Basic Scientific Literacy

- Presenter:

INTRODUCTION

This project was supported through Federal funds from the Division of AIDS (DAIDS), National Institute of Allergy and Infectious Diseases, National Institutes of Health, Department of Health and Human Services Grant # UM01 AI068614: "Leadership Group for a Global HIV Vaccine Clinical Trials (Office of HIV/AIDS Network Coordination)."

What Will We Do in This Workshop?

- Demonstrate how science helps people.
- Learn about the scientific method.
- Describe scientific research.
- Explore the human side of science.

Basic Scientific Literacy

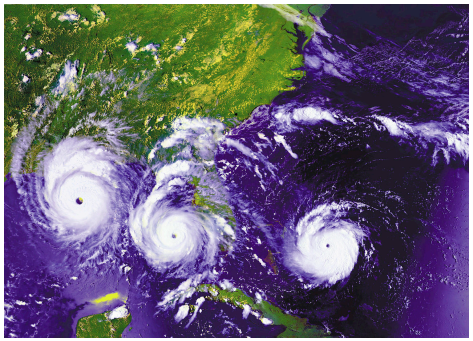
Welcome to this workshop about basic scientific literacy that will provide a general foundation in science.

Science provides knowledge about how and why things work the way they do.

This knowledge can help you understand the world around you—and your place in it.

The Basics of Science

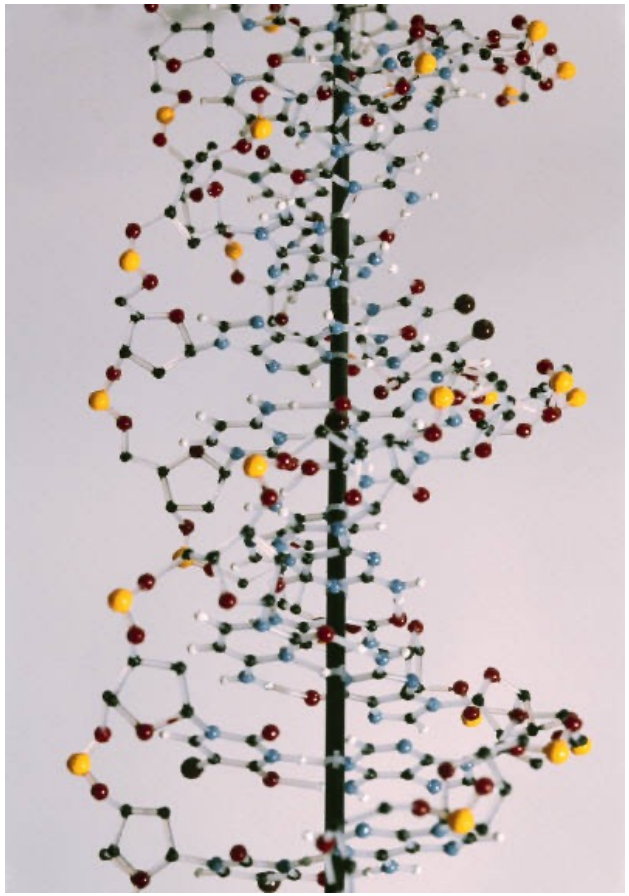
- Biology:
  - How living things work so we have a better understanding of our bodies and health.
  - How to maintain health and treat diseases.
  - How living things are connected to understand our place in the world.
- Social science:
  - How people interact.
  - What people have done in the past that impact the future.
  - Looking at things in new ways.
  - How people from different backgrounds live so we can better understand them.



The Importance of Science

Everything we know and all new discoveries are based on science. Everything we rely on is related to science.

Without science, the human race would be far from where it is today, and there would be many unanswered questions about the world around us.



Science Studies the Natural World

Agenda

Morning

Introduction What Is Science?	Break	What Is Science? (continued)

Afternoon

What Is the Scientific Method? The Human Side of Science	Break	The Human Side of Science (continued) Conclusion

Housekeeping

- Fire drills
- Rest rooms
- Messages
- Breaks and Lunch
- Smoking

Remember to:

Ask questions

Share what you know

Participate in all activities

Icebreaker

What is your name?

What do you do?

Tell us something special about yourself.

WHAT IS SCIENCE?

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Objectives

- The definition of science
- Natural science and social science
- Why research is important in science
- Scientific research and some of the problems scientists face when conducting research

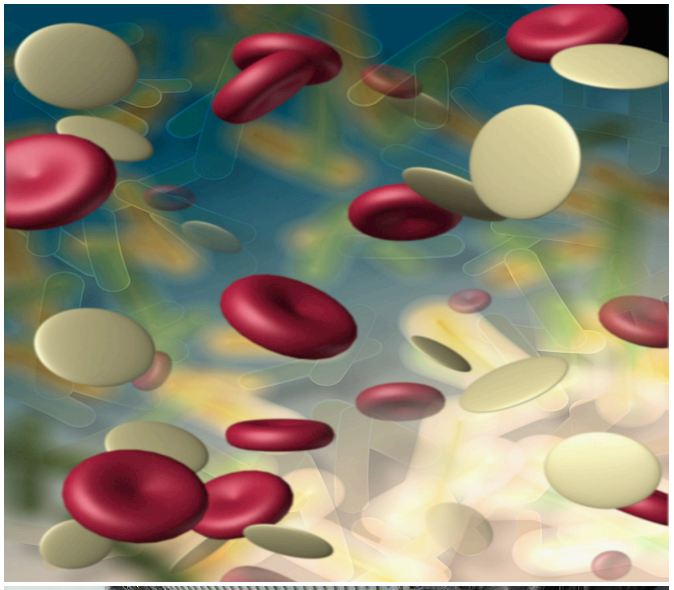
Introduction

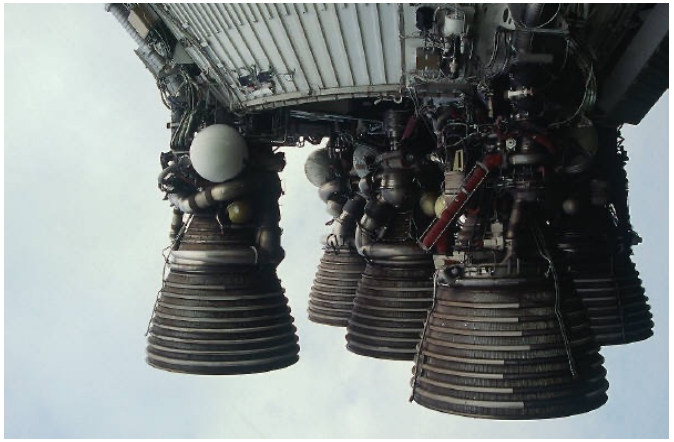
Science has given us the knowledge to develop tools and conveniences we take for granted:

- Use cell phones and Skype™ to call friends and family around the world.
- Develop vaccines to prevent diseases like polio.

Science Also Helps Us…

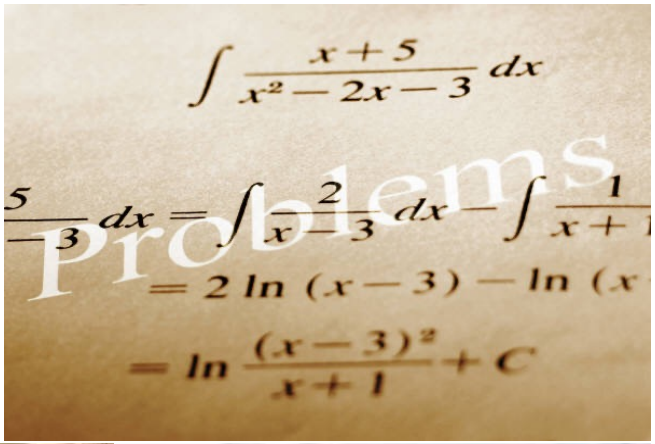
- Increase Americans' average lifespan because of improved:
  - Food and water safety
  - Hygiene and sanitation
  - Vaccines, antibiotics, and other medications
  - Better nutrition
  - Improved access to health care
- Build skyscrapers.
- Drive cars, motorcycles, trucks, and airplanes to move us to more places faster and more comfortably.

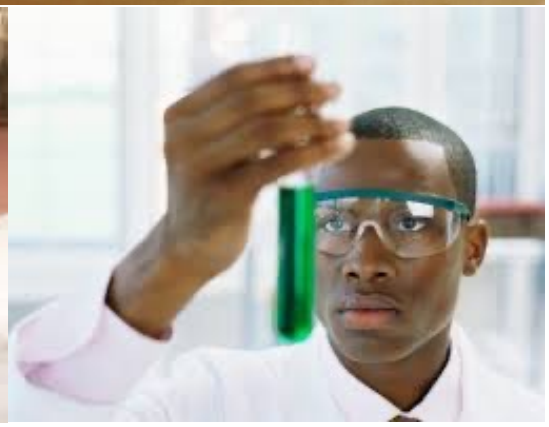




Science Helps Us Answer Important Questions

- Where and when will the next tornado occur?
- Where and when will a volcano erupt?
- How can crops be protected from pests?
- How can risk of disease be predicted?
- How can the study of genetics help us?





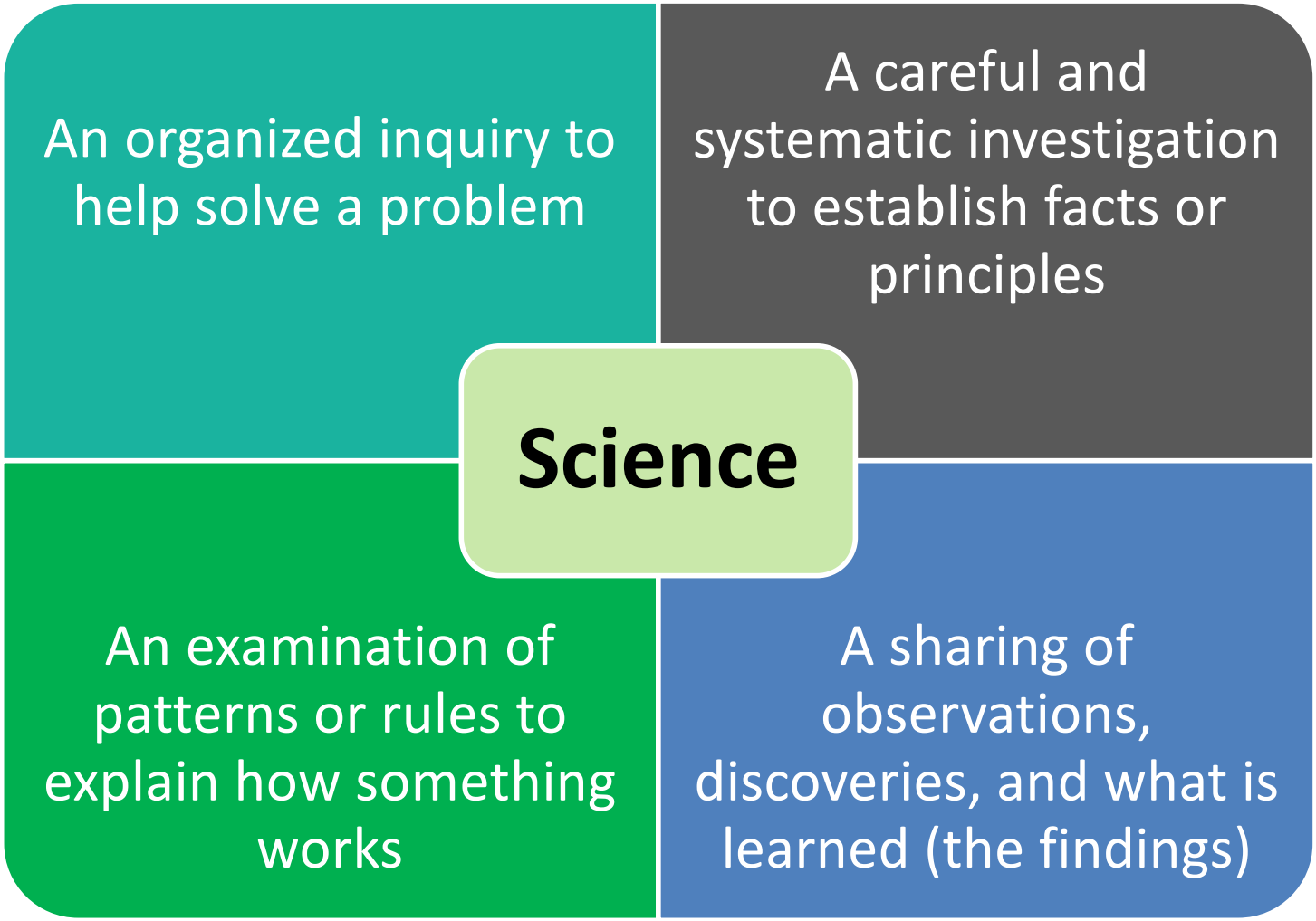
Science Is a Detailed Study of a Subject

What Is Science? Activity

This is science

This is NOT science

Science Is Also…



Science Provides…

A rigorous and relevant contribution to knowledge

An understanding of causes and effects of a given situation or phenomenon

Development of:

- Laws and processes that can be observed over and over again
- An explanation of why the laws and processes happen
- Predictions about what ***will*** happen

Science Answers…

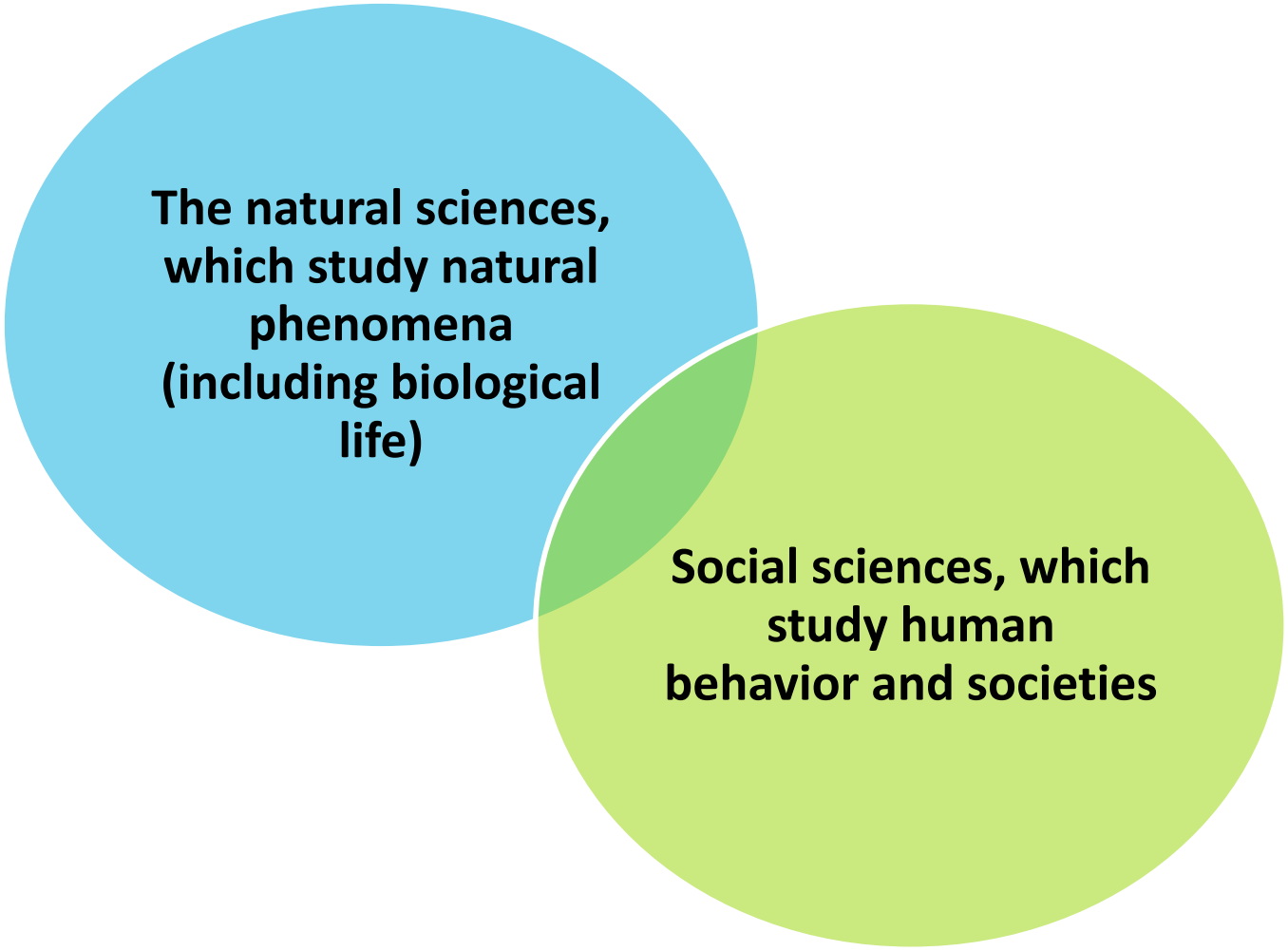
How? Why?

For example, the law of gravity explains how people and things stay on earth instead of floating away into outer space.

Science is important to help us understand our world and our place in it.

Natural Science and Social Science

Science is usually divided into two major groups:



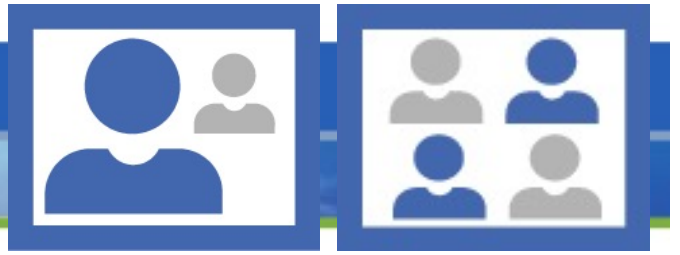
"Empirical" Sciences

The natural and social sciences are "empirical" sciences. This means they are:

- Based on observation
- Capable of being tested

Scientific research needs to be tested and reproducible by other researchers working under the same conditions.

What Kind of Science? Activity



This is a natural science

This is a social science

Why Research Is Important in Science

- Research is an important part of science because it helps us understand how things work, how things are made, and why things happen the way they do. Research asks and answers the questions that solve problems and produce knowledge that can be used in new ways.
- Research leads to the science that helps us understand our world and our place in it.

The Importance of Research

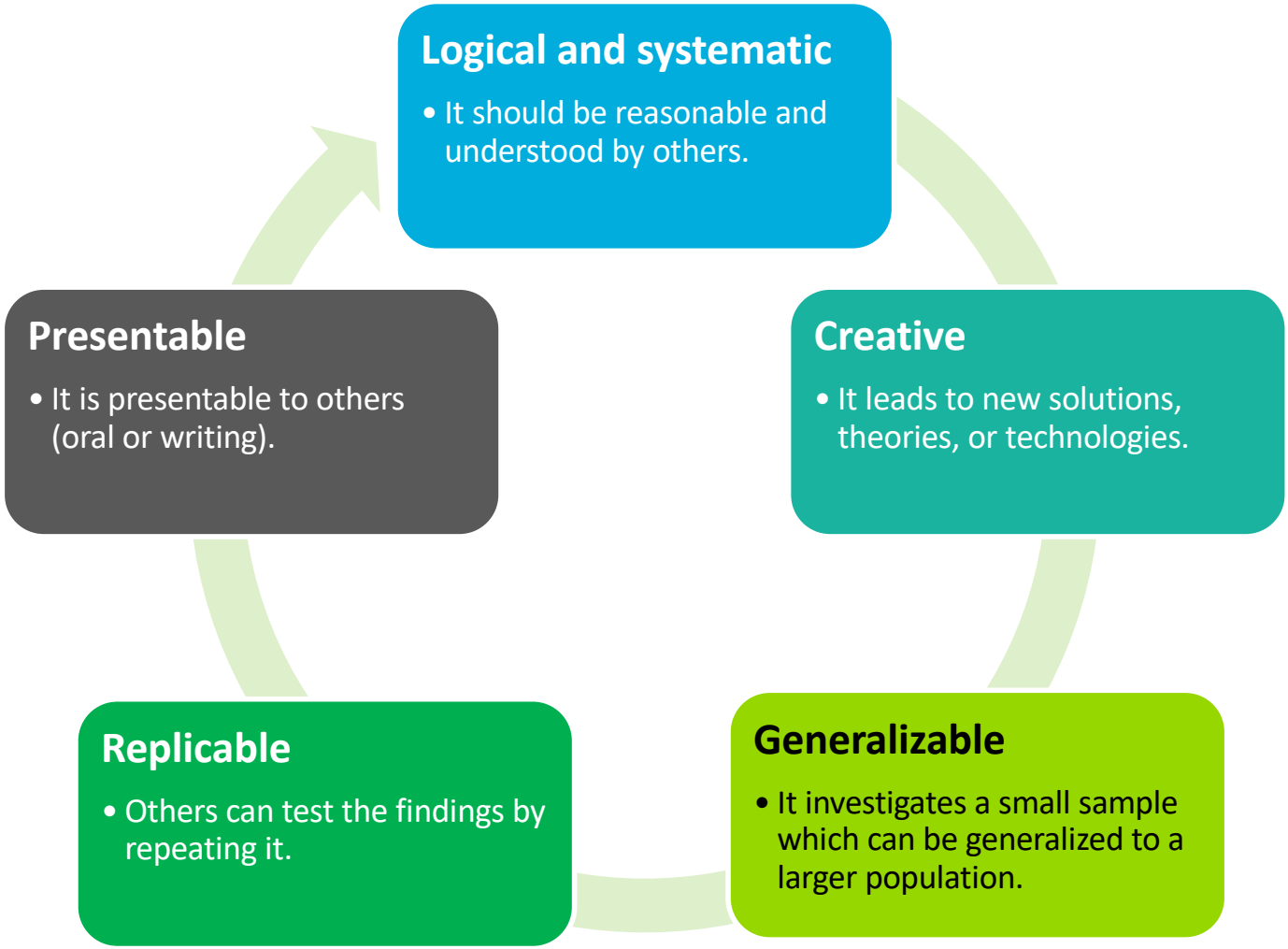
"Ideas are what power our economy. It's what sets us apart. It's what America has been all about. We have been a nation of dreamers and risk-takers; people who see what nobody else sees sooner than anybody else sees it…

…We support labs and universities to help them learn and explore. And we fund grants to help them turn a dream into a reality…

And the investments don't always pay off. But when they do, they change our lives in ways that we could never have imagined…And sometimes, in fact, some of the best products and services spin off completely from unintended research that nobody expected to have certain applications."

- April 2, 2013, President Barack Obama

Scientific Research Shares the Same Ingredients



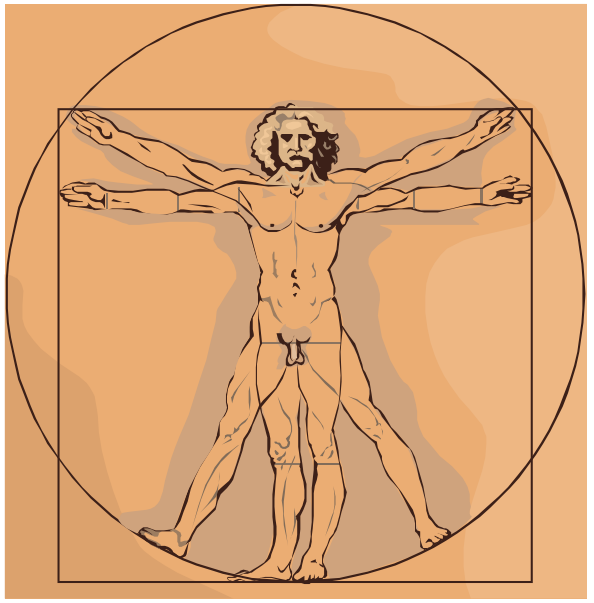
Example: The Human Genome Project (HGP)

The Human Genome Project (HGP) is a good example of significant research.

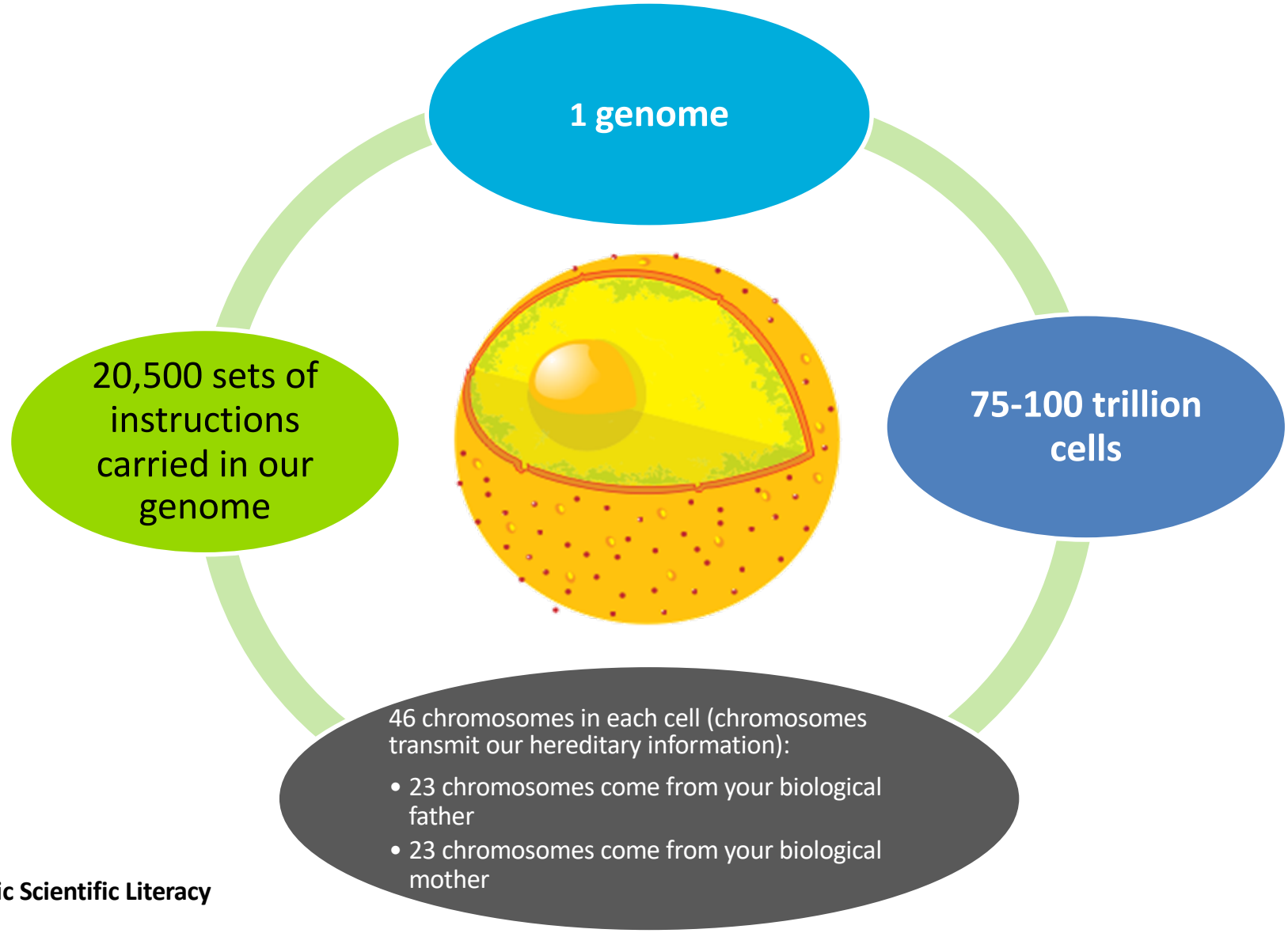
The goal of this significant research is to provide researchers with powerful tools to understand how inheritance impacts human disease.

Each human cell contains a molecule that carries the instructions that make each of us unique individuals.

Researchers call this complete set of instructions a genome.



Each of Us Has…

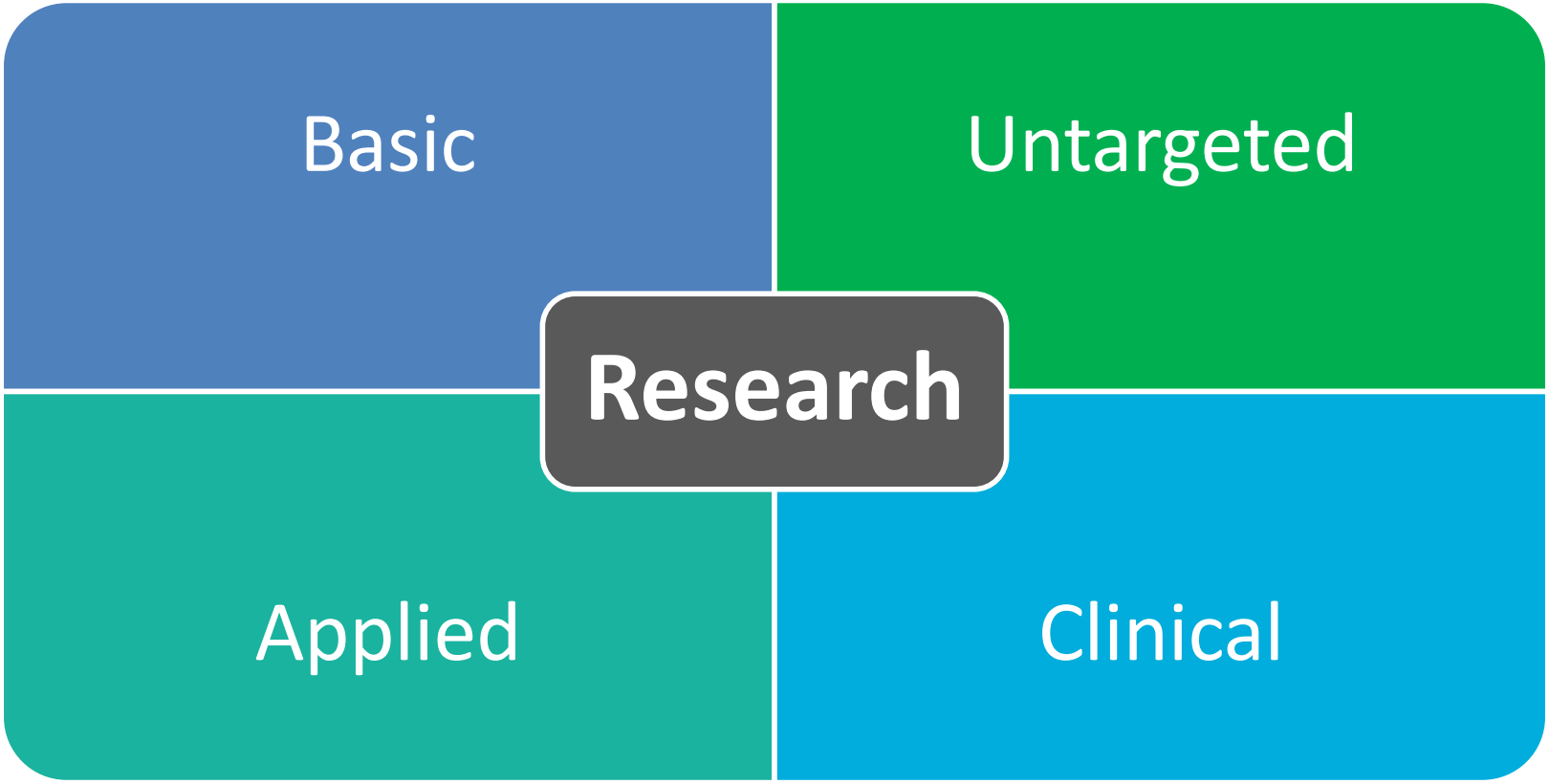


Variations in Our Cells Make Us Unique

- Hair, eyes, and skin color
- Risk of disease and response to drugs

HGP research has produced important new strategies for disease diagnosis, treatment, and prevention.

Types of Research

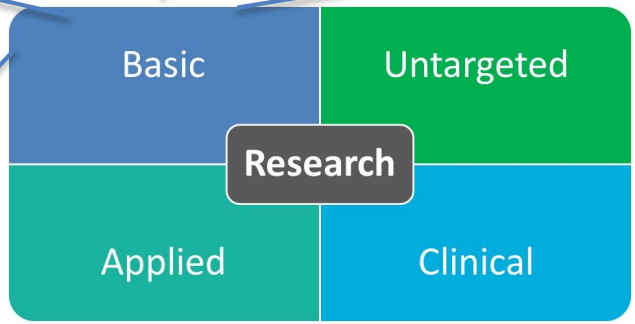


Basic Research

Basic research focuses on an understanding of the cells and molecules.

Basic research provides a base of knowledge for the diagnosis, treatment, and prevention of diseases.

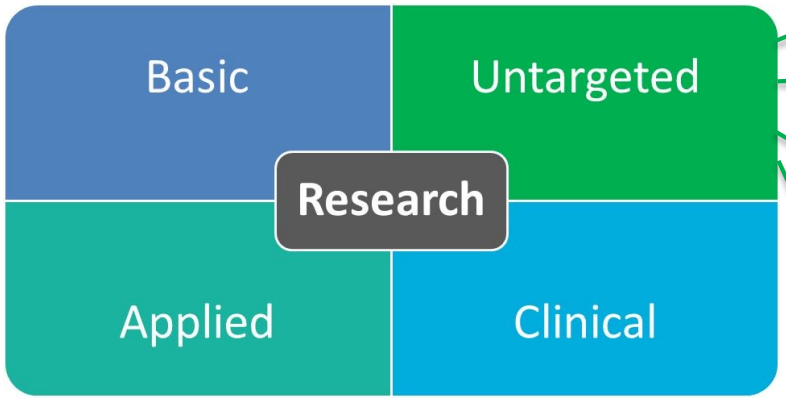
Basic research focuses on what we do not know.



Examples: How the universe began; what protons, neutrons, and electrons are composed of; how molds reproduce.

- Our understanding of heredity is largely due to the studies of pea plants in the 1860s and experiments with fruit flies in the early 20th century. Pea pods and fruit flies were used because it was easier to design experiments using them than using higher forms of life. Fruit flies are still being used today in HGP.
- Many of today's electrical devices (e.g., radios, generators, and alternators) were the result of basic research done in 1831 with electromagnetic induction (the relationship between electricity and magnetism).

Untargeted Research



Untargeted research is usually not connected to a specific disease.

Untargeted research looks at more general questions about how living things work.

Untargeted research provides the fundamental theories and concepts for more disease-oriented research.

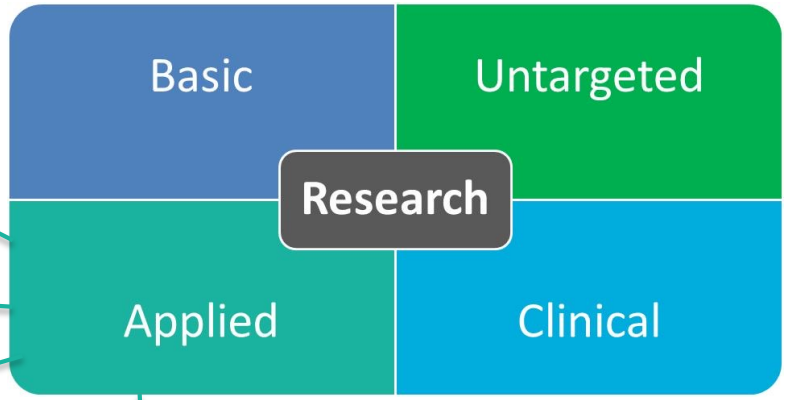
Examples: How living things work, follow leads that most likely lead to missing pieces of information (even if the new knowledge is not immediately clear).

Applied Research

Applied research focuses on solving specific problems.

Applied research is used to find solutions to everyday problems, cure disease, and develop new technology.

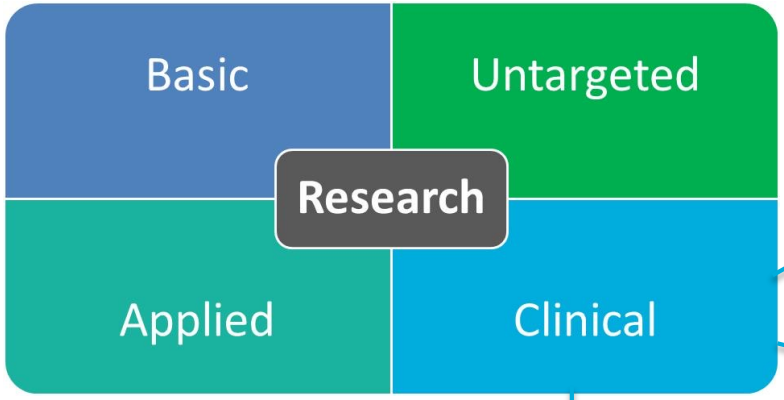
Applied research is directed to the real world.



Examples:: Improve crop production, energy efficiency, modes of transportation.

- A chance discovery occurred in 1928 when a Penicillium mold accidentally contaminated bacterial culture in the laboratory. The bacteria could not grow near the mold, suggesting that the mold was producing a natural anti-bacterial agent. The scientist stated that "nature created penicillin. I only found it."
- Velcro was invented when a scientist noticed that the seeds of the cocklebur contained tiny hooks that enabled the seeds to cling to fur and clothing. A material containing similar hooks was created to use as a fastener. Velcro was created in 1957, but it took many years for technology to catch up to mass produce it inexpensively.

Clinical Research



Clinical research involves testing interventions on people based on previous basic research in the test tube and/or with animals.

Clinical research follows strict scientific guidelines that protect participants by using strict ethical standards.

Examples: Causes of cancer, impacts of treatments on health (clinical research uses live subjects and/or tissues).

Research Dilemmas

The difference between basic and applied research is not always clear. A good question to ask is:

"How long will it be before some practical application results from the research?"

- If a practical use is only a few years away, it is applied research.
- If a practical use is still 20-50 years away, it is a little of both, or a combination of applied and basic research.
- If a practical use is not envisioned in the foreseeable future, it is basic or untargeted.

Questions Facing Research Activities

Some important questions facing research activities today are difficult to answer and include:

- Who will pay for what?
- How do we set priorities for research projects?
- How can the result be applied on a population-wide level?

Example: Edward Jenner

Sometimes research priorities change over time. And sometimes what is not currently acceptable may become acceptable and valuable.

In 1796, Edward Jenner tested his theory, drawn from the folklore of the countryside, that milkmaids who suffered the mild disease of cowpox never contracted smallpox, one of the greatest killers of the period, particularly among children.

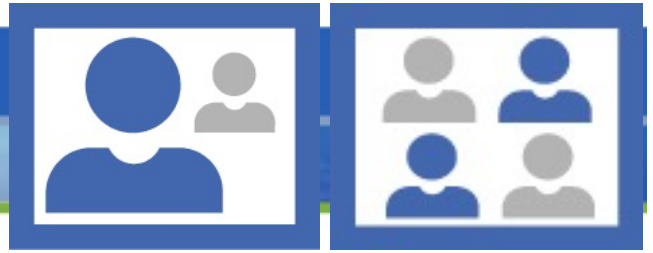
- Hand of a person infected with cowpox.

What Did Edward Jenner Find?

- He found that an inoculation using cowpox made people immune to smallpox. Jenner was told that his ideas were too revolutionary and that he needed more proof.
- So he conducted more research.
- In 1798, the results were finally published and Jenner coined the word vaccine from the Latin “vacca” for cow.
- Jenner was widely ridiculed.
- Critics said it was repulsive and ungodly to inoculate someone with material from a diseased animal.
- But the obvious advantages of vaccination and the protection it provided soon became widespread.

The Edward Jenner Story

What Does it Mean? Activity

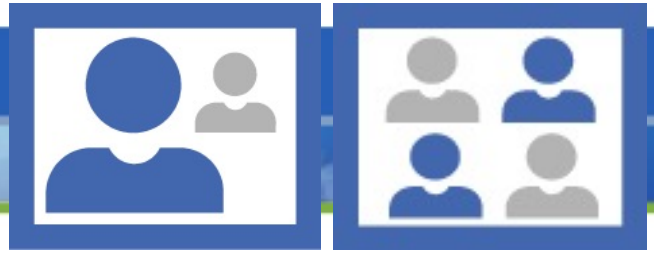


Work with a partner

Conduct research

Share your results

What Did You Learn?



In this activity, you will brainstorm how you can apply what you learned about science by answering a question.

With your group:

- Brainstorm the question you are assigned (you only need to brainstorm one of the questions).
- Share your answers with the whole group so they can hear your ideas.

How can you use what you have learned about science in your life?

What have you heard in the news recently about any area of science that you would like to know more about (for example, health, space, technology, weather, etc.)?

Imagine that someone in your family has asked you to help develop a family health history so everyone related to you will have information to share with their doctors. What kinds of information would be important to collect about your family members' health without intruding on their privacy?

Imagine that you are a scientist and you can investigate or invent something, what would it be and why?

Summary

Research is designed to help answer questions, make decisions, and solve problems.

Anyone can do research because we answer questions, make decisions, and solve problems every day.

Research is conducted by ordinary and extraordinary people who have a passion to understand the world around them.

QUESTIONS?

WHAT IS THE SCIENTIFIC METHOD?

This project was supported through Federal funds from the Division of AIDS (DAIDS), National Institute of Allergy and Infectious Diseases, National Institutes of Health, Department of Health and Human Services Grant # UM01 AI068614: "Leadership Group for a Global HIV Vaccine Clinical Trials (Office of HIV/AIDS Network Coordination)."

Objectives

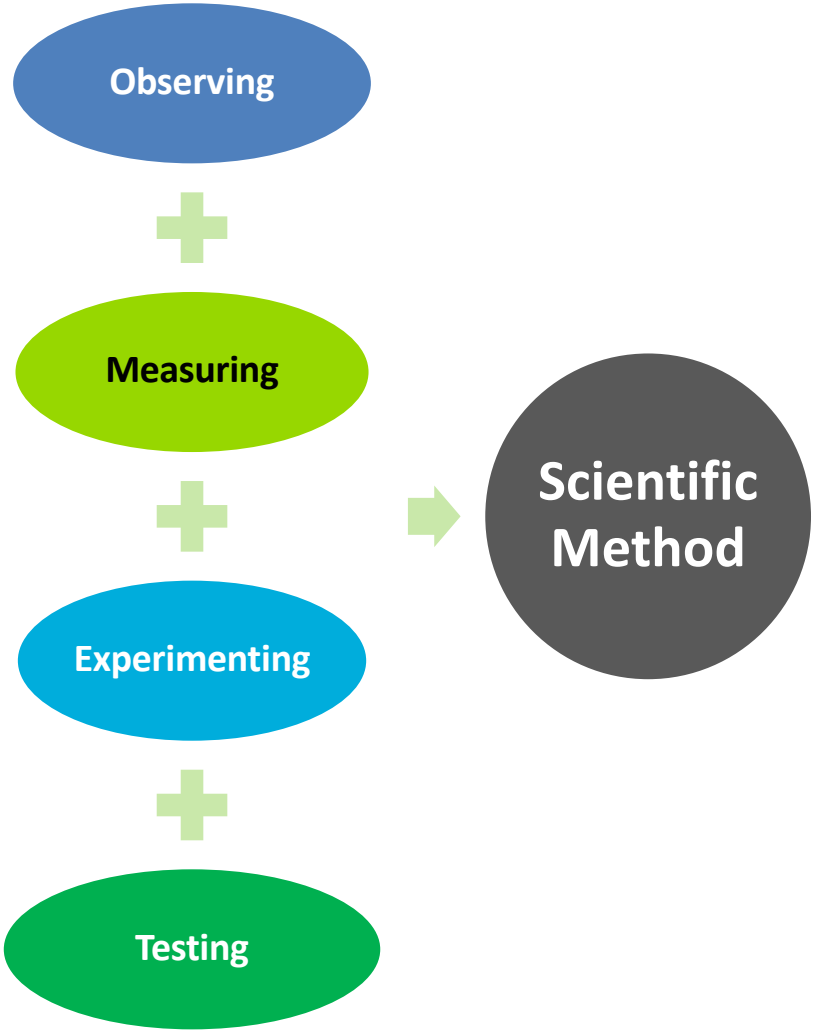
- Learn about the four steps of the scientific method
- Practice using the scientific method
- Explore common mistakes using the scientific method

Introduction

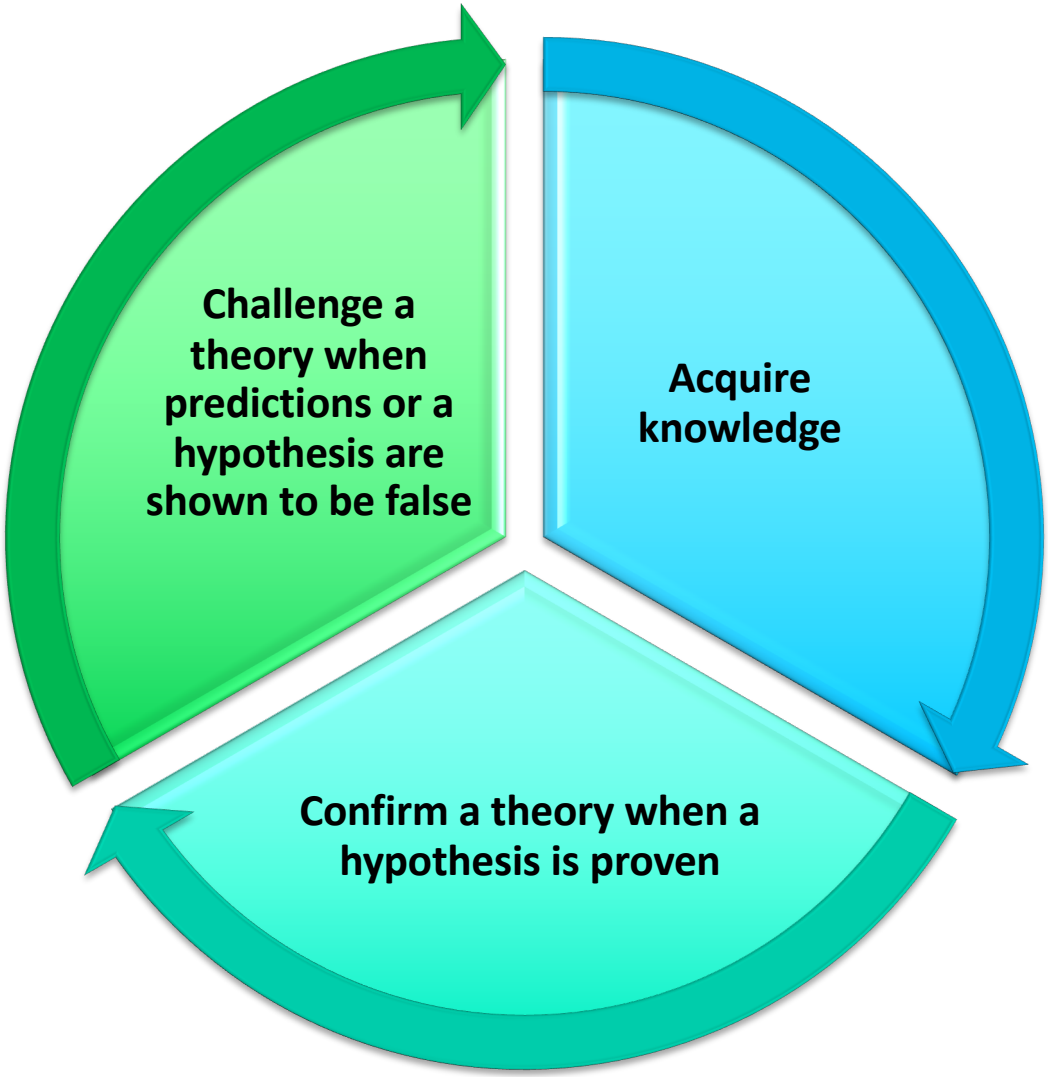
The scientific method starts with a *hypothesis*, which is a question the research is designed to answer.

It is often a proposed explanation for something that is happening.

After stating a hypothesis, scientists and researchers conduct research that either proves or disproves the hypothesis by:



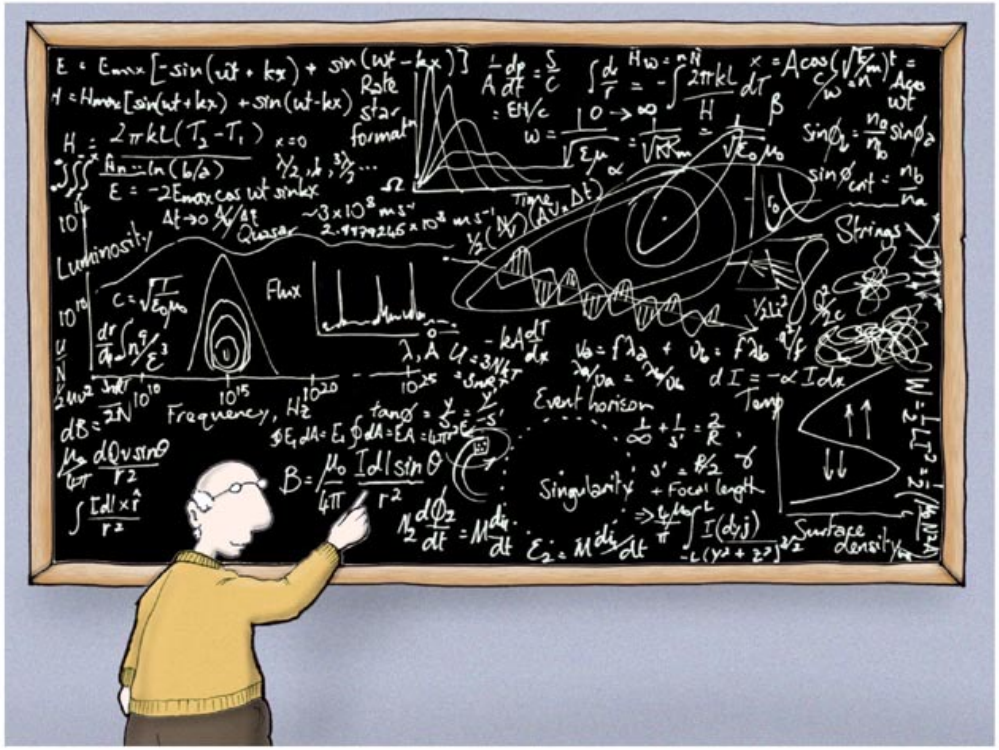
What the Scientific Method Allows Scientists and Research to Do



What Scientists and Researchers Do

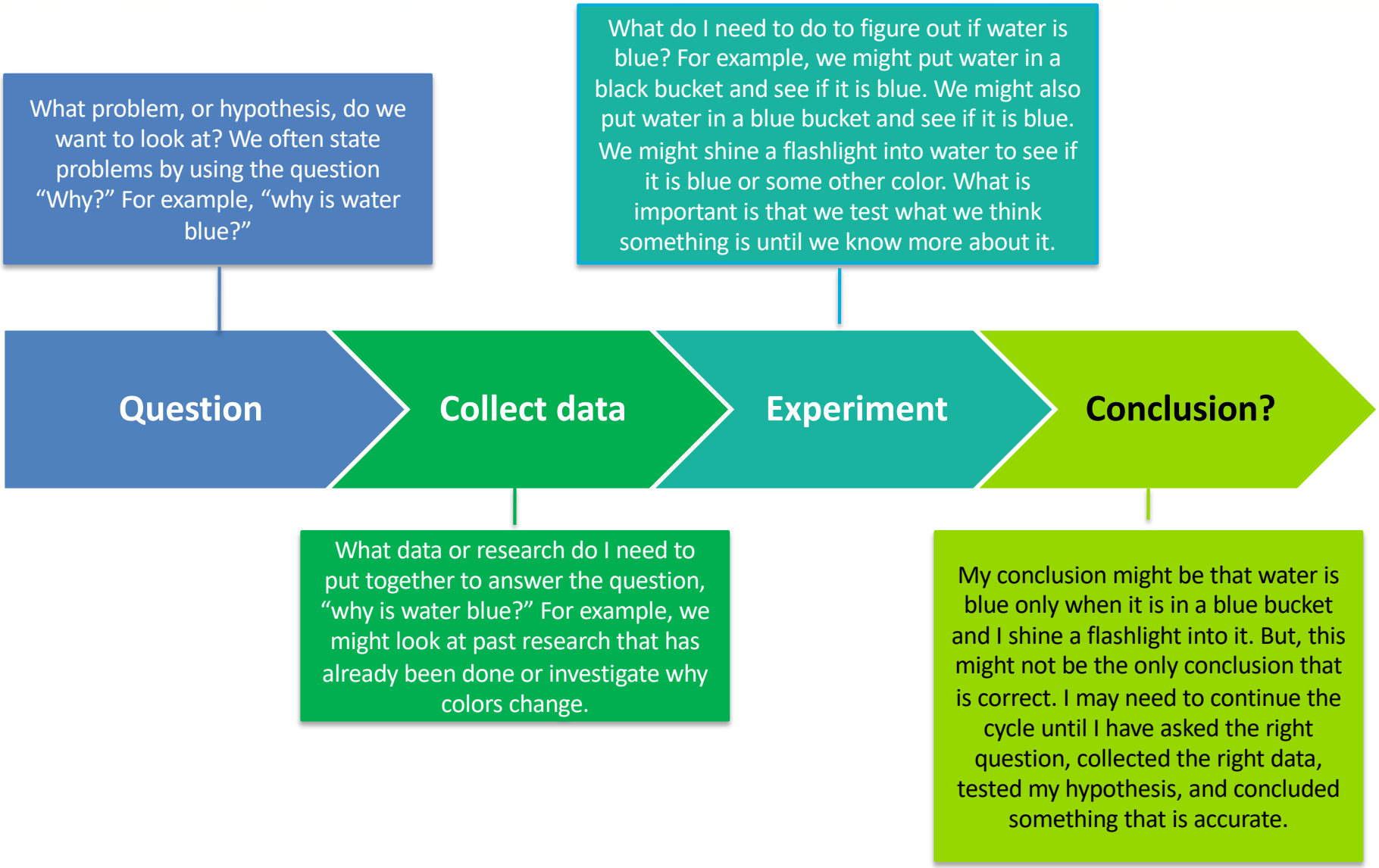
Scientists and researchers propose a hypothesis and design experiments or studies to test the hypothesis.

The exciting thing about science is that it builds on and advances previous knowledge, which improves our understanding.



Astrophysics made simple

Scientific Method Cycle



Step 1: Ask a Question (the Hypothesis)

Deciding on which question to ask is important because it focuses:

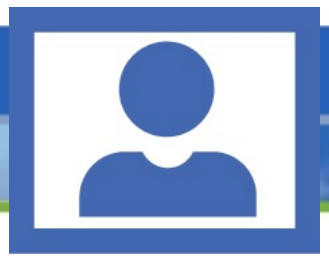
- Data collection
- Testing

The question can be:

- An explanation of a specific observation (for example, “Why is water blue?”)
- An open-ended question (for example, “Does sound travel faster in air or water?”)

Researchers often decide on which question to ask because they are curious or passionate about something.

Experiment Activity: Step 1



Use step 1 of the scientific method

Create a question (hypothesis) about graphology

Step 2: Collect Data

Focusing on the question, a researcher then reviews what research already exists and begins thinking about which experiments to use. Researchers should ask the following questions:

- Has the question already been tested?
- If so, what were the results?
- Were there areas that were suggested for further explanation?

The question to be explored ***must*** be considered based on research and data that already exists. Researchers do not decide if the research is true or not at this point.

If the question still seems interesting, the researcher goes to the next step.

Experiment Activity: Step 2

Review the research

Answer the questions

Step 3: Experiment

Experiments give researchers a chance to see if what happens during tests really does happen. During experiments, researchers:

- Make observations
- Compare test results against the original hypothesis
- Make rational conclusions based on the observed results (or data) about the reality of what happened

Another way to look at the experiment step is to think of problem solving. Problem solving is a process to work through details of a problem to reach a solution.

The 5 Whys Problem-Solving Technique

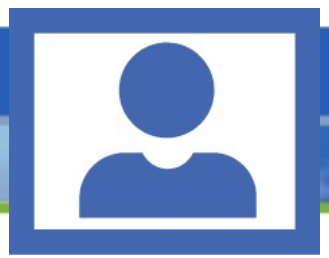
The 5 Whys problem-solving technique is very useful to help reach a conclusion and/or solution.

To find out a reason for something, ask Why? at least five times.

For example, you have a problem: Your car will not start.

Why?	The battery is dead
Why?	The alternator is not working
Why?	The alternator belt broke
Why?	The alternator belt is old
Why?	Replacement parts are no longer available
Solution	Buy a new car

Experiment Activity: Step 3



Write a paragraph

Use the Graphology Analysis Checklist

Answer the questions

Step 4: Conclusion?

At this point, researchers have evaluated their findings from their experiments. And they have probably refined the original question (hypothesis).

After assembling all the research and results from the experiments, it is time to draw a conclusion. A conclusion is what you get when you put together:

- What you know
- What research shows

A conclusion is what you decide is true after thinking about it carefully and looking at all the evidence.

Review and Publish

After a conclusion has been reached, researchers likely publish their results to share their findings so others can repeat and validate the results.

However, before results are published, they will be peer reviewed by other experts in the field.

These experts provide validity to the research and conclusions, which supports the value of the work.

Experiment Activity: Step 4

Do you have enough information to come to a conclusion that you feel confident about?

Do you believe your results from your graphology checklist?

What might you do next?

Review the original question: Is it possible to use graphology to determine the sex of a writer?

The Peer Review Process and Funding Research

The peer review process is the evaluation of research by other reputable people in the same field in order to maintain or enhance the quality of the work. Peer review is also used when reviewing research funding requests.

The Importance of Peer Reviews

"To maintain our edge . . . we've got to protect our rigorous peer review system and ensure that we only fund proposals that promise the biggest bang for taxpayer dollars . . . that's what's going to maintain our standards of scientific excellence for years to come."

- April 29, 2013, President Barack Obama

Funding Research

Most scientific research is funded by government grants, private companies, and non-profit organizations. Most scientific research is funded by government grants, private companies, and non-profit organizations.

For example, in the U.S., the National Institutes of Health (NIH) funds and supports research about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce the burdens of illness and disability.

The NIH uses the peer review process to identify the most promising biomedical research. The research funding requests are evaluated for their scientific and technical merit.

NIH Applications and Reviewers

Currently, the NIH:

- Handles approximately 80,000 applications for funding requests each year
- Uses approximately 20,000 reviewers each year

And the NIH is just one of many funding organizations.

Common Mistakes Using the Scientific Method

The graphology activity showed some common mistakes when using the scientific method:	
The original question/hypothesis is faulty.	Graphology does not result in information that can be proven. It is subjective.
The prior research cannot be proven.	Just because research has been published or is available on the internet does not mean it is true.
Researchers know what they want the outcome to be.	As in the graphology hypothesis, when you were asked your opinion, you already made a decision about what would probably happen.
Researchers ignore data that does not support the hypothesis.	Researchers who want to get a certain result may only look for proof that supports that result and discount or ignore evidence to the contrary.
Data is handled differently by different researchers.	Many members of a scientific community may work on a project. The experiments, tests, and conclusions may vary because of differences in experience, methods, and priorities.

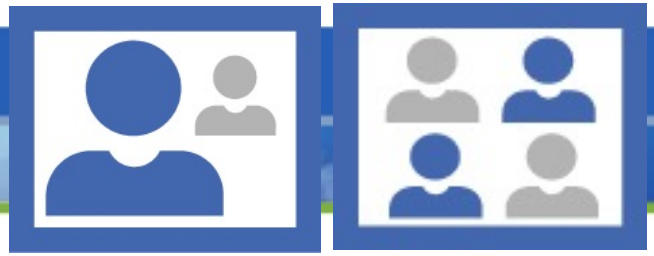
Example

For example, in 2010, a prominent English medical journal retracted a 1998 research paper that stated the measles, mumps, and rubella (MMR) vaccine caused autism.

After the 1998 research paper was published, MMR vaccination rates dropped in England and the number of measles cases soared.

After 12 years of investigation, the researcher was found to have financial and scientific conflicts that were not revealed as part of his publication.

What Did You Learn?



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With your group:

- Brainstorm the question you are assigned (you only need to brainstorm one of the questions).
- Share your answers with the whole group so they can hear your ideas.

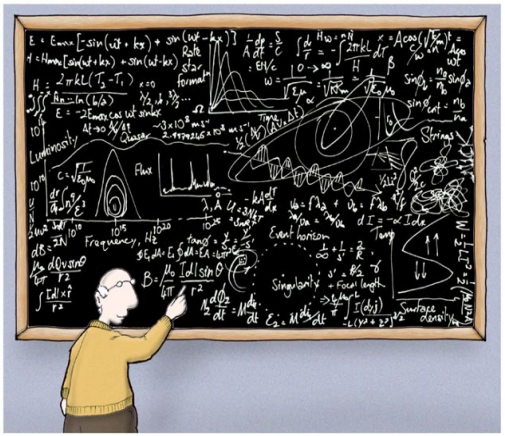
How can you use what you have learned about the scientific method in your life?

In what ways can you use problem solving in your daily life?

If you could be a scientist and make a difference to the world, what research would you work on and why (list 2-3 options)?

In what ways has this information about the scientific method impacted YOU?

Summary



Astrophysics made simple

One of the outstanding things about science is the objectivity of its findings. Researchers and scientists are trained to observe, to experiment, and to analyze objectively. Wishful thinking has no place in their work. Their findings will not become a permanent part of science until they have been challenged and confirmed by other scientists and researchers. In other words, science is a very democratic process. Anyone can question a "law" of science.

The strength of science and its power rests on:

- The thorough testing of its structure
- An interesting combination of collaboration and competition
- Scientists' independence

QUESTIONS?

THE HUMAN SIDE OF SCIENCE

This project was supported through Federal funds from the Division of AIDS (DAIDS), National Institute of Allergy and Infectious Diseases, National Institutes of Health, Department of Health and Human Services Grant # UM01 AI068614: "Leadership Group for a Global HIV Vaccine Clinical Trials (Office of HIV/AIDS Network Coordination)."

Objectives

- The characteristics of life
- The role of inheritance and experience in who we are
- The importance of research participants
- Ways to protect research participants

Introduction

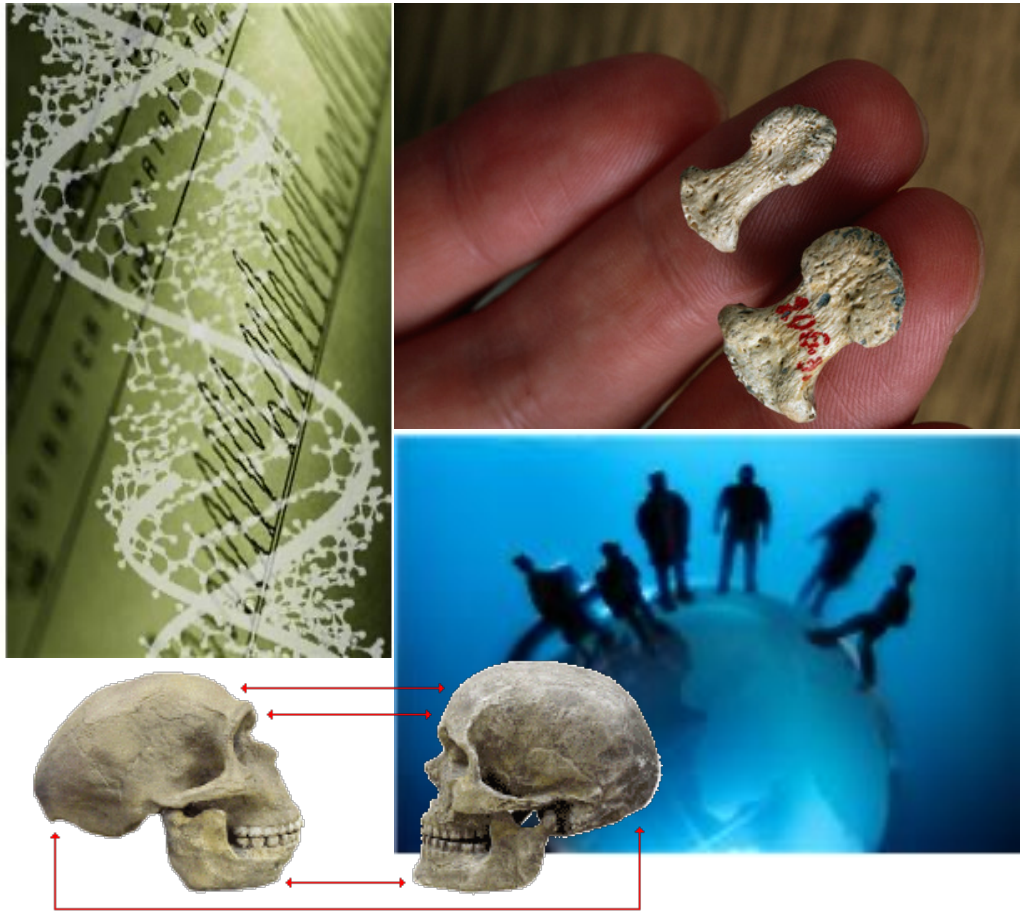
The study and science of life helps us to understand how life changes, how life reproduces, and how it adapts over time.

Understanding how we fit into the world around us impacts who we are, where we came from, and where we might go in the future.

Humans have inhabited the earth for approximately 200,000 years. During that time, we have adapted and changed in order to survive and grow.

New Research Helps Us Explain More of the World

As science develops, new research is conducted that helps us explain more of the world around us.



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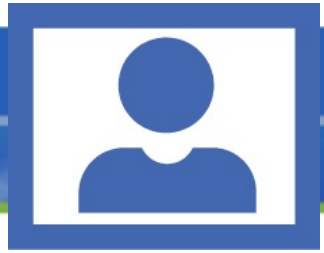
Who Am I? Activity



What makes you who you are…special?

Introduction to the Characteristics of Life Video

-Video courtesy of Frank Gregorio, a Gregorio Educational Production

Characteristics of Life

Life is diverse. Plants, animals, people, the universe—all contain life. There is a basic connection between all life forms:

- All life is made of cells, proteins, and the DNA molecule that determines its structure and function.
- All life needs energy:
  - Plants get energy directly using sunlight (a process called photosynthesis).
  - Animals (including people) get energy by metabolizing the food they eat.
- By definition, a common characteristic of all life forms is a process of reproduction that ensures that life goes on even if individuals die.
- All life changes or evolves over time because changes in the DNA molecule create changes of the life form.

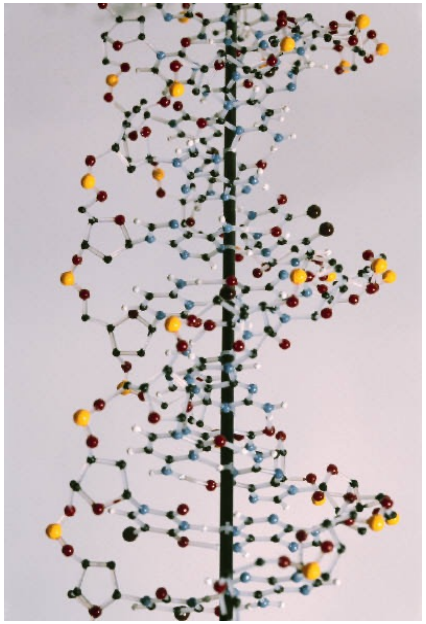
DNA is Important in Science

DNA is important in science because it helps explain life.

Think of DNA as the internal building blocks of a person or organism:

- Our ancestors
- Us as individuals today
- Future generations

DNA is an important part of genome research and understanding the basics of life.



Introduction to DNA Video

-Video courtesy of Frank Gregorio, a Gregorio Educational Production

Inheritance

DNA makes each of us unique individuals. In other words, each of us inherits certain characteristics from our parents:

- Traits (contained in DNA) are observable characteristics passed from parent to child.
- People have many traits in common with others and more so with siblings and parents.
- People's overall combination of traits makes them unique.
- Some traits are more common in a population than others.
- An equal number of traits are passed from each parent.
- Variations in DNA lead to the inheritance of different traits.

Experience

The rest of what makes us different are our experiences, including:

- Where we live
- How we were raised
- The things we learned
- How we react to things

Simply said, people are the sum of both their inheritance (DNA) and their experiences.

WHY Am I Who I Am? Activity

Which of the things you circled are traits (things you probably inherited from your parents)?

What are the things you said make you special?

People and Research

Scientists and researchers today are focusing on understanding:

- DNA (the molecule that carries the instructions that make us who we are)
- Genomes (the complete set of instructions for each person: each person has one genome)

This focus is important for understanding how different people respond to:

- Diseases
- Vaccines and drugs
- Their environment

Results of Understanding How Different People Respond

Results of this understanding help:

- Develop personalized medical treatment to treat a disease or other health conditions
- Develop a personalized plan to prevent a disease or other health conditions

Benefits of DNA Research

Help themselves and their families

Help future generations

Give back to society

Other Benefits May Include

- Ability to predict risks of disease
- Improve lab tests for early detection of disease or other health conditions
- Develop new medications and treatments for serious health issues like HIV, cancer, diabetes, and heart disease

Informed Consent to Protect People Participating in Research

Informed consent is the process of providing potential participants with important facts about the research before they decide to participate.

What Does Informed Consent Include?

- Risks of taking part (e.g., privacy, side effects)
- Sharing health and family information
- Access to health information
- Rights to control research specimens after donation
- De-identification of research participants' results
- Costs to participate, if not covered
- Consequences of withdrawing from the research
- Receiving key findings
- Whether release of findings can affect participant insurability
- Possibility of families learning information about the participant

Ethical, Legal, and Social Issues (ELSI)

Ethics

Respect for persons

Respect for persons includes the right and capacity of all individuals to make their own choices and decisions. It also includes respect for a person's culture, beliefs, and the community a participant belongs to.

Beneficence

Beneficence makes researchers responsible for participants' physical, mental, and social well-being during the study. Benefits for the participant are weighed against potential risks (also known as a risk/benefit analysis). Also included are the potential benefits to the community.

Justice

Justice requires researchers to distribute risks and benefits equitably for both participants and communities. Low-resource communities should not be used for the benefit of more privileged communities. Research participants should be equitably recruited.

Ethical Principles Must Guide All Research Activities

All phases of research	Formation of research questions
	Design of the study
	Conduct of research
	Analysis of data
	Interpretation of findings
Sharing new knowledge with the public	Informed consent
	DNA testing as inclusion criteria for certain studies
	Repository for DNA samples for future research
	Develop policy and guidelines for information access and sharing as more DNA information is decoded

Example: Henrietta Lacks

In 1951, researchers took cells from a cancer patient named Henrietta Lacks, known by scientists as HeLa.

Henrietta Lacks was never informed that researchers took the cells.

Henrietta Lacks' cells were commercialized and have generated millions of dollars in profit for the medical researchers who patented her tissue. Those cells are still in use today.

Lacks' family, however, did not know the cell cultures existed until more than 20 years after her death.

Henrietta Lacks History

In 1951, an African-American woman named Henrietta Lacks was diagnosed with terminal cervical cancer. She was treated at Johns Hopkins University, where tumor cells were snipped from her cervix without her knowledge.

Since then, Lacks' cells have been used in research into the genes that cause cancer and those that suppress it; they helped develop drugs for treating herpes, leukemia, influenza, hemophilia, and Parkinson's disease; and they've been used to study lactose digestion, sexually transmitted diseases, appendicitis, human longevity.

There are calculations that if you could lay all HeLa cells ever grown end-to-end, they would wrap around the Earth at least three times, spanning more than 350 million feet despite the fact that neither Lacks nor her family ever gave permission for her cells to be used for scientific research.

Safe Practices to Reduce Research Participant Risks

Institutional Review Board (IRB)	An IRB committee is an independent committee that ensures that research (studies and clinical trials) are ethical and that the rights of all participants are protected before the study begins. The IRB carefully reviews the research before it is conducted to ensure that the risks are minimal and offset by the potential benefits. The IRB also ensures that potential research participants are well-informed about the research prior to their enrollment through the informed consent process. An IRB includes physicians, statisticians, and other members of the community.
Data and Safety Monitoring Board (DSMB)	The DSMB is an independent group of experts who monitor patient safety and the conduct of the study at regular intervals while the study is being conducted. These experts have access to confidential data from the study to make sure that no one is being harmed and to monitor the effects of the treatment or prevention method being tested. If these experts see a positive effect early on, they can recommend a study be stopped so that the beneficial treatment or prevention can be made more broadly available. If the experts see that it is not working or that the study will never be able to determine effectiveness, the can recommend that a study be stopped.
Ethics Committee (EC)	The EC is made up of people from different backgrounds not directly involved in the research. They must have no conflict of interest, include community representatives, and be trained. The EC ensures the research is ethical, just like the DSMB does.

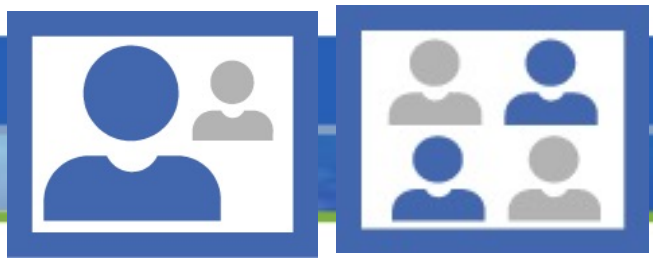
QUESTIONS?

The Future of Science

As people continue to move into new areas of research, the future of science can only be imagined. These are some of the questions that science will likely try to answer:

- What are the limits of intelligence?
- Can a machine think?
- How big is the universe?
- Is there life and intelligence beyond earth?
- How and why do men and women behave differently?
- How can we find cures for AIDS, cancer, diabetes, and heart disease?
- Will people time travel?
- Will people travel to the Milky Way?
- Can aging be slowed or reversed?

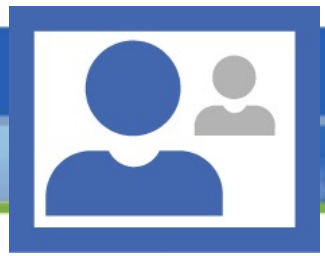
What Will We Be When We Grow Up? Activity



What will people be like 100 years from now?

Be creative

What Did You Learn?



In this activity, you will brainstorm how you can apply what you learned about science by answering a question.

With your group:

- Brainstorm the question you are assigned (you only need to brainstorm one of the questions).
- Share your answers with the whole group so they can hear your ideas.

How can you use what you have learned about the human side of science in your life?

What have you heard in the news recently about research that you would like to know more about?

In what ways has the information about people and research impacted YOU?

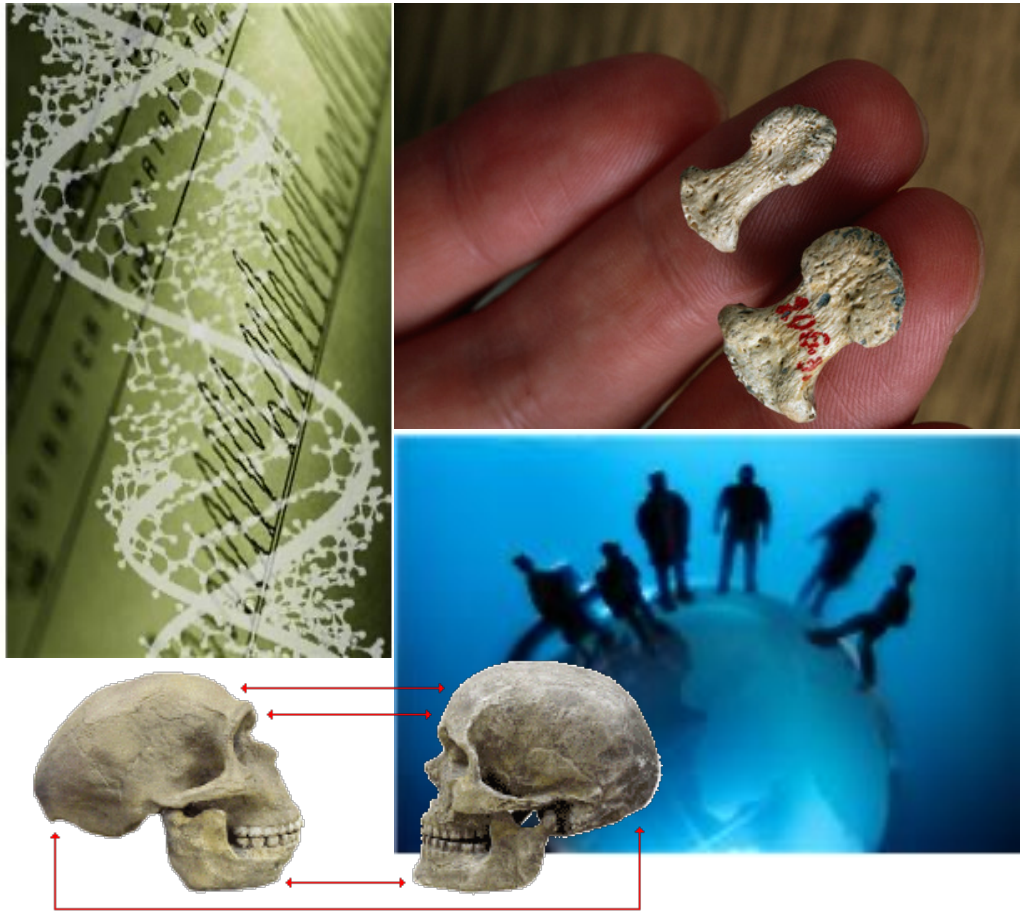
In what ways has the information about DNA and inheritance impacted YOU?

Summary

The mysteries of who we are and how we evolve give us a fascinating look at the wonder of our world and our place in it.

100 years ago, we could not imagine what we know today.

100 years from now, our place in the world and our understanding of the world will be just as amazing.



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QUESTIONS?

CONCLUSION

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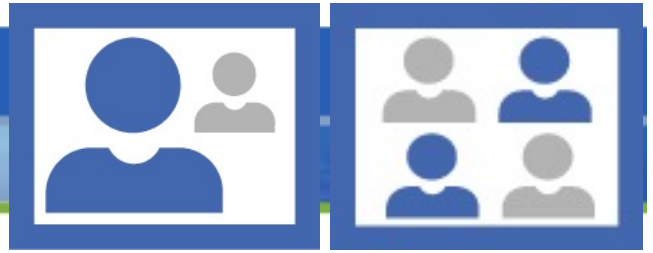
Laws of Flight Activity



Follow the scientific process

Create a paper airplane experiment

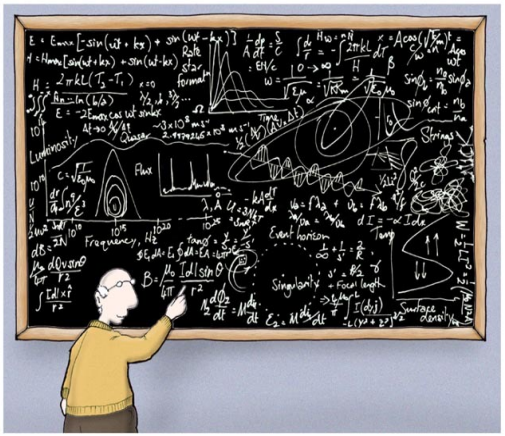
What Is Science?

Research is designed to help answer questions, make decisions, and solve problems.

Anyone can do research because we answer questions, make decisions, and solve problems every day.

Research is conducted by ordinary and extraordinary people who have a passion to understand the world around them.

What Is the Scientific Method?



Astrophysics made simple

One of the outstanding things about science is the objectivity of its findings. Researchers and scientists are trained to observe, to experiment, and to analyze objectively. Wishful thinking has no place in their work. Their findings will not become a permanent part of science until they have been challenged and confirmed by other scientists and researchers. In other words, science is a very democratic process. Anyone can question a "law" of science.

The strength of science and its power rests on:

- The thorough testing of its structure
- An interesting combination of collaboration and competition
- Scientists' independence

The Human Side of Science

The mysteries of who we are and how we evolve give us a fascinating look at the wonder of our world and our place in it.

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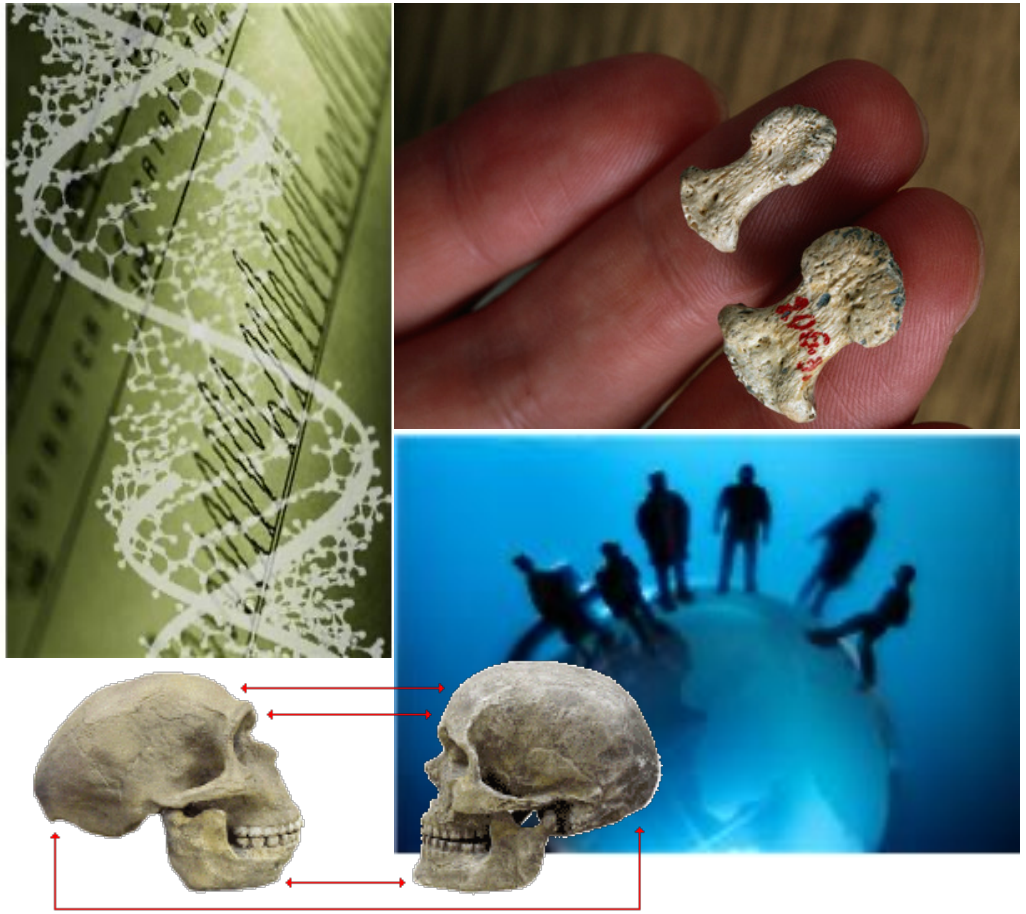

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QUESTIONS? ...AND THANK YOU!