com

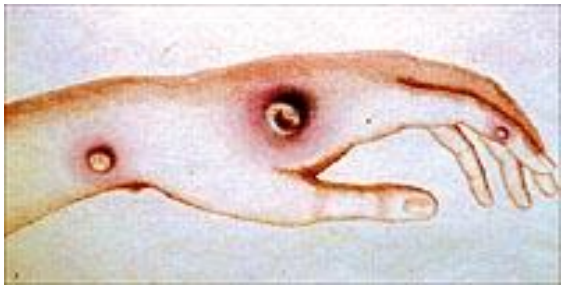
Image: Scientific Method Flowchart, Science Buddies

The Beginnings of Immunology

Edward Jenner and the first vaccine



cowpox: Infectious disease that causes mild discomfort, aching, a few pustules, some swelling…symptoms that disappeared in a few days. No biggie.



smallpox: Infectious disease that causes massive disfigurement, sometimes blindness, and often death.

- Caused two airborne virus variants, *Variola major* and *Variola minor*.
- Approx 500 million deaths worldwide in the 20th century. And millions more throughout previous history.
- Eradicated in 1979 though widespread vaccination.

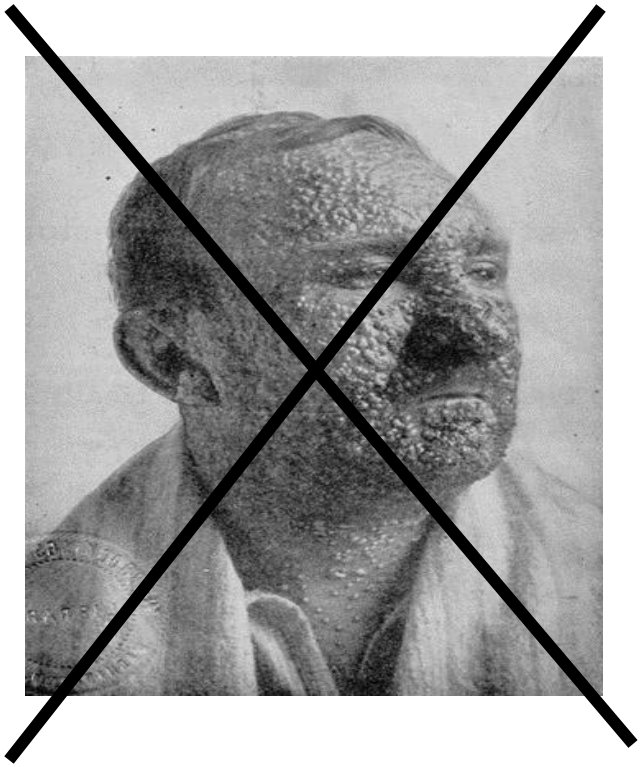
Images: Cowpox on Udder Wiki; Child with Smallpox, James Hicks, CDC

The Beginnings of Immunology

Edward Jenner and the first vaccine

Dr. Edward Jenner was aware that farm workers believed that if they ever contracted **cowpox**, they then wouldn't get **smallpox**.

=



Images: Dr. Edward Jenner by James Northcote Cowpox on Udder Wiki; Man with smallpox, 1912, Illinois Department of Health

The Beginnings of Immunology

Edward Jenner and the first vaccine

Match each statement with it 's corresponding step number in the Scientific Method.

_____ Jenner made small incisions or punctures with cowpox material in arms of human subjects in order to prevent smallpox.

_____ If I infect someone with cowpox, they will then be immune to smallpox.

_____ At first his peers doubted the safety and efficacy of his treatment, but eventually the value of the cowpox inoculum was recognized.

_____ He saw that the people that he infected with cow pox, when later exposed to smallpox, would get a little bit sick, but never come down with a full-blown case of smallpox.

_____ Dr. Jenner was aware that farm workers believed that if you had ever contracted cowpox, you wouldn't get smallpox.

_____ Does having cowpox make a person immune to smallpox?

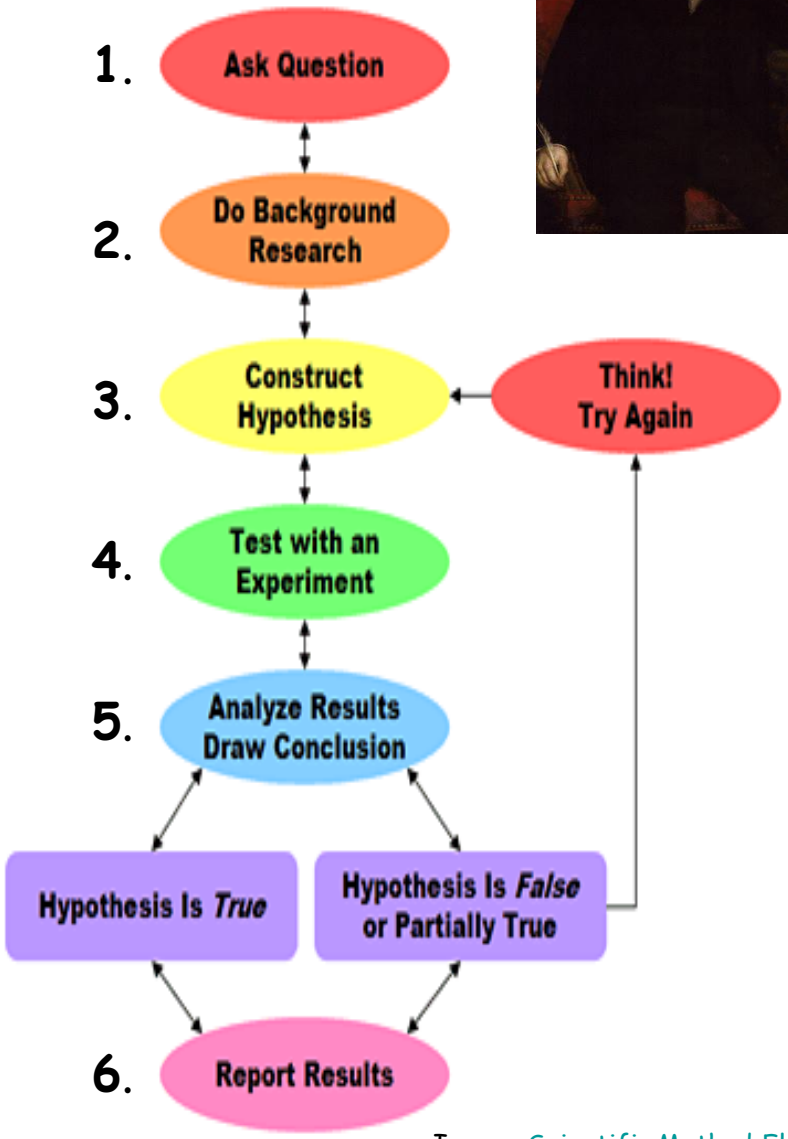


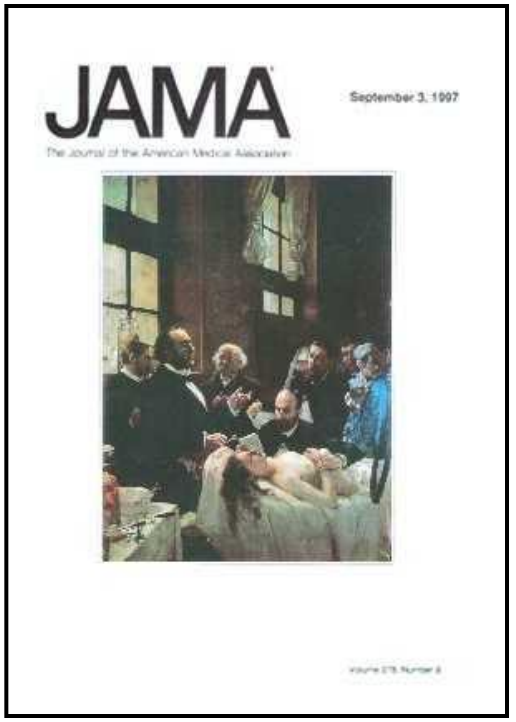
Image: Scientific Method Flowchart, Science Buddies; Dr. Edward Jenner by James Northcote

Verification is another quality control measure to eliminate bias.

Results are verified by **independent duplication** and publication in a **peer-reviewed journal**.

Independent duplication = Two or more scientists from different institutions investigate the same question separately and get similar results.

Peer-reviewed Journal = A journal that publishes articles only after they have been checked for quality by several expert, objective scientists from different institutions.



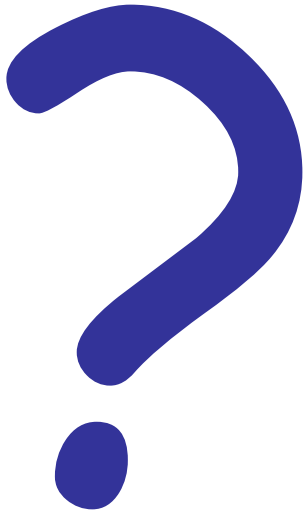
So that's Science…

Now, what's the difference between:

1. Science

2. Non-science

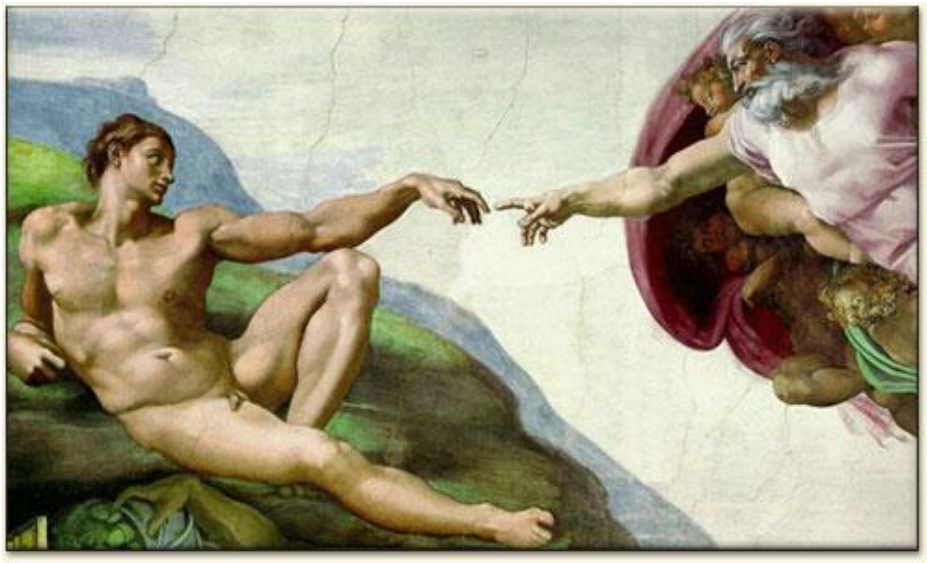
3. Pseudoscience



Non-science = Outside the Domain of Science

Non-science is important in human thinking and experience.

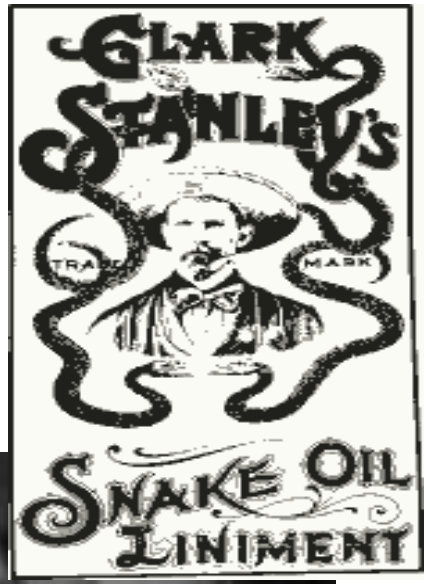
- Values
- Religious beliefs
- Art
- Creativity & Intuition



Subjects of non-science are usually easily separated from science.

Pseudoscience

When Non-science Claims to Be Science



- **Claims that can be tested scientifically, but are not.**

- **Try to pose as science.**

  Religious "science": constantly upholds hypotheses instead of trying to falsify them.

  Unidentified flying objects: none of the UFO "sightings" stand to careful scrutiny

  Hauntings: none of the ghost "sightings" stand to careful scrutiny

Images: Snake Oil Poster, Wiki; Brown Lady Ghost, Wiki

Confused?

Smart Links

Here are some links to fun resources that further explain the Scientific Method:

- Scientific Method Main Page from the Virtual Cell Biology Classroom at Science Prof Online.
- "Science Is Real" music video by They Might Be Giants.
- Scientific Method Cartoon & Quizzes from BrainPop.
- "Put It To The Test" music video by They Might Be Giants.
- Scene from Monty Python's Holy Grail used to explain Scientific Method.
- Pasteur's Experiment interactive science tutorial.
- "She Blinded Me With Science" music video Thomas Dolby.

(You must be in PPT slideshow view to click on links.)

Animal Behavior Experiment with Isopod Commonly Known as the Pillbug

They get their common names (pillbug, wood lice, sowbug, roly-polie) because they often respond to mechanical stimuli by rolling up into a ball.

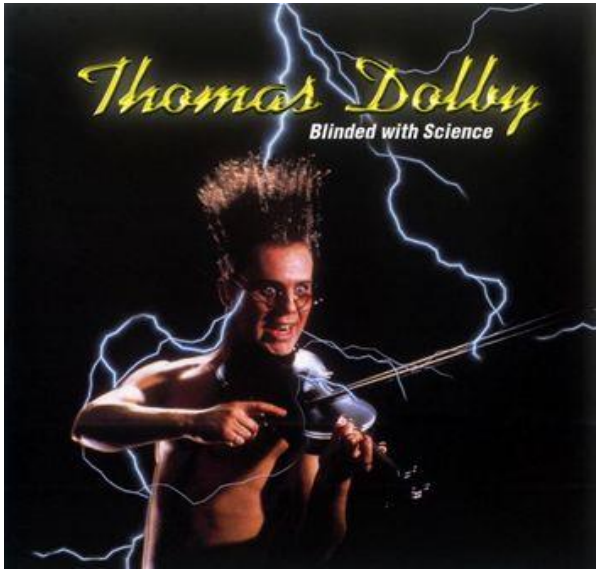
They are a crustacean. Most crustaceans are aquatic (shrimp, lobster, crab), but pillbugs are terrestrial. Still, much of their behavior is due to their need to avoid desiccation (drying out).

Images: Pillbug, *Armadillidium vulgare*, Franco Folini, Wiki; Wood louse, benjamint444, Wiki

Pillbug Experiment

See the ScienceProfOnline Virtual Cell Biology Classroom: **Scientific Method Lecture** for a printable Word .doc of this assignment.

- You will be designing an experiment to help you better understand the scientific method.
- Break up into groups (of 3 to 5 members) and design an experiment to investigate the pillbugs' response to light, pH, food hiding place or background color.
- Choose only one variable to manipulate.
- You will must work through all of the steps of the scientific method:
  - ask a question
  - develop a hypothesis
  - state the objectives of your experiment
  - design your experiment *(list materials that you will use, and outline your procedure in detail, determine what data you will collect)*
  - analyze your data
  - draw a conclusion (*was your hypothesis supported or not?)*
- I will need to approve your experiment before you begin.



Are you feeling blinded by science?

Do yourself a favor. Use the…

Virtual Cell Biology Classroom *(VCBC)*!

The VCBC is full of resources to help you succeed, including:

- practice test questions
- review questions
- study guides and learning objectives
- PowerPoints on other topics

You can access the VCBC by going to the Science Prof Online website
www.ScienceProfOnline.com

Images: Blinded With Science album, Thomas Dolby; Endomembrane system, Mariana Ruiz, Wiki