

# The Scientific Method



# BIOLOGY

The study of living organisms.

# Areas of Study (know 3)

- Botany
- Genetics
- Physiology
- Biochemistry
- Ecology
- Microbiology
- Horticulture etc.....

# Scientific Investigations



- Curiosity and observations lead to
- An idea/explanation of how something works
- Investigations into whether the idea is correct
- Sometimes the idea is correct and
- Sometimes the idea is wrong....
- Share idea with others so they can investigate also

# Scientific Method based on:

1. Making Observations
2. Forming a Hypothesis (suggested explanation-educated guess)
3. Design experiment
4. Collect & Interpret Data
5. Forming a conclusion
6. Communication (Publication in SCIENTIFIC Journals –on internet not accepted in LC exam)

# Definitions (LEARN):

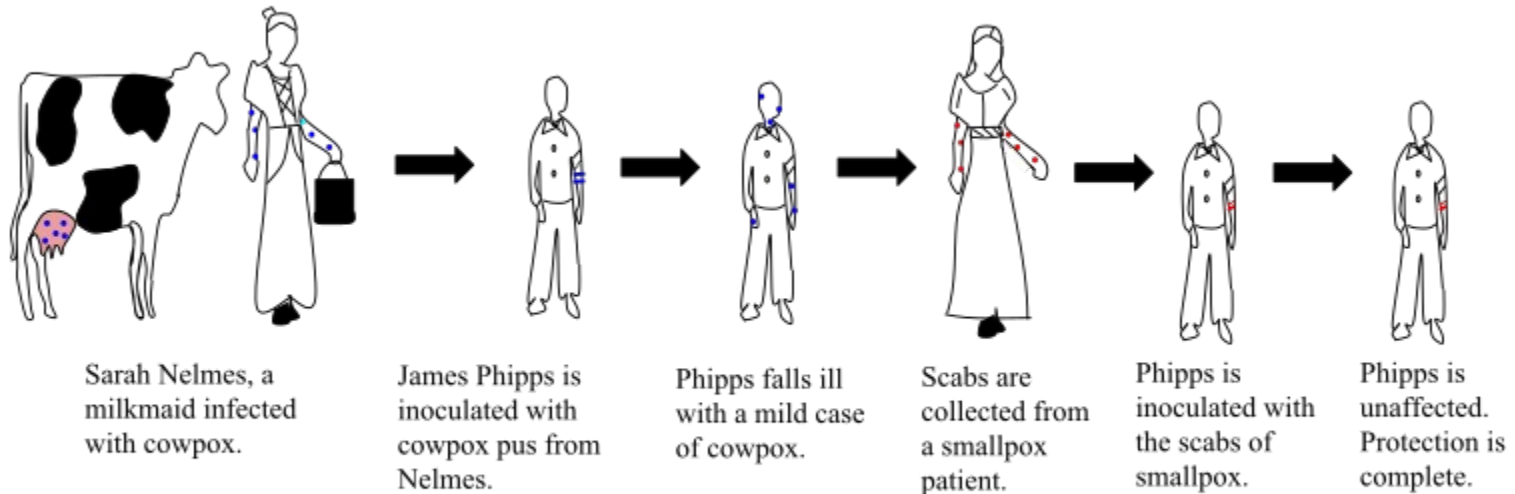
- A **Hypothesis** is an educated guess based on observations
- (“If ..... Then .....”)
- An **experiment** is a test for a hypothesis
- **Data** is the information gathered in experiments

# Definitions (LEARN)

- **A theory** is an explanation based on repeated hypothesis and experimentation (Example-Theory of Evolution)
- **A principle or law** arises from a theory when it is seen always to be true under all conditions over a long period of time (Example-Law of Gravity)

# Small Pox and the Scientific Method

- <https://youtu.be/yqUFy-t4MIQ>





# Example - vaccinations

- **Observation**: milk maids do not get small pox (serious condition).
- **Hypothesis**: milk maids get cow pox (mild condition) which protects them from small pox.
- **Experiment**: Small boy was infected with cow pox and suffered cow pox. Two months later he was injected with small pox.

Cont...

- **Result**: Boy did not suffer small pox.
- **Conclusion**: Cow pox protects from small pox. Cow pox fluid can be used to give immunity to small pox.
- Edward Jenner – experiment 1796.

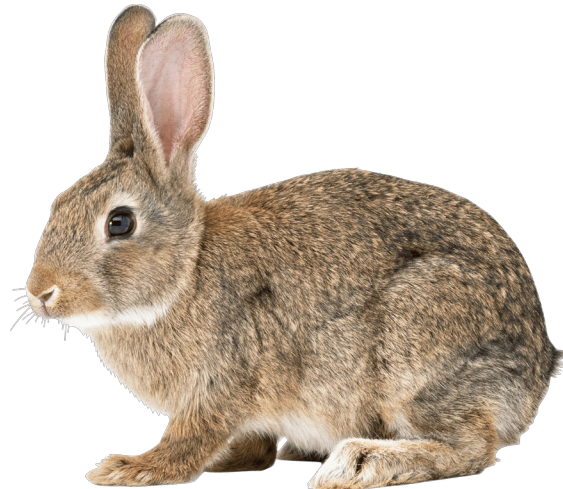
# Scientific investigations lead to...

- When a hypothesis is confirmed it can lead to a Theory
  - E.g. Theory of Evolution
- When a theory is confirmed over many years it becomes a Scientific Principle
- When a Principle is judged to be of great basic importance it is called a LAW.
  - E.g. Law of Gravity

Hypothesis - Theory- Principle - Law

# Limitations of the Scientific Method

- Experiments are only based on current knowledge
- Results are limited by our ability to interpret them
- The natural world is in constant change  
(myxomatosis- rabbits now resistant to it)



- Dishonesty- 1998 a report claiming MMR vaccine had links to autism

<https://youtu.be/GUpd2HJHUt8>

- Accidental- discovery-Viagra
- Sample Size-too small –results cannot be trusted

# Experimental Design – a fair test

- Large sample size (if possible)
- Only one variable changes
- Other variables remain constant
- Replicate-Repeat many times to verify results
- Use a control (a setup for comparison)
- Data must stand up to independent scrutiny

# Terminology

- Qualitative data – descriptive/observations/subjective
- Quantitative data – measurements/numbers/objective
- Independent variable – the variable that is being changed
- Dependent variable – the variable that changes as a result of the independent variable



# Drug testing on humans (Learn DEFINITIONS)



- **Placebo** – an identical tablet to the one being tested but which does not contain the drug. This is the control group
- **Blind test** – the individual does not know if they have received the drug or the placebo.
- **Double blind test** – the individual being tested and the test administrator does not know who is receiving the placebo.

# Ethics

- Throughout this course we will come across scientific issues which have ethical implications.
- **Ethical issues relate to what is right and what is wrong.**