

No Participant Guide page.

Welcome participants to the course. Tell participants to sit down anywhere they will be comfortable.

Thank participants for coming to the workshop. Remind participants that the course will be more interesting and fun if they ask questions and share their experiences.

Distribute a copy of the Participant Guide to each attendee. Tell participants they can write their names on their copy, that the Participant Guide is a reference for the workshop and includes space for them to take notes during the workshop.

Explain that the Participant Guide contains a lot of information. Ask participants to look at the Table of Contents and review with them the topics covered in the course.

Be sure to read the headings on each slide before discussing the slide.

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)."

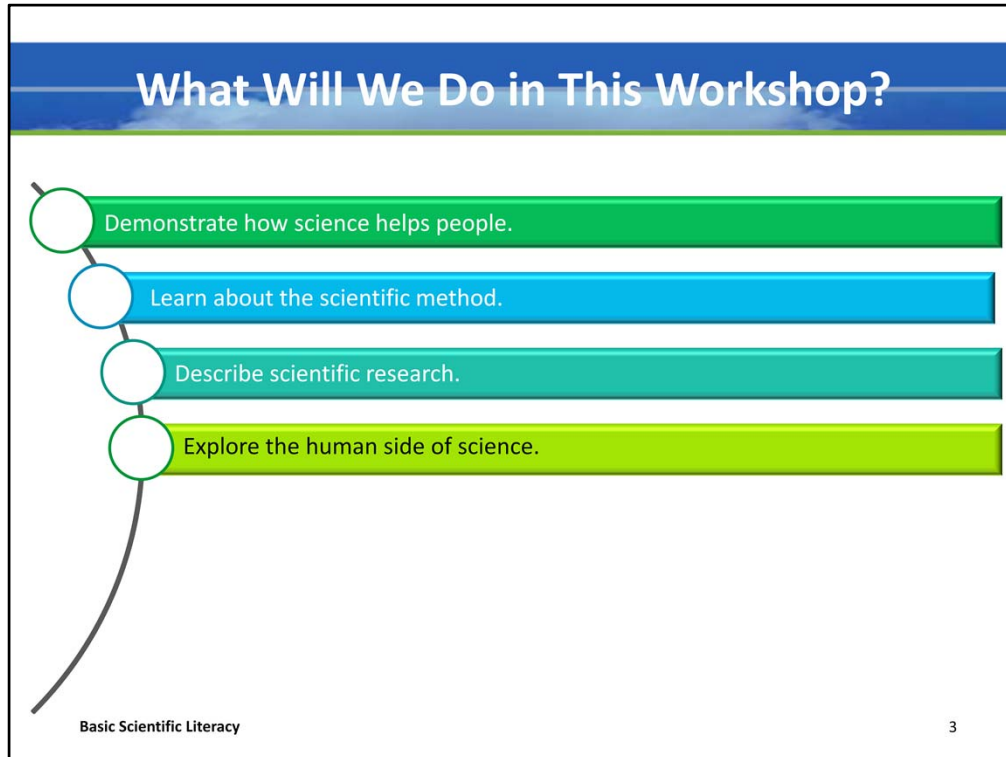
Basic Scientific Literacy

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Participant Guide page 1.

Review the content on the slide.

Estimated timing for this section is 20 minutes. Add 15 minutes if using the optional quiz.



Participant Guide page 1.

Tell participants before reviewing the slide content: In this workshop, we will look at many important and interesting areas of science. We will present important information and you will be able to ask questions. We will also do activities together to help you remember what you learn.

Review the objectives on the slide.

Tell participants: This workshop is designed to give you an opportunity to:

- Apply the information you learn in activities and discussions.
- Ask questions about information you do not understand.
- Practice what you learn.

The Participant Guide includes information, facts, and space to write your own notes, and a glossary for each section of the material. The glossary includes many words, abbreviations, and definitions that may not be familiar to you.

Presenter notes: The optional quiz can be used here (see quiz handout) or when participants arrive. The quiz can be given at the beginning of the presentation and at the end of the presentation. There are 10 questions. Allow approximately 15 mins for participants to complete the quiz. The quiz answers will be reviewed at the end of the presentation.

Notes have been inserted in the PPT that provide the content needed to answer each of the questions in the quiz. These notes are titled: "Information related to the optional quiz." Presenters should add the answers to the presentation if the optional quiz is included.

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.



Participant Guide page 1.

Review the content on the slide.

Tell participants before reviewing the slide content: Science helps us explain the interrelationships among ourselves and our world: past, present, and future.

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.



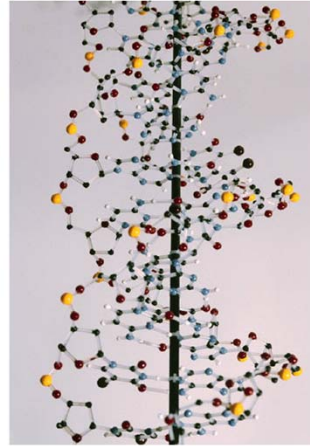
Participant Guide page 2.

Review the content on the slide.

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.



Basic Scientific Literacy

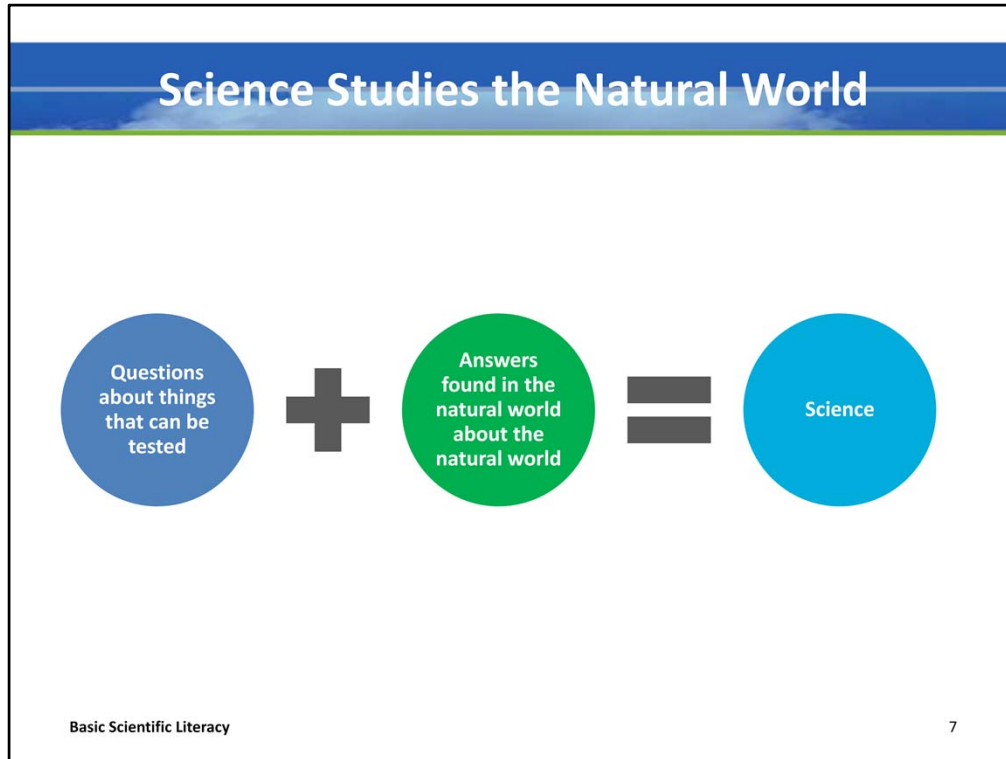
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Participant Guide page 3.

Review the content on the slide.

Tell participants after reviewing the slide content: The picture is a model of DNA, which is the hereditary material in humans and almost all other organisms. 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, and future generations.

Presenter note: This is the first instance where we begin to talk about DNA and heredity that will be discussed later. Some participants may be uncomfortable with the term “genetics,” so avoid using the term until later in the workshop.



Participant Guide page 3.

Review the content on the slide.

Tell participants before reviewing the slide content:

- Things that can be tested include how pollution affects our bodies, how lenses help us see planets, what we inherit from our ancestors, what makes leaves change color, etc.
- The natural world includes the physical universe around us (atoms, plants, ecosystems, people, societies, and galaxies) and natural forces at work on those things.

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

Basic Scientific Literacy

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No Participant Guide page.

Review the high-level agenda for the workshop. Be prepared to change this slide if the workshop is given with a different time structure.

Review the logistics of breaks and lunch, depending on the location.

Housekeeping

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

Breaks
Messages
Smoking
Restrooms
Lunch
Emergencies

Remember to:

Ask questions

Share what you know

Participate in all activities


Basic Scientific Literacy

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No Participant Guide page.

Review the content on the slide.

Icebreaker



What is your name?

What do you do?

Tell us something special about yourself.

Basic Scientific Literacy

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No Participant Guide page.

Introduce a whole group activity to introduce attendees to each other (take approximately 5 minutes).

Go around the room and ask each person to stand up and state : Your name, what you do, and why you are taking this workshop. Begin with yourself to provide an example. Or feel free to use a different introductions activity or “ice breaker,” if desired.

WHAT IS 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)."

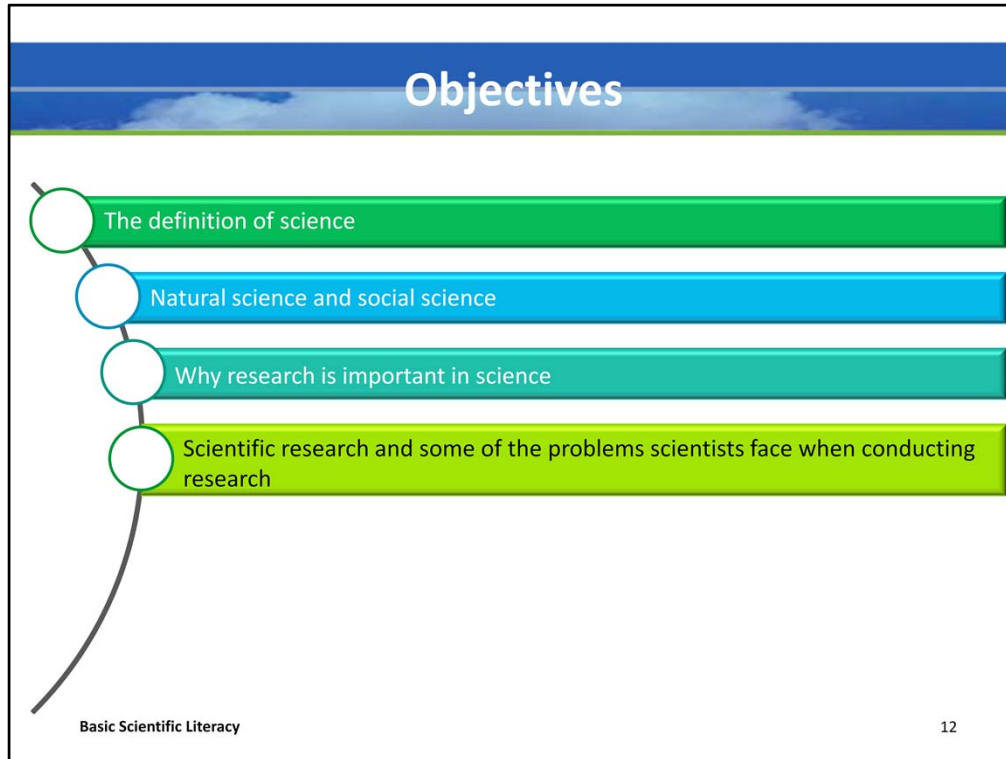
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Participant Guide page 4.

Review the content on the slide.

Estimated timing for this section is 2 hours, 25 minutes.



Participant Guide page 4.

Tell participants before reviewing the slide content: In this session (What Is Science?), you will learn about...

Review the objectives on the slide.

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.

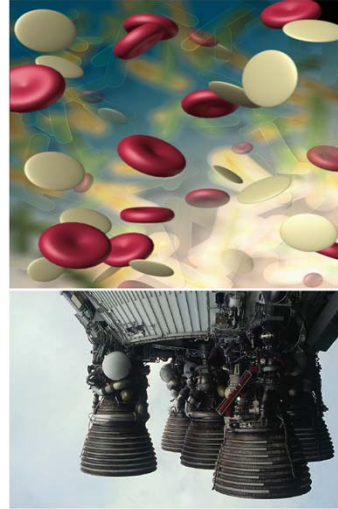
Participant Guide page 4.

Review the content on the slide.

After reviewing the content, tell participants about the photo: This is a picture of test tubes in a lab used in research.

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.



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Participant Guide page 4.

Review the content on the slide.

After reading the “Improved access to health care” bullet, tell participants:

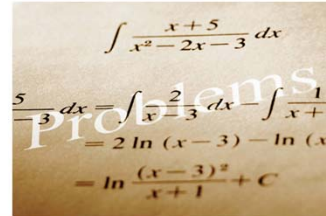
- 100 years ago, the life expectancy for Americans was just 48 years—now it is 78 years, a significant improvement of 40%.
- This 40% increase in life expectancy in one century is bigger than what occurred in the previous 200,000 years of human existence.
- The major causes of death 100 years ago were infectious diseases and complications of childbirth.

After reviewing the content, tell participants about the photos:

- The top photo is a magnified view of red and white blood cells to investigate and solve health problems.
- The bottom photo is a photo of rocket boosters that help us explore space.

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?



Problems

$$\int \frac{x+5}{x^2-2x-3} dx$$
$$\frac{5}{3} dx = \int \frac{2}{x-3} dx - \int \frac{1}{x+1} dx$$
$$= 2 \ln(x-3) - \ln(x+1)$$
$$= \ln \frac{(x-3)^2}{x+1} + C$$



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Participant Guide page 5.

Review the content on the slide.

After reading the last bullet, tell participants that:

- Genetics is the branch of biology that studies heredity and variation in plants and animals.
- Biology is the science of life and living organisms.

After reviewing the content, tell participants about the photos:

- The photo at the top is an example of using data to solve problems.
- The photos on the bottom show teams of scientists working together.

Science Is a Detailed Study of a Subject



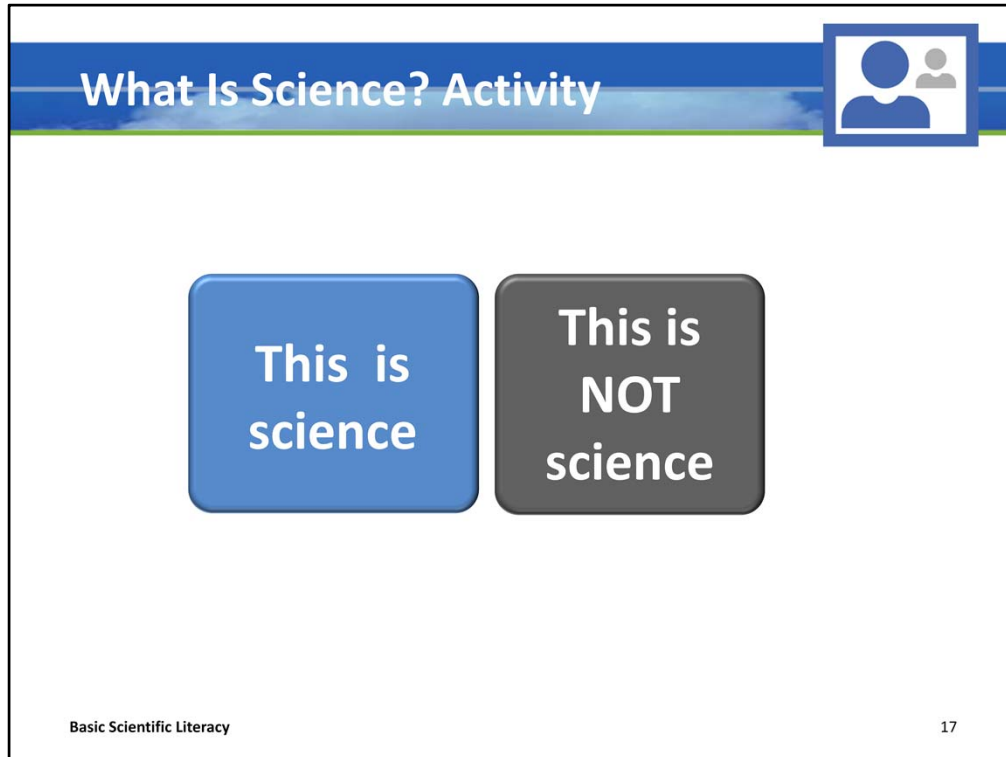
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Participant Guide page 6.

Review the content on the slide.

After reviewing the content, end with the comment that all of these things are what we call “science.”



No Participant Guide page.

Divide participants into 3-4 groups of 3-4 members for each group.

The activity builds through this section of the course using the same activity cards in different ways.

This activity must occur before reading the definition of science (the next topic).

Introduce a small group activity with cards: "What Is Science?"

Distribute one set of activity cards to each table group.

Tell participants to divide the cards into two piles:

- One pile of cards should be things they think are science ("This is science")
- The other pile of cards should be things they think are NOT science ("This is NOT science").

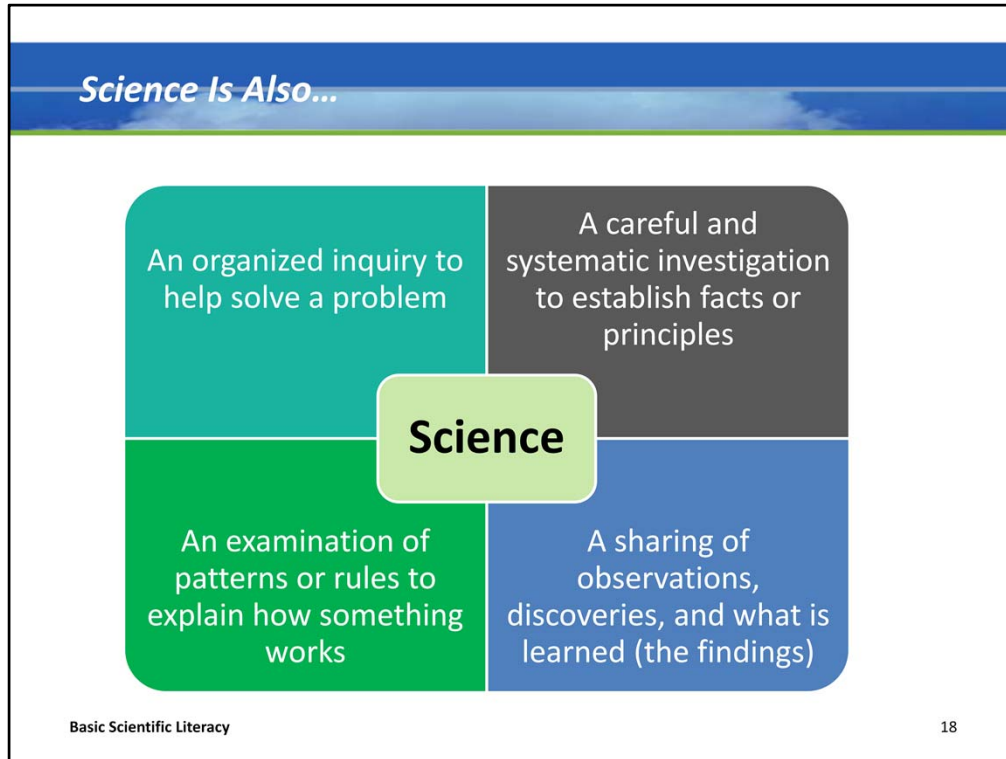
Although all of the cards should be in the "This is science" pile, they probably will not be, which is fine.

DO NOT PROVIDE ANSWERS AT THIS TIME. Tell participants we will reveal the answers later. Participants will have an opportunity to review the two piles again after they hear the definition of science on the next two pages.

During the group discussion/debrief, ask participants to share why they decided some of the cards should be in the "This is NOT science" pile.

Allow approximately 15 mins for groups to make their piles. Allow approximately 5 mins for participants to share their reasons why they think some of the cards are not science.

Total time for the activity: 20 mins.



Participant Guide page 6.

Review the content on the slide.

Information related to the optional quiz: Q1: True.

Q: Science is a detailed study of a subject to discover new information and reach a new understanding.

A: Science is an organized inquiry to help solve a problem; a careful and systematic investigation to establish facts or principles; an examination of patterns or rules to explain how something works; and a sharing of observations, discoveries, and what is learned (the findings).

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

Participant Guide page 6.

Review the content on the slide.

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.



Participant Guide page 6.

Review the content on the slide.

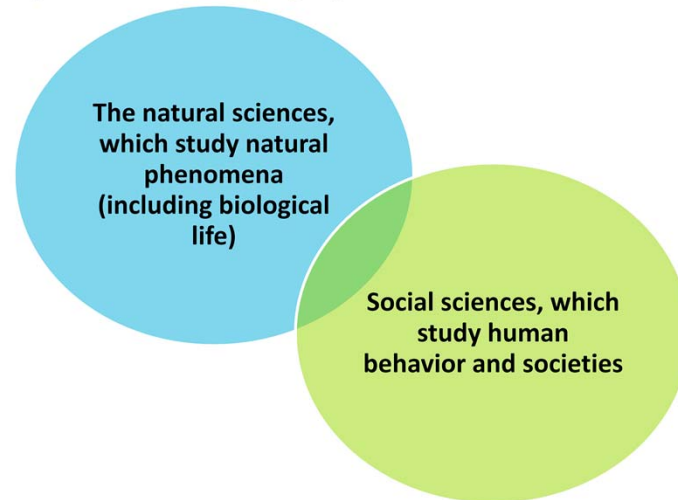
Tell participants after the example about the law of gravity: There are advantages of knowing the law of gravity:

- Because rain obeys the law of gravity, crops receive nutrients.
- Because waterfalls obey the law of gravity, the power of the falling water can be harnessed for electrical energy.

After reviewing the content, emphasize the importance of science: It 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:



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Participant Guide page 7.

Review the content on the slide.

“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.



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Participant Guide page 7.



Review the content on the slide.

After reviewing the bullets on the slide, describe the photos in the collage. The photos are a lead-in to the activity on the next slide, so be sure to discuss the photos using the words below:

- Top left: Biology (cells/natural science)
- Top right: Anthropology (aboriginal cave painting; this is an example of a social science)
- Center: Chemistry (periodic table of elements; this is an example of a natural science)
- Bottom left: Earth science (rock, atmosphere; this is an example of a natural science)
- Bottom center: Language and communication (this is an example of a social science)
- Bottom right: Physics (Newton’s cradle laws of gravity; this is an example of a natural science)

Tell participants after reviewing the photos: All of these photos are examples of science.

What Kind of Science? Activity



This is a natural science

This is a social science

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No Participant Guide page.

Introduce a small group activity, which is a continuation of the earlier: What Is Science? Activity

Ask participants to look at their two piles of cards (This is science/This is NOT science) again and move any cards they need to based on the definition of science. All cards should now be in the “This is science” pile.

Reinforce that all of the cards are science because they are examples of natural science and/or social science.

DO NOT REVIEW WHICH ARE NATURAL SCIENCES AND SOCIAL SCIENCES AT THIS POINT.

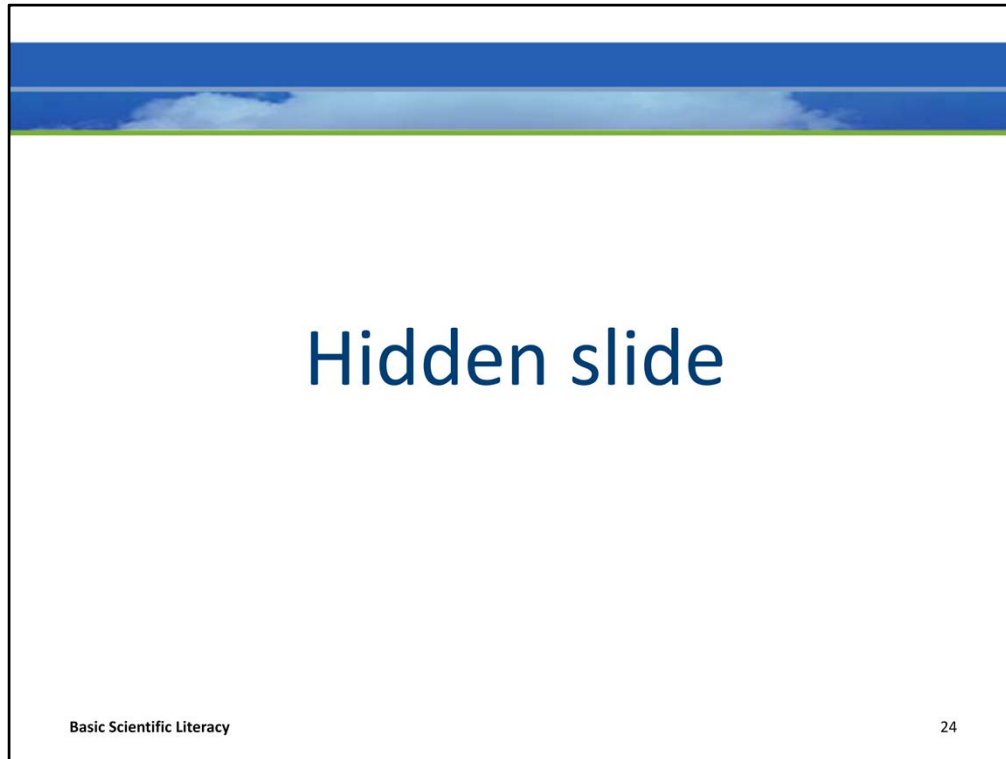
Stop and ask for questions before going to the next part of the activity.

Now tell participants to look at the slide and separate the cards into these two new piles (This is natural science/This is social science).

During the group discussion/debrief, ask participants to share why they put their cards in the two different piles. Be prepared to discuss that there may be an overlap between the two, but they are all still “science.”

Remind participants that these examples are all examples of empirical sciences, which means they are:

- Based on observation
- Capable of being tested



Then lead a whole group discussion using one of the examples and ask how it can be based on observation and capable of being tested.

Provide one example (there will likely be more questions about how the social sciences fit the definition). "Foreign languages" might include a question such as "What are the differences between Russian and English?" In order to answer this question, researchers might OBSERVE the two written alphabets and the differences in the meanings of the same word in writing and in speech. Researchers would then make statements they believe are true and then develop tests to either prove or disprove those statements.

Ask participants to go through the same process for 1-2 more of the sciences.

The answers are:

- Natural sciences: Tides, X-rays, Doppler radar, Combustion engine, Radio waves, Dolly the sheep (cloning), Polio vaccine, Stones, Rain gardens, Cockroaches, Weather prediction
- Social sciences: Foreign languages, International relations, Education, Criminology, Human personality, U.S. constitutional law, Philosophy, Economics, Graffiti

Allow approximately 10 mins for groups to make their piles. Allow approximately 5 mins for participants to share their reasons why they think some of the cards are natural or social science. Allow approximately 5 mins for the "testing" discussion.

Total time for the activity: 20 mins.

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.

Participant Guide page 8.

Review the content on the slide.

Information related to the optional quiz: Q2: True.

Q: Research asks and answers the questions that solve problems and produce knowledge that can be used in new ways.

A: 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 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...

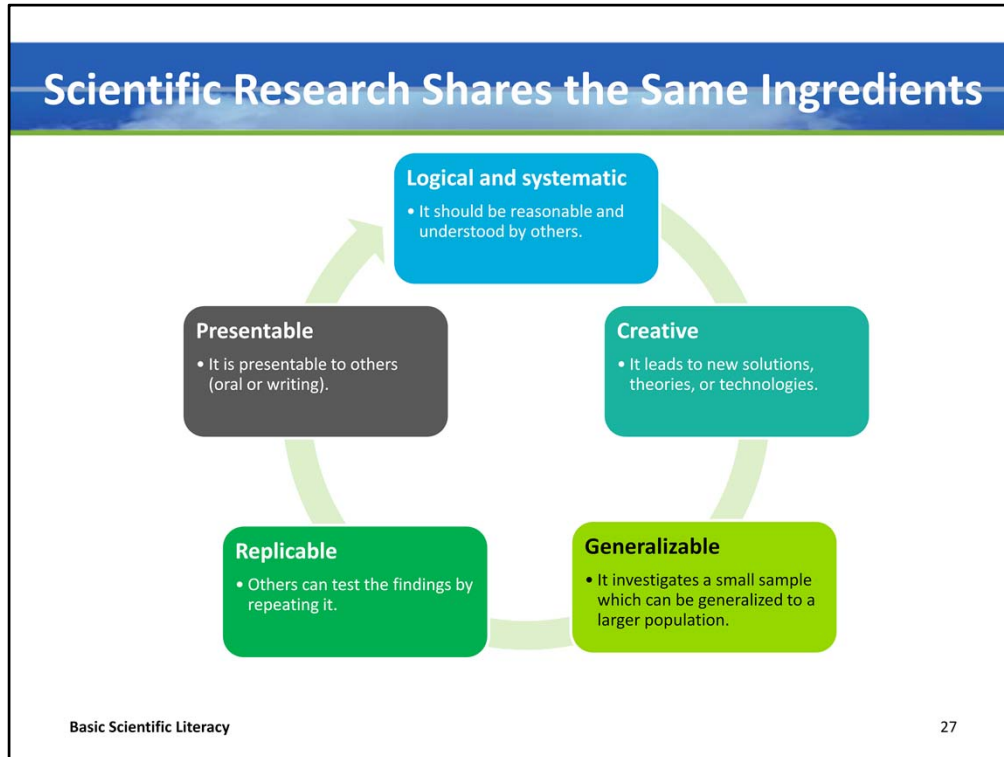
And the investments don't always pay off. But when they do, they change our lives in ways that we could never have imagined...And sometimes, in fact, some of the best products and services spin off completely from unintended research that nobody expected to have certain applications."

- April 2, 2013, President Barack Obama

Participant Guide page 8.

Review the content on the slide.

Summarize the quotation by telling participants that research is the cornerstone of science, and the results of scientific research impact us in limitless ways.



Participant Guide page 8.

Review the content on the slide.

Information related to the optional quiz: Q3: False.

Q: All scientific research shares just one thing: it must be logical and systematic.

A: All scientific research shares five things. It is logical and systematic (it should be reasonable and understood by others); it is creative (it leads to new solutions, theories, or technologies); it is generalizable (it investigates a small sample which can be generalized to a larger population); it is replicable (others can test the findings by repeating it); and it is presentable (it includes presentation to others (oral or writing)).

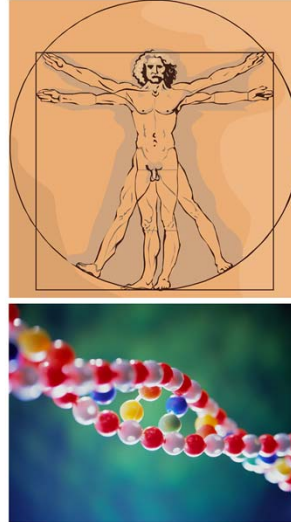
Example: The Human Genome Project (HGP)

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.



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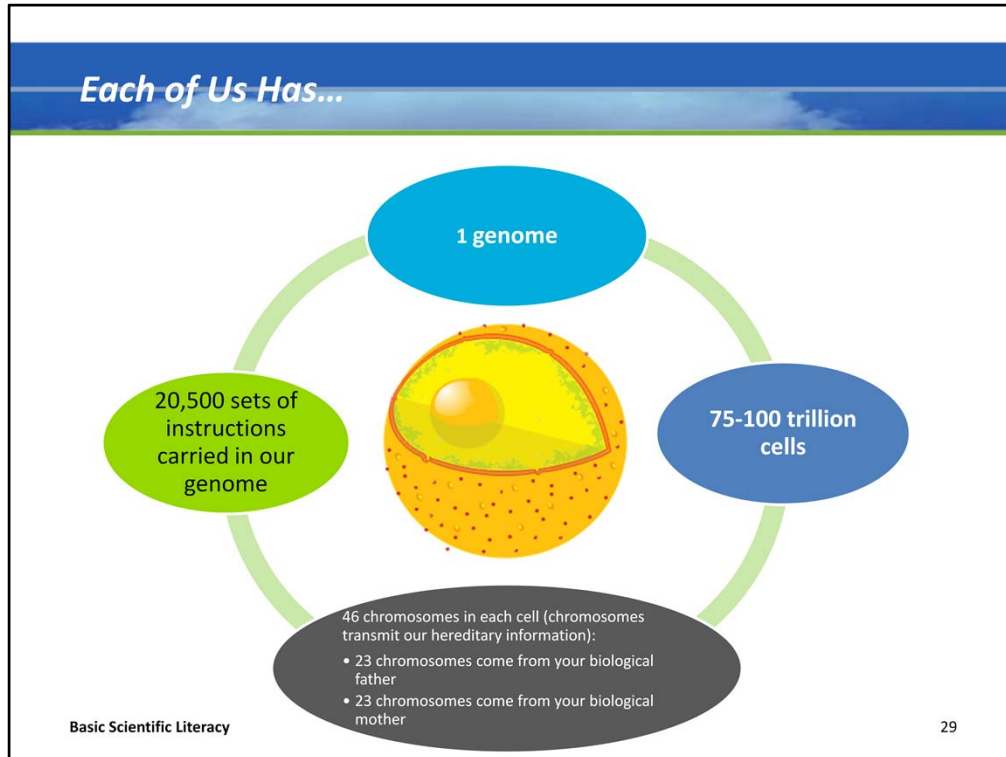
Participant Guide page 9.

Review the content on the slide.

Avoid using the term “genetics” at this point in the workshop.

After reviewing the content, tell participants about the photos:

- Top photo: A drawing by Leonardo da Vinci from the late 1490s that demonstrates the blend of art and science.
- Bottom photo: The human genome resembles a twisted ladder; the “rungs” on the ladder are the instructions that make up a human.



Participant Guide page 9.

Review the content on the slide.

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.

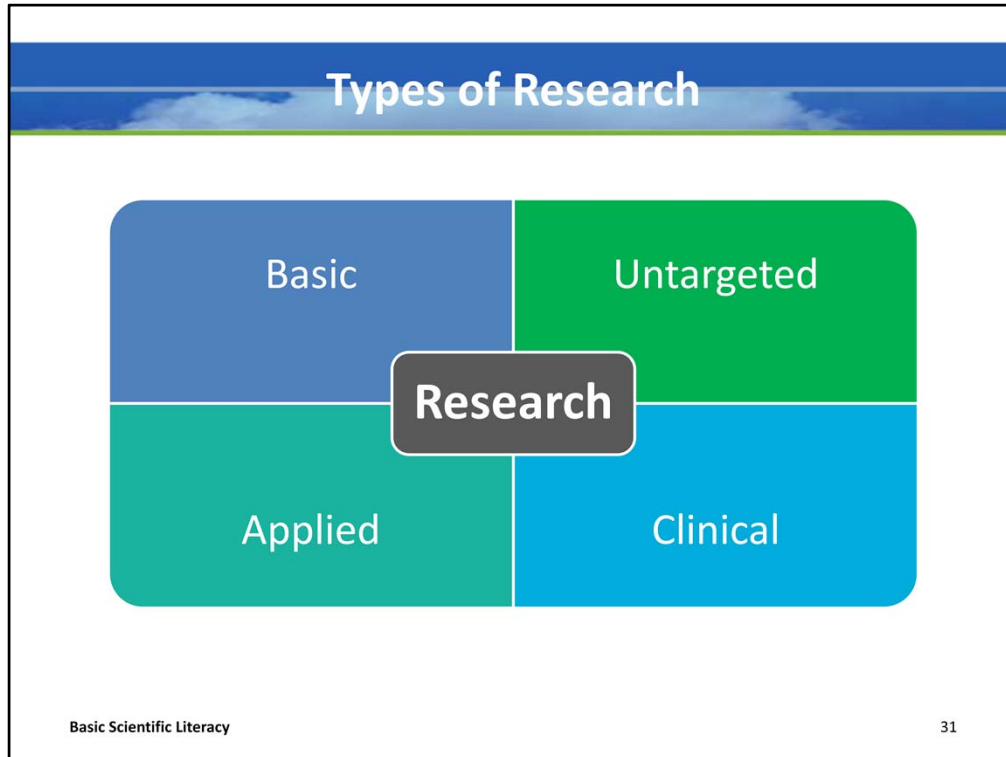


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Participant Guide page 9.

Review the content on the slide.



Participant Guide page 10.

Review the content on the slide.

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.

Basic
Untargeted
Research
Applied
Clinical

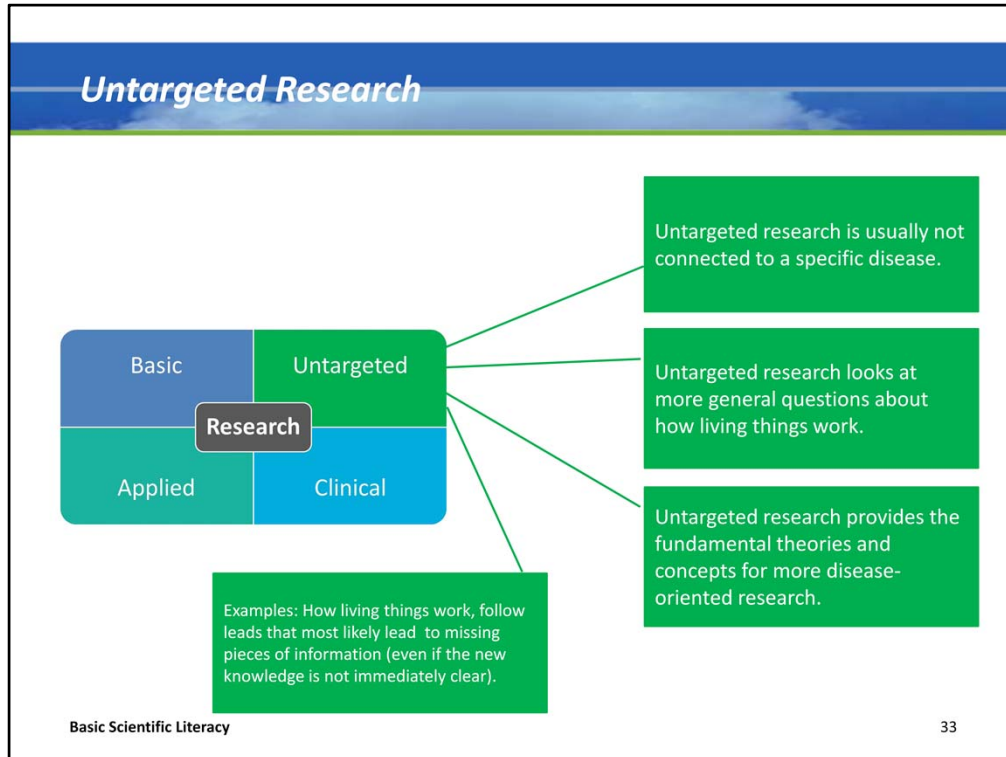
Examples: How the universe began; what protons, neutrons, and electrons are composed of; how molds reproduce.

- 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).

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Participant Guide page 10.

Review the content on the slide.



Participant Guide page 10.

Review the content on the slide.

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.

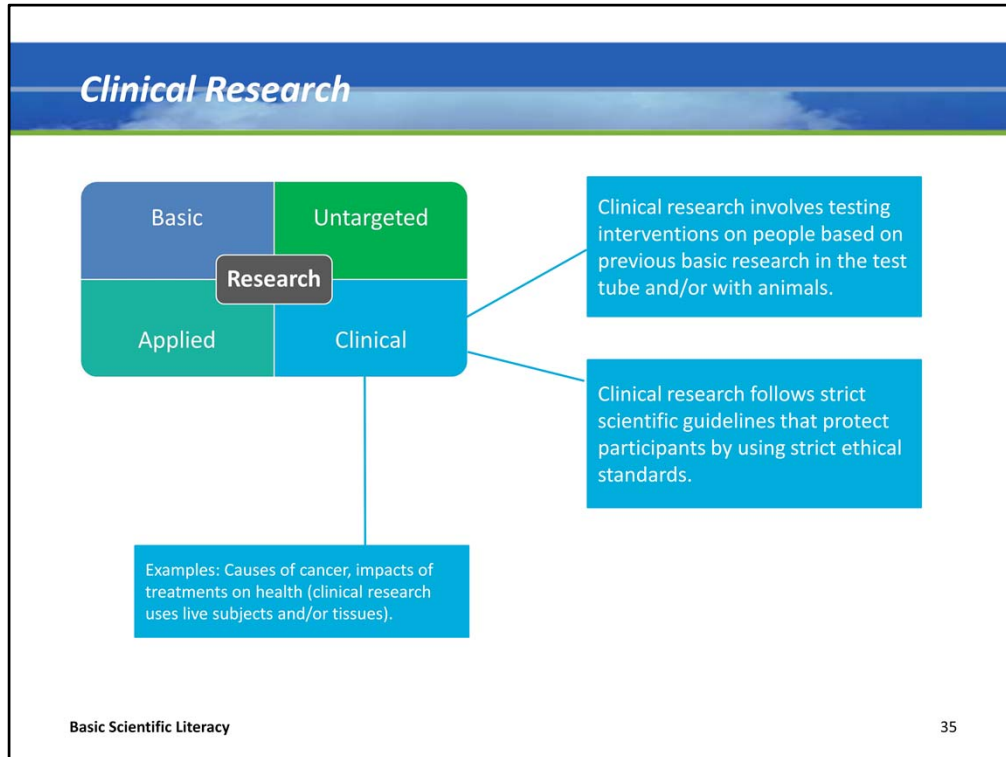
Examples:: Improve crop production, energy efficiency, modes of transportation.

- 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.

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Participant Guide page 10.

Review the content on the slide.



Participant Guide page 10.

Review the content on the slide.

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.

Participant Guide page 11.

Review the content on the slide.

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?

Participant Guide page 11.

Review the content on the slide.

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.

Participant Guide page 12.

Review the content on the slide.

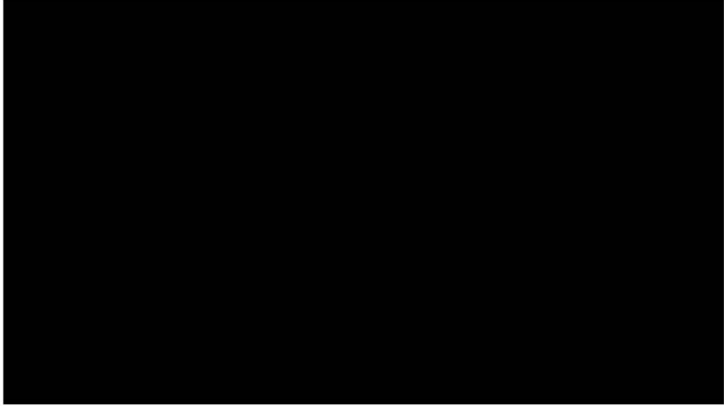
What Did Edward Jenner Find?

- 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.

Participant Guide page 12.

Review the content on the slide.

The Edward Jenner Story



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No Participant Guide page.

Note: No credit for this video is required.



This slide contains a link to an optional video about Edward Jenner. The presentation is very simple but effective in explaining how the smallpox vaccine came about and Edward Jenner's role. It is 2 minutes, 31 seconds long. To play the video, double click on the black box. It is a direct link to YouTube, so an internet connection is needed. Be prepared to cancel any pop-up ads.

Introduce the video by telling participants: This is an easy-to-understand cartoon that quickly explains the role of scientists, their curiosity to solve problems, and Edward Jenner's role in developing the smallpox vaccine.

After playing the video, take a few minutes to ask participants if they learned something new about science and to share what they learned.

Tell participants that science first starts with an idea (what we call an "hypothesis"), and then the hypothesis is tested.

What Does it Mean? Activity

Work with a partner

Conduct research

Share your results

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Participant Guide pages 13-14.

Introduce the activity.

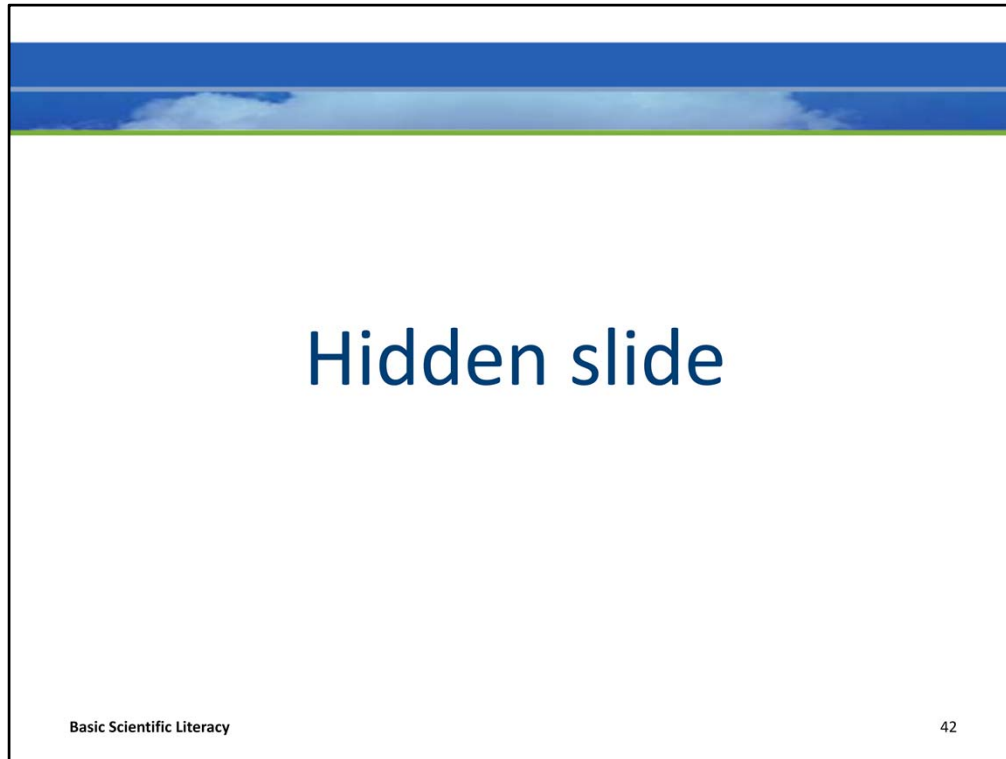
Ask participants to choose a partner to work with for this activity. Distribute four pieces of paper to each pair. Tell participants to exchange Participant Guides so the performer's answers are written in his/her book.

Note: The instructor should practice doing question 4 to make sure you can demonstrate to participants what they're supposed to do. To reduce your hands to the right size, interlace your fingers so the triangle gets smaller. It would be a good idea to demonstrate the instructions BEFORE letting them start the activity.

Tell participants before starting the activity: The questions you will answer are designed to get you to start thinking about how your body and brain work together. The questions in the first part of the activity (Questions to Ask Your Partner) are research questions that highlight the differences among people. The questions in the second part of the activity (Questions to Answer WITH Your Partner) are designed to remind you about what research does.

This activity should take approximately 30 minutes (15 minutes for the research part and 15 minutes for a whole group discussion using the debrief below).

Research is an important part of science because it helps us understand how things work, how they 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."

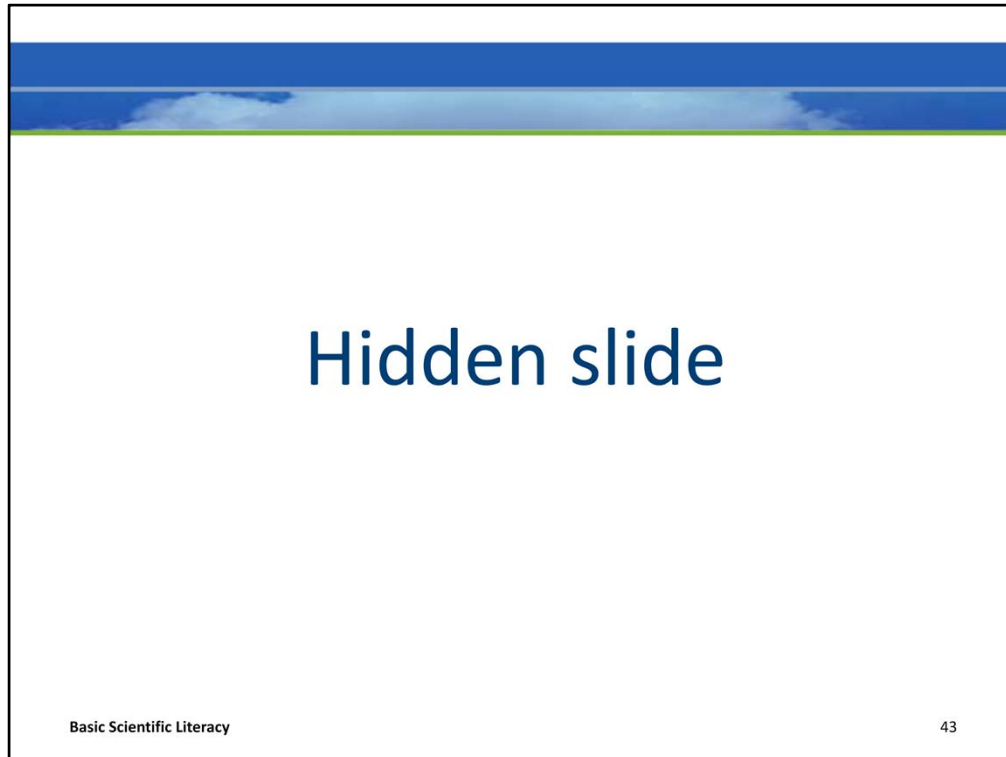


Continue the debrief by asking the following questions:

- From your research, how many of you are right handed?
- How many of you are left handed?
- How many of you answered the first question differently than what the research showed?

Interesting information to share after the debrief:

- Around 90% of people are right handed [calculate the % for the class].
- Scientists do not know why most people favor their right side. Some think it is related to:
 - Which side of your brain you use for language; the right side of your body is controlled by the left side of your brain; in 90% of people, the left side of the brain also controls language.
 - Culture since the word "right" is associated with being correct and doing the right thing while the word "left" originally meant "weak".
 - Social development as more children were taught important skills by right-handed people and various tools were designed to be used with the right hand.
- Around 80% of people are right footed.
- Around 70% of people favor their right eye. These percentages are lower than those who are right handed and this could be because our body has more freedom of choice in choosing its favored foot and eye than that of its favored hand. In other words, you are more likely to be trained to use your right hand than your right foot and even more so than your right eye.





- It is not strange to find people who favor the opposite hand and foot (e.g., left hand and right foot), and some people are lucky enough to be ambidextrous, meaning they can use their left and right sides with equal skill.
- Interesting fact: In 2009, only 7% of professional basketball players were left handed; in 2008, 26% of professional baseball pitchers were left handed. Both of these statistics are outside the averages.

Provide an example as a summary to the activity: A disproportionately high percentage of left-handed athletes have long dominated the world of sports, especially considering that left-handed people make up only 10% of the population. In athletic contests that involve competing one on one, such as boxing and tennis, lefties possess an advantage that has everything to do with surprise [\[http://science.howstuffworks.com/life/left-handed-sports1.htm\]](http://science.howstuffworks.com/life/left-handed-sports1.htm).

Taking what you learned during your research for this activity, look at how many ways you can continue investigating and researching to produce knowledge that can be used in new ways.

Final discussion questions: Ask for a few people to share their answers from the questions they answered with their partners. And then ask: Knowing what you do now, what research might you want to pursue and why?

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?

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Participant Guide pages 15-16.

Introduce a small group activity.

Divide the whole group into 4 smaller groups.

Assign one of the questions in the boxes to each group.

Allow approximately 5 minutes for the groups to brainstorm their answers.

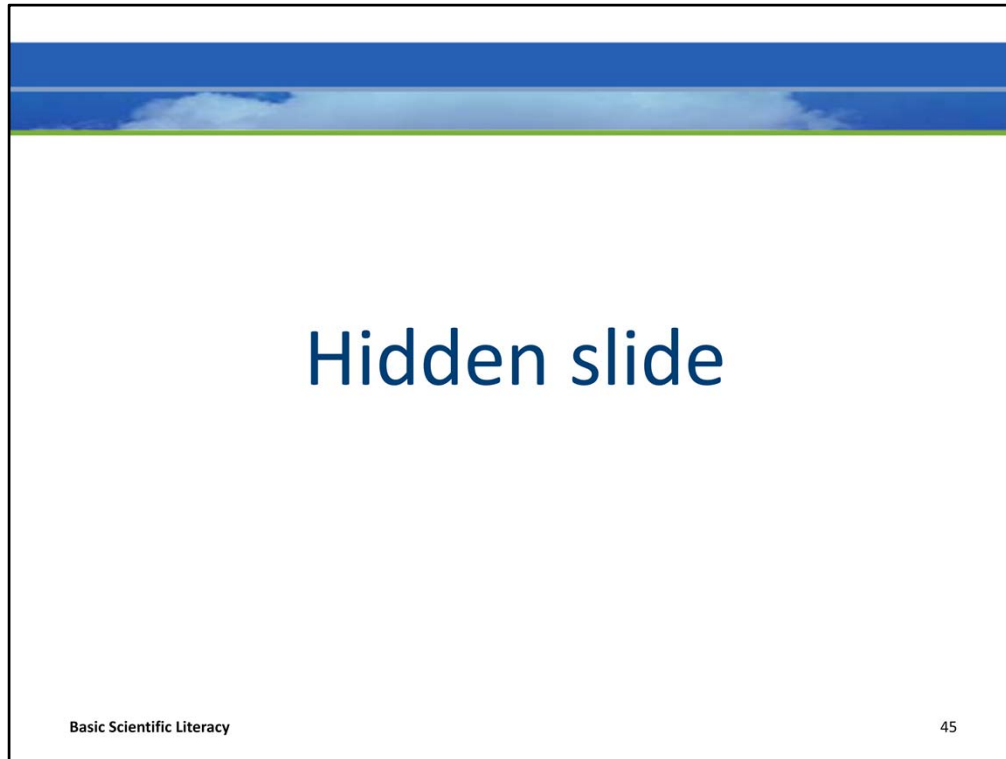
Encourage participants to write their brainstorm on a flip chart, white board, and/or in their Participant Guides (each question has been reproduced in the Participant Guide with space to write).

Ask someone from each group to share some/all of their answers.

Encourage the other groups to write these answers in the provided space in their Participant Guides.

Possible answers include:

- Question 1: How can you use what you have learned about science in your life? Look up information about medical research that affects me and my family so I can better understand and support new technologies and treatments that will improve our health.
- Question 2: What have you heard in the news recently about science that you would like to know more about? Some examples of recent science news include "Antifreeze to Lower Cost of Solar Energy," Exercise Makes Brain More Resilient," and "US Researchers make 'bionic ear' with 3-D printer."



- Question 3: 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? Important information is a history of diseases, cause and ages of death for ancestors, current health issues and medications, etc. The important thing is to be sensitive to each person's privacy, especially when discussing current health status.
- Question 4: Imagine that you are a scientist and you can investigate or invent something, what would it be and why? There is no recommended answer for this question. Look for reasons why people want to investigate or invent something.

Activity timing: 15 mins (5 minutes for the brainstorm; 10 minutes for the whole group sharing).

Allow for questions before ending the activity and going to the summary.

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.

Participant Guide page 17.

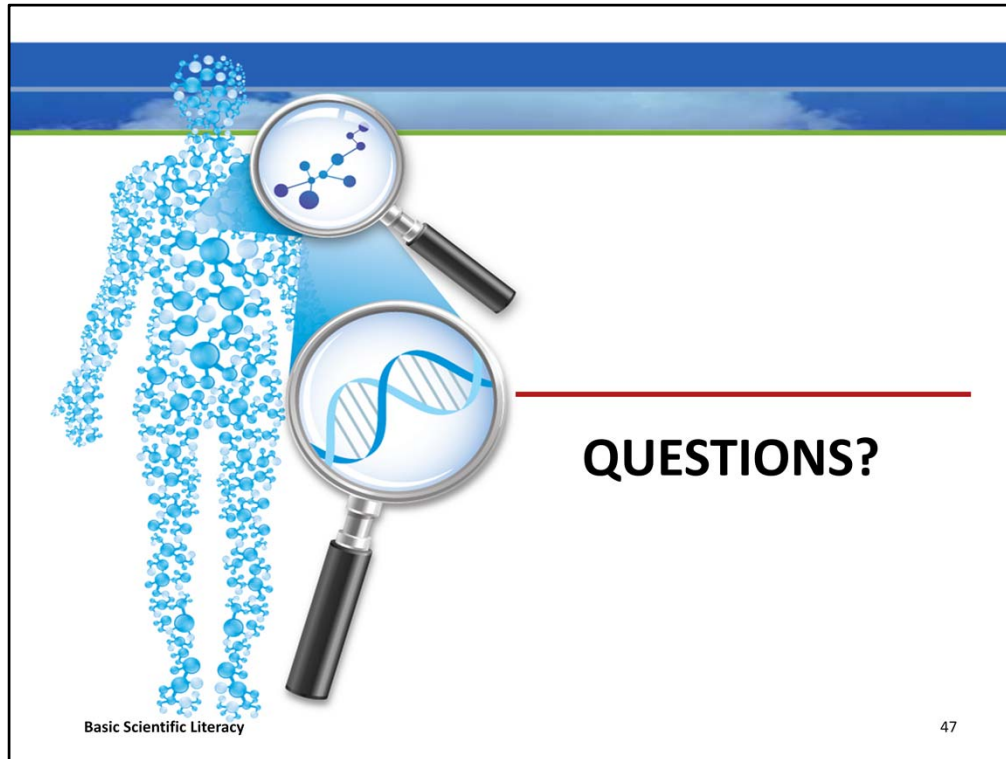
Review the content on the slide.

Tell participants where to find the glossary of terms and abbreviations used in this session in case they have questions about them.

Review the Frequently Asked Questions (FAQs) and additional resources for more information.

Ask participants if they have any additional resources they would like to share.

Save and add any additional resources for future use.



No Participant Guide page.

Ask participants if they have any questions. Answer all questions, if possible. If not, make a note of these questions to prepare for the next training session.

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)."

Basic Scientific Literacy

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Participant Guide page 22.

Review the content on the slide.

Presenter note: This section of the course is very basic in order to be understandable for the target audience.

Estimated timing for this section is 1 hour, 45 minutes.

Objectives

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

Basic Scientific Literacy

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Participant Guide page 22.

Tell participants before reviewing the slide content: In this session (What Is the Scientific Method?), you will learn about...

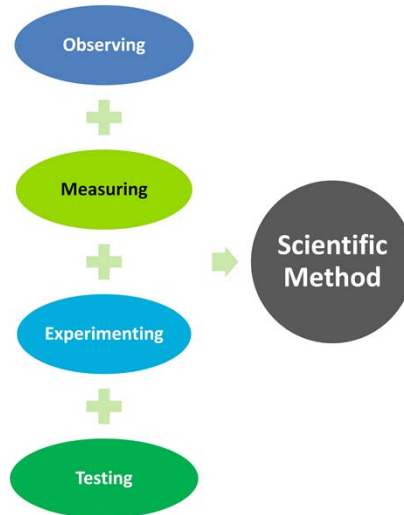
Review the objectives on the slide.

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:



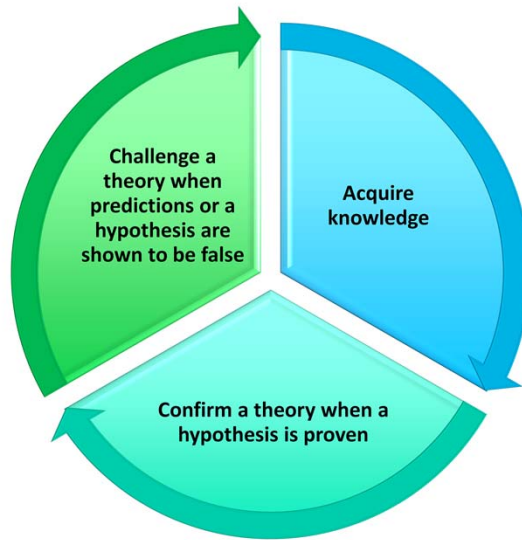
Basic Scientific Literacy

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Participant Guide page 22.

Review the content on the slide.

What the Scientific Method Allows Scientists and Research to Do



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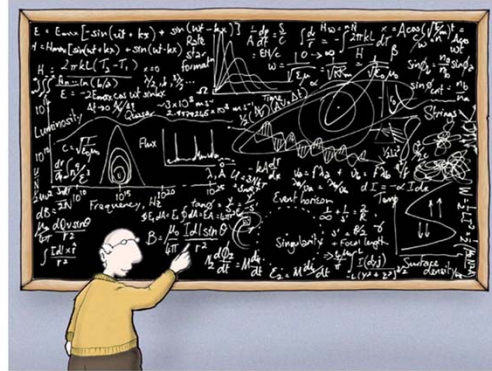
Participant Guide page 22.

Review the content on the slide.

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

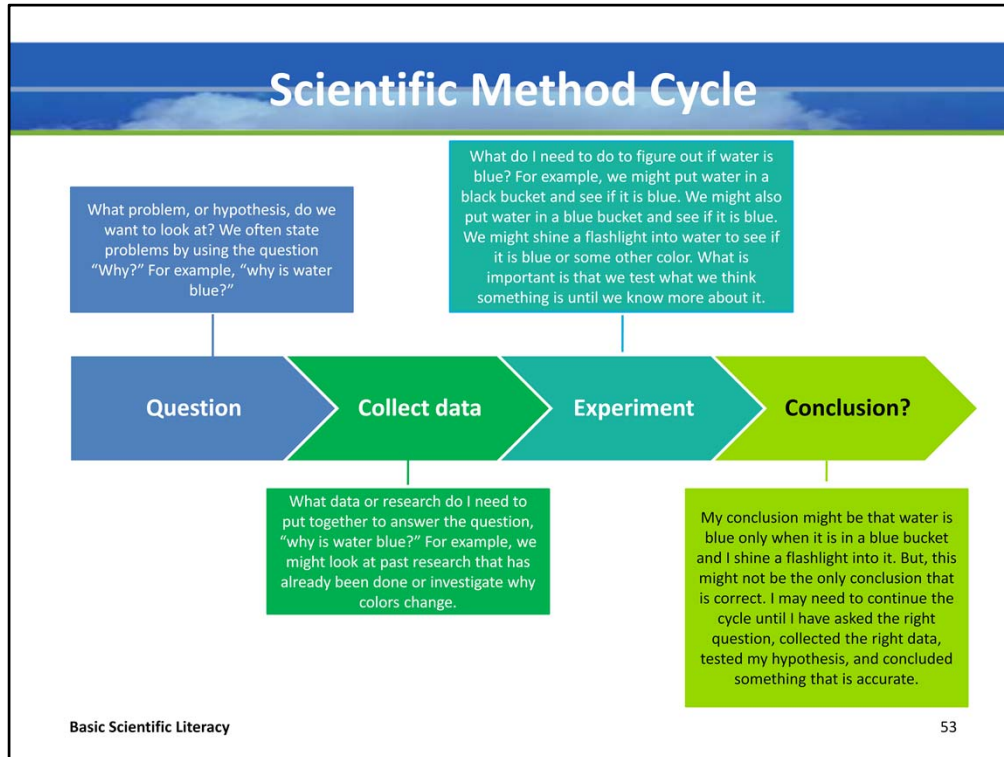
Basic Scientific Literacy

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Participant Guide page 23.

Review the content on the slide.

Tell participants after reviewing the content on the slide: Scientists look at complex problems, but their experience makes their work easier than for non-scientists like us.



Participant Guide page 23.

Review the content on the slide. The descriptions for each segment of the graphic are color coded.

After reviewing the slide, tell participants: Scientists perform this cycle over and over until they arrive at an answer that is true. For example, my true conclusion might be a statement such as: "Water is blue only when viewed through sunglasses on a sunny day when there are no clouds in the sky and I am standing on the equator." As you can see, it would take a lot of data collection and testing to come to that conclusion!

Information related to the optional quiz: Q4: False.

Q: There are three steps in the scientific method cycle: question, collect data, and experiment.

A: There are four steps in the scientific method cycle. The final step is to draw a conclusion, which includes what you now know and what research has shown.

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.

Participant Guide page 24.

Review the content on the slide.

Experiment Activity: Step 1



Use step 1 of the scientific method

Create a question (hypothesis) about graphology

Basic Scientific Literacy

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Participant Guide page 25.

Introduce an individual activity.

Before reviewing the directions, tell participants: We will use this fun experiment for every step of the scientific method to give us a first-hand idea of how the scientific method works.

Tell participants to go to the Participant Guide page.

Read the “What Is Graphology” paragraph to the class.

Then tell participants: Disclaimer: This experiment is for illustration purposes only!

Read the line under the graphology paragraph: “Our question (hypothesis) is: Is it possible to use graphology to determine the sex of a writer?”

Allow 3-4 minutes for participants to write their opinions in the space. Then lead a whole group discussion about their opinions by asking the following questions:

- How many people think the answer is yes?
- How many people think the answer is no?
- How many people are not sure?
- If you are a scientist, should you even have an opinion yet?

End with the statement that, because we are practicing being scientists, we will not decide anything until we have more data and conduct some tests.

Total time for this activity is 10 minutes.

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.

Participant Guide page 26.

Review the content on the slide.

Experiment Activity: Step 2



Review the research

Answer the questions

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Participant Guide pages 26-27.

Introduce the second part of the experiment activity. Tell participants to go to the Participant Guide page.

Before reviewing the handwriting samples and research in the Participant Guide, tell participants: I conducted some basic research for you, and this is what I found. You might not understand it completely yet, but it applies to the question and it might be useful.

Ask volunteers that you think might be capable readers to read the three research paragraphs, read them yourself, or let participants read them silently.

Then tell participants to go to the next page in the Participant Guide to answer some questions about this step in the scientific method (this part of the activity is individual).

Allow 5 minutes for participants to write their answers to the questions. Then lead a whole group discussion about their answers.

Before asking for their answers, ask them if they had trouble answering the questions. Most will probably say yes.

Remind participants that this is a very simplified experiment, and they really do not have enough information based on the three signatures they have. In real life, they would need to do a lot more research and collect a lot more data and then look at it very carefully. The research presented here is not very scientific because we do not really know if it is true.

End with the statement that, because we are practicing being scientists, we will decide to go to the next step.

Total time for this activity is 15 minutes.

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.

Participant Guide page 28.

Review the content on the slide.

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

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Participant Guide page 28.

Review the content on the slide.

Ask participants: Is this solution the only solution? We do not know at this time. It is only one possible solution based on what we currently know.

Experiment Activity: Step 3



Write a paragraph

Use the Graphology Analysis Checklist

Answer the questions

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Participant Guide pages 29-30.

Introduce the third part of the experiment activity. Tell participants to go to the Participant Guide page.

This is still an individual activity.

Review the instructions in the Participant Guide, and read the paragraph.

After reviewing the instructions, tell participants: It does not matter if you spell things wrong or your spacing. Write as you would usually write.

Allow 5 minutes for participants to write in the box.

Now distribute one Graphology Analysis Checklist to each participant.

Do NOT offer to explain the descriptions, and do not encourage questions. Tell participants to do the best they can in filling out the checklist.

Allow approximately 10 minutes for this part of the activity.

After everyone has filled out the checklist, ask by a show of hands how many people disagree/agree with their descriptions. More people will likely disagree or say they are not sure.

Debrief the activity by telling participants that they probably need to do more research, including getting a better understanding of what the descriptions mean. Both of these things are common problems for researchers.

Avoid any further discussion at this point.

Total time for this activity is 15 minutes.

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.

Participant Guide page 31.

Review the content on the slide.

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.



Participant Guide page 31.


Review the content on the slide.

Information related to the optional quiz: Q5: True.

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

A: 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?

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Participant Guide page 32.

Introduce this last part of the experiment activity as a whole group discussion.

Tell participants there is space to write notes.

Ask each of the questions. The answers to the first two questions should be “no.” Explain that in the real world there would be a variety of experiments and tests.

For the third question, the answer should be: Go back and check prior research to see if it is really valid and collect more data.

For the last question, the answer is no. In fact, the graphology experiment was useless because there was nothing that referred to male or female. There was nothing in the experiment that can give us the right data. In fact, graphology is too subjective to draw any real valid conclusions. When we asked what your opinion was of the hypothesis, it pushed people to decide on a conclusion before the investigation.

End with the statement that, it is easy to get caught up in the process and the research. But, ultimately, science follows a very clear method based on fact.

Total time for this activity is 10 minutes.

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.



Participant Guide page 33.

Review the content on the slide.

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

Participant Guide page 33.

Review the content on the slide.

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.

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Participant Guide page 33.

Review the content on the slide.

The photo show the NIH headquarters in Washington, DC.

Information related to the optional quiz: Q6: True.

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

A: 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. Other non-profit organizations (such as the Bill and Melinda Gates Foundation) and private companies (such as pharmaceutical companies) also fund scientific research.

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.



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Participant Guide page 33.

Review the content on the slide.

Presenter notes:

- "NSF" is the National Science Foundation.
- "USGS" is the U.S. Geological Survey.

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.

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Participant Guide page 34.

Review the content on the slide.

Information related to the optional quiz: Q7: False.

Q: Researchers can assume that prior research is sound and can use it in their own research.

A: Just because research has been published or is available on the internet does not mean it is true.

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.

Participant Guide page 34.

Review the content on the slide.

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 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?

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Participant Guide pages 35-36.

Introduce a small group activity.

Divide the whole group into 4 smaller groups

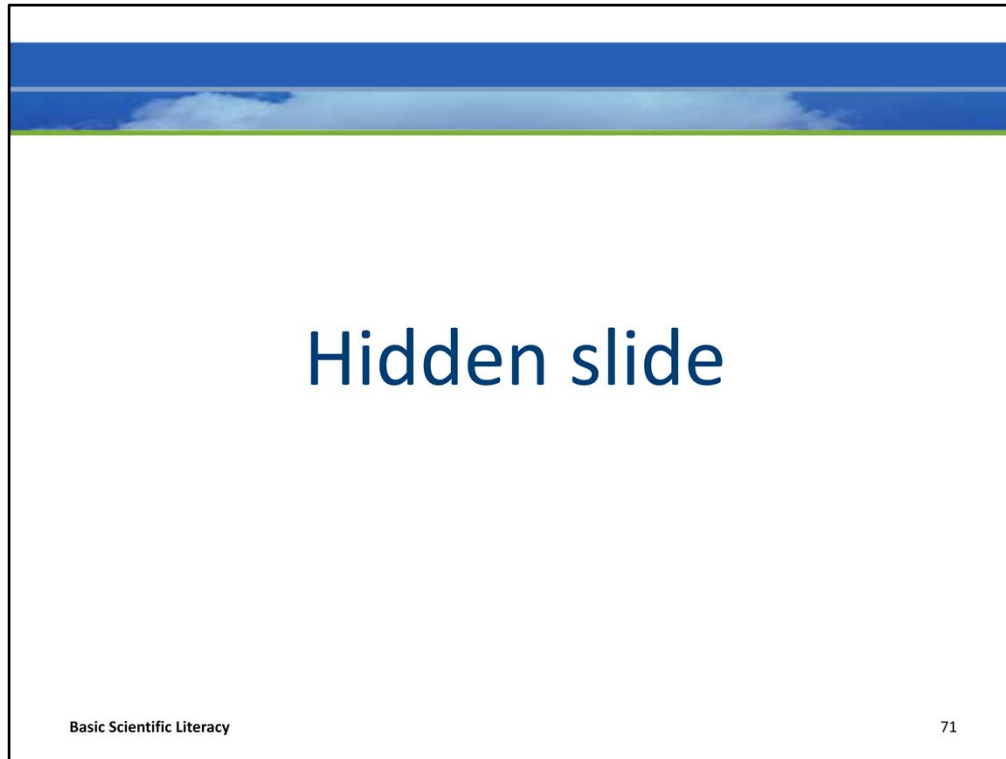
Assign one of the questions in the boxes to each group

Allow approximately 5 minutes for the groups to brainstorm their answers

Encourage participants to write their brainstorm on a flip chart, white board, and/or in their Participant Guides (each question has been reproduced in the Participant Guide with space to write)

Ask someone from each group to share some/all of their answers

Encourage the other groups to write these answers in the provided space in their Participant Guides.



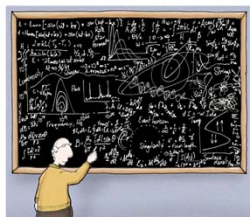
Possible answers include:

- Question 1: How can you use what you have learned about the scientific method in your life? When reading about new research results, know what to look for to help decide the value of the research results. Also look for who supported the research financially to see if there is a special interest that might make the research incomplete or untrue.
- Question 2: In what ways can you use problem solving in your daily life? Problem solving can be used in many areas of life, from how to plan trips, help friends and family...anything that helps to arrive at good answers to questions.
- Question 3: 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)? There are no specific answers for this question. Look for answers that are clearly stated and reasons why.
- Question 4: In what ways has this information about the scientific method impacted YOU? There are no specific answers for this question. Look for answers that are clearly stated and that involve asking questions (hypotheses), collecting data, experimenting, and drawing conclusions.

Activity timing: 15 mins (5 minutes for the brainstorm; 10 minutes for the whole group sharing)

Allow for questions before ending the activity and going to the summary.

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

Participant Guide page 37.

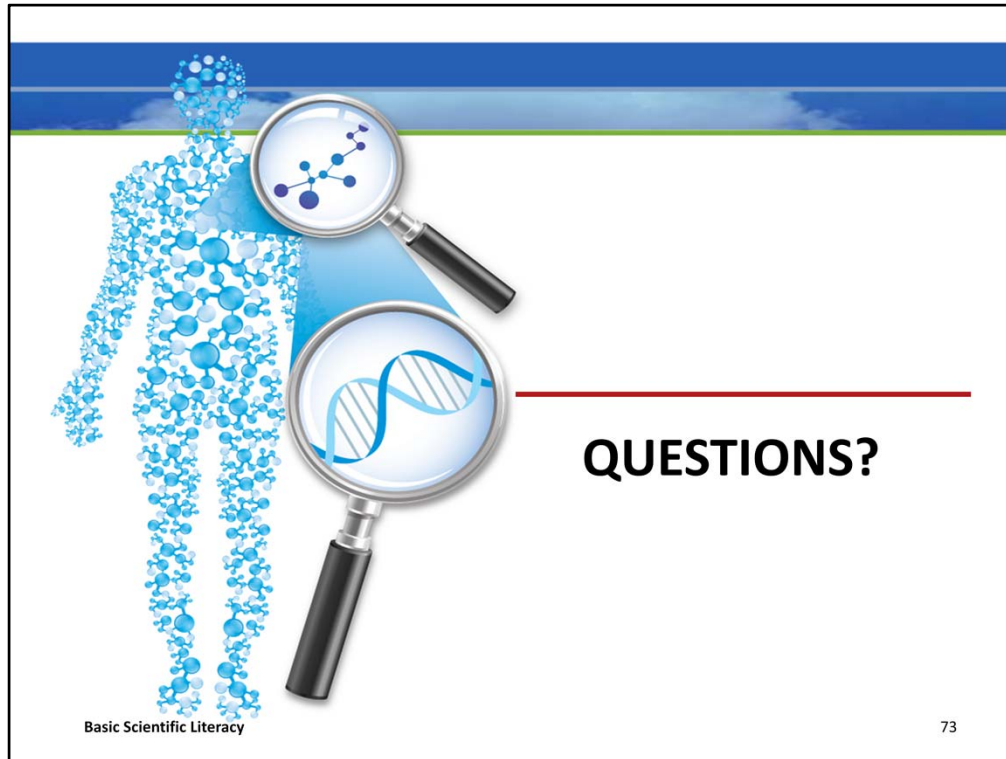
Review the content on the slide.

Tell participants where to find the glossary of terms and abbreviations used in this session in case they have questions about them.

Review the Frequently Asked Questions (FAQs) and additional resources for more information.

Ask participants if they have any additional resources they would like to share.

Save and add any additional resources for future use.



No Participant Guide page.

Ask participants if they have any questions. Answer all questions, if possible. If not, make a note of these questions to prepare for the next training session.

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)."

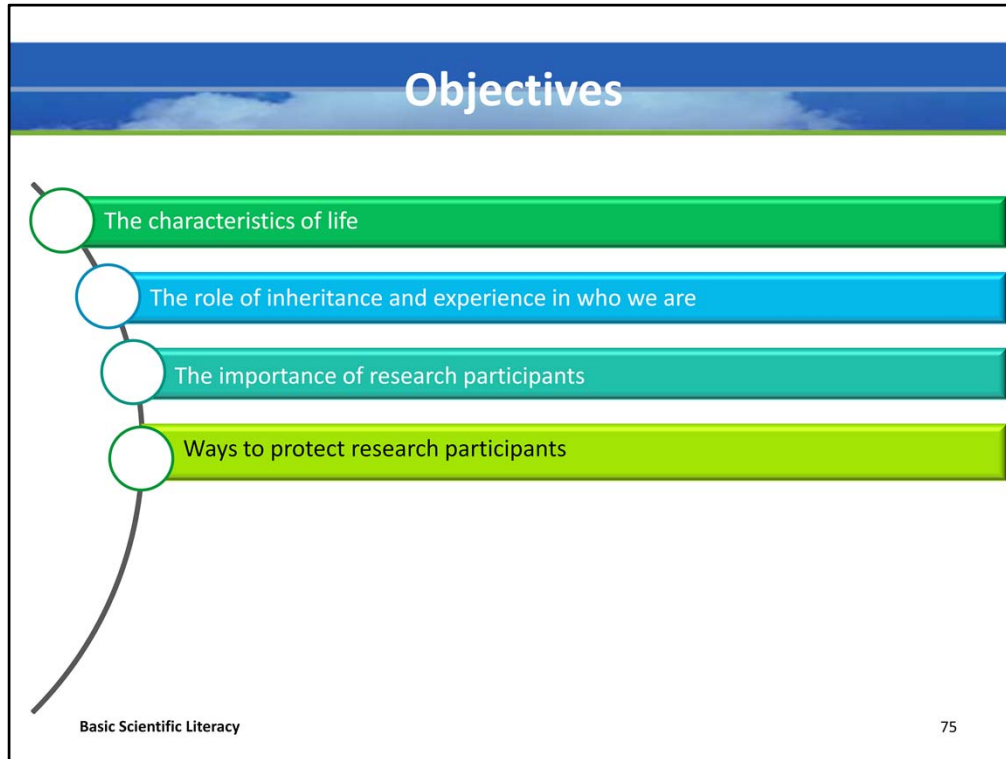
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Participant Guide page 40.

Review the content on the slide.

Estimated timing for this section is 1 hour, 45 minutes.



Participant Guide page 40.

Tell participants before reviewing the slide content: In this session (The Human Side of Science), you will learn about...

Review the objectives on the slide.

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.

Participant Guide page 40.

Review the content on the slide.

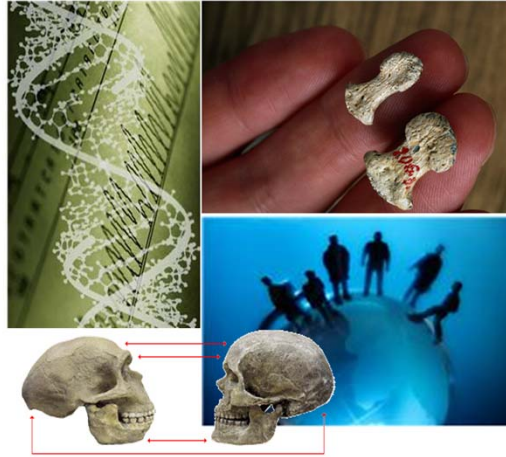
Information related to the optional quiz: Q8: False.

Q: Humans have inhabited the earth for approximately 100,000 years.

A: 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.



-Fingertip photo courtesy of IRA BLOCK/National Geographic Creative; skull photo from http://anthro.palomar.edu/homo2/mod_homo_4.htm

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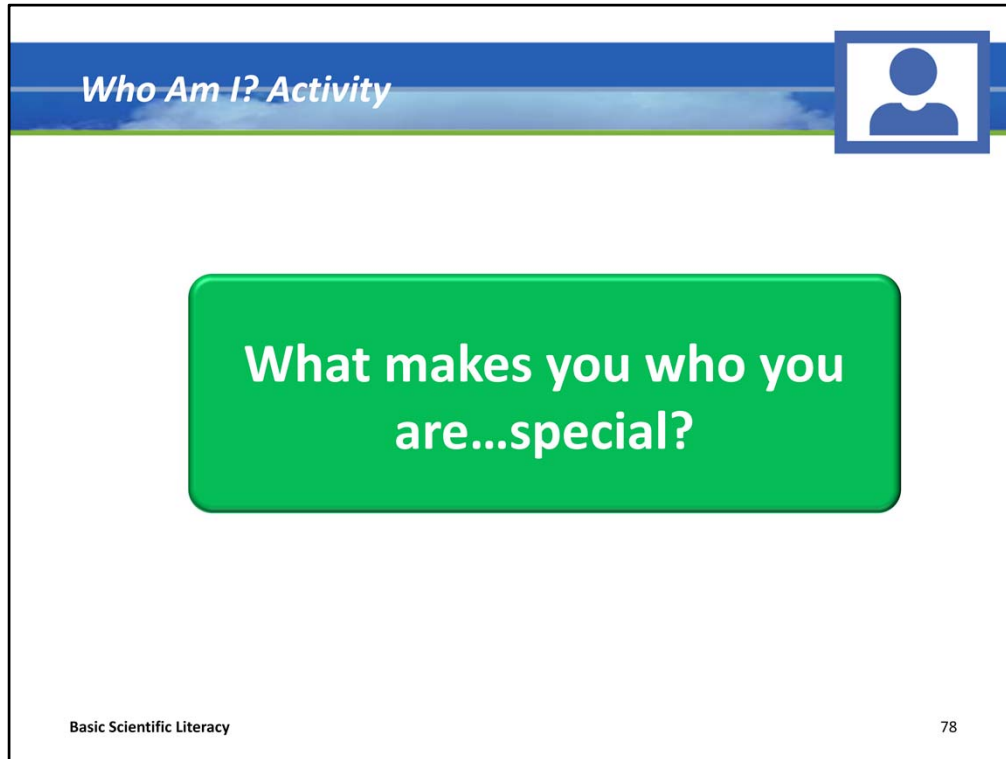
Participant Guide page 40.

Review the content on the slide.

Then review the photos:

- Top left: The science of biology includes the study of inheritance and who we are.
- Top right: The fingertip bone on the left is of an early human; the fingertip bone on the right is from a modern human. This difference in size highlights the amount of change in humans over time.
- Bottom left: The skull on the left is of an early human. The skull on the right is a modern human. As modern humans have adapted and populations have increased, they can better survive disease and hardship. Modern humans generally have more delicate skeletons but better abilities to survive.
- Bottom right: Science studies the relationships between us and our world.

End with the comment that all of these things focus on the human side of science.



Participant Guide pages 41-42.

Introduce an individual activity.

This activity is the start of an activity that will build on it in the Inheritance and Experience section.

For more information about inherited traits, see http://learn.genetics.utah.edu/content/begin/traits/activities/pdfs/inherited%20human%20traits%20quick%20reference_public.pdf. The information in this resource does not need to be shared with participants, but contains useful background information about traits and percentage of occurrence.

Review the activity instructions in the Participant Guide with participants. Participants should answer item 1 in the Participant Guide. Remind participants that their answers are confidential.


Allow approximately 5 mins for participants to complete item 1 in the activity.

Then ask participants to go to the next page and ask if there are any other things that make them special. They should write down their answers in the space provided for item 2. Be prepared to share examples that apply to you.

Do NOT ask participants to share their circled items.

Activity timing: 15 minutes

Introduction to the Characteristics of Life Video



-Video courtesy of Frank Gregorio, a Gregorio Educational Production

Basic Scientific Literacy 79

No Participant Guide page.

Introduce an optional video. Double click on the black box to start. This is an embedded file, so you will need to have the actual video stored in the same folder as this PPT for the link to work. If speakers are not available, the video can be shown without audio, or it can be deleted from the PPT entirely. The video is 3 minutes, 40 seconds.

Tell participants: This video is called “Introduction to the Characteristics of Life” and it was created by a science teacher in Virginia. The video showcases the wonderful world of nature with beautiful scenes and music. Sit back and enjoy it.

Translation notes: the video has very little script and can be enjoyed without translation. If needed, this is the script of the video and it can be translated and read to the class before showing the video:

Video script: Earth is the only place in the universe... where we have found life... so far. Life’s presence has transformed our world into a magical place. From its rivers and mountains... to its deserts and oceans... Life is everywhere on Earth! Millions of unique species share our world! But what does it mean to be alive? What characteristics do all living things share? Is it the ability to move? Water moves... but it is not alive! Maybe it’s life’s ability to reproduce! Yet fire reproduces also... as do clouds! Perhaps it’s life’s ability to react to its surroundings! Yet sand, ice and rock also react to their surroundings! Let’s explore the Characteristics of Life!

After the video, ask general questions about what participants liked about the video and whether or not they learned something new.

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.

Participant Guide page 43.

Review the content on the slide.

In the middle of the slide, the word “metabolizing” should be defined. Share the following definition with participants: To metabolize food, the body uses the calories from food for energy.

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.




Participant Guide page 43.

Review the content on the slide.

Remind participants that the picture is a model of DNA, which is the hereditary material in humans and almost all other organisms. Think of DNA as the internal building blocks of a person or organism: our answers , us as individuals today, and future generations.

Introduction to DNA Video



-Video courtesy of Frank Gregorio, a Gregorio Educational Production

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No Participant Guide page.

Introduce an optional video. Double click on the black box to start. This is an embedded file, so you will need to have the actual video stored in the same folder as this PPT for the link to work. If speakers are not available, the video can be shown without audio, or it can be deleted from the PPT entirely. The video is 4 minutes.

Tell participants: This video is called “Introduction to DNA” and it was created by a science teacher in Virginia. The video showcases the wonderful world of nature with beautiful scenes and music. Sit back and enjoy it. Translation notes: the video has very little script and can be enjoyed without translation. If needed, this is the script of the video and it can be translated and read to the class before showing the video.

Video script: The Tree of Life on Earth... has millions of branches! The roots of our tree began very long ago... in a single drop of water! As countless drops combined... something magical happened! LIFE appeared! Life started in the sea... Over time, it evolved! It took to the land... and the air! We developed fur... and intelligence! The branches of our Tree of Life... may be unique... in all of the universe! ... and we owe it all... to one incredible molecule! It is a thin twisted compound... made of just four small parts! Yet it contains the blueprint... for making all life on Earth! Where did it first come from? How does it work? What is its secret of Reproduction? Join me now... to explore... DNA!

Before discussing the content on the next slide, ask participants what they liked about the video and what they remembered from the video (there are no right/wrong answers).

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.

Participant Guide page 44.

Review the content on the slide.

Then go back to the first sentence: "DNA makes each of us unique individuals."

Tell participants: Identical twins share the same DNA. However, they have different phenotypes, which means the same DNA is expressed in different ways (for example, fingerprints and physical appearance). A DNA test cannot tell the difference between identical twins, but a fingerprint can.

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.

Participant Guide page 44.

Review the content on the slide.

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?

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Participant Guide page 45.

Introduce an individual activity.

Tell participants to use the page in the Participant Guide to write their answers.

Allow 8 minutes for people to write their traits in the boxes for items 1 and 2. Tell participants they can tear out this page (the Who Am I? Activity page) to make it easier to copy the circled items to this page.

Then lead a whole group discussion using the following questions (ask for volunteers to answer these questions). There are no right/wrong answers to this activity.

The objective is to encourage participants to think about the things they can/cannot change:

- What are some examples of your experiences that make you special?
- What traits do you have that you wish you did not have, and why?
- If you had a choice, which traits would you pass on to your children, and why?

Debrief the activity by emphasizing the importance of inheritance in who we are.

Total activity timing: 15 minutes

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

Participant Guide page 46.

Review the content on the slide.

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

Participant Guide page 46.

Review the content on the slide.

Benefits of DNA Research



Help themselves
and their families



Help future
generations



Give back to society

Participant Guide page 47.

Review the content on the slide.

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

Participant Guide page 47.

Review the content on the slide.

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.

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Participant Guide page 48.

Review the content on the slide.

Information related to the optional quiz: Q9: True.

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

A: Informed consent includes: 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.

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

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Participant Guide page 48.

Review the content on the slide.

After reviewing all of the boxes, ask the following questions:

- Why do you think informed consent is important? Look for responses that indicate they understand how privacy is needed to protect people from anything that can negatively impact them, their families, and their friends.
- How do you think you would feel if someone you know decided to participate in research because they had a disease you did not even know about? Look for answers that show bias/discrimination or that would result in different treatment because you now know something new about that person that makes you uncomfortable. Also look for answers that are positive (for example, now that you know your friend/family member has cancer, you can help that person).

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.

Participant Guide page 48.

Review the content on the slide.

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

Participant Guide page 49.

Review the content on the slide.

Information related to the optional quiz: Q10: True.

Q: Ethical principles must guide all research activities.

A: Ethical principles must guide all research activities and include formation of research questions, design of the research (sometimes called a “study” and “clinical trial”), conduct of research, analysis of data, and interpretation of findings.

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.

Participant Guide page 50.

Review the content on the slide.

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.

Participant Guide page 50.

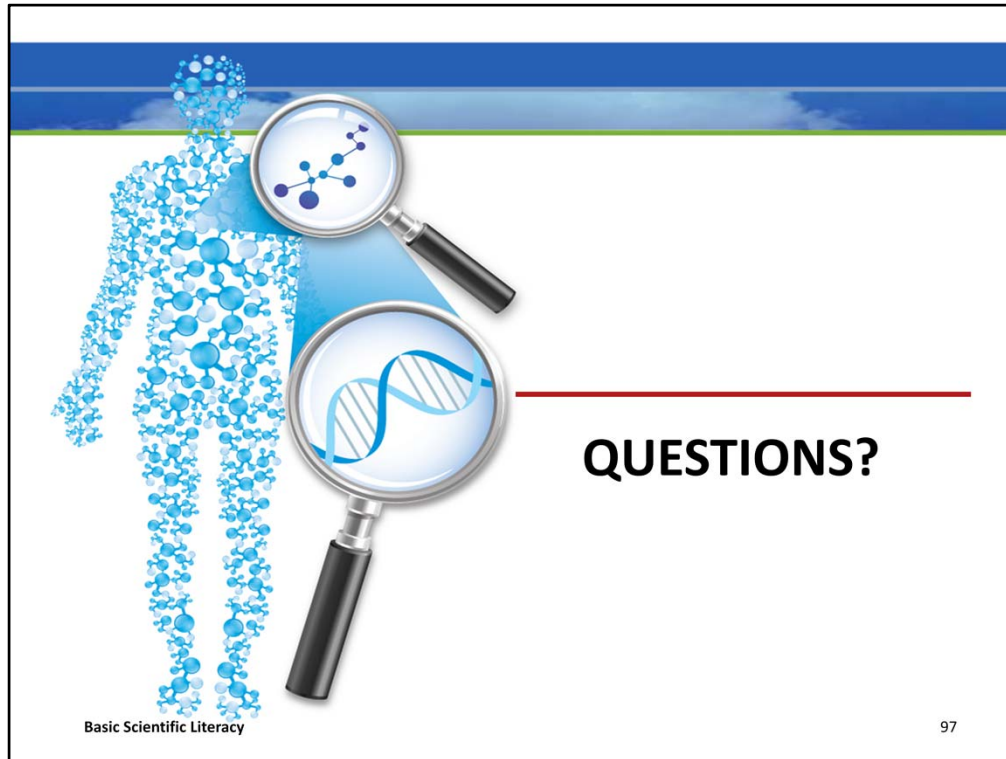
Review the content on the slide.

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, they 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.

Participant Guide page 51.

Review the content on the slide.



No Participant Guide page.

Be sure to stop and ask for questions before going to the next topic.

There is no activity for this content, so a change in focus is needed.

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?

Participant Guide page 52.

Review the content on the slide.

What Will We Be When We Grow Up? Activity



What will people be like 100 years from now?

Be creative

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Participant Guide page 53.

Introduce this small group activity.

Tell participants they can use their creativity and have some fun in this activity.

Review the instructions in the Participant Guide.

Allow 15 minutes for participants to develop their presentations and 10 minutes for presentations and debriefing.

To debrief the activity, lead a whole group discussion using the following questions (there are no right/wrong answers):

- What would need to happen from today to the future to bring about your future?
- How would science and research have helped to bring about your future?
- If you described something negative for the future, how could we change that negativity into something positive by using science and research?

Total activity timing: 25 mins

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?

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Participant Guide pages 54-55.

Remind participants that this section of the course is about the human side of science. This includes understanding how we fit into the world around us.

Introduce a small group activity. Divide the whole group into 4 smaller groups. Assign one of the questions in the boxes to each group. Allow approximately 5 minutes for the groups to brainstorm their answers. Encourage participants to write their brainstorm on a flip chart, white board, and/or in their Participant Guides (each question has been reproduced in the Participant Guide with space to write). Ask someone from each group to share some/all of their answers. Encourage the other groups to write these answers in the provided space in their Participant Guides. Possible answers include:

- Question 1: How can you use what you have learned about the human side of science in your life? Consider participating in research, especially for issues I have inherited that may positively affect others in my family; find out my family's health history and share it with my doctor.
- Question 2: What have you heard in the news recently about research that you would like to know more about? How to exercise even when it is very hot or cold (walk in malls); why children tend to gain weight over summer recess; how exercise can calm anxiety.
- Question 3: In what ways has the information about people and research impacted YOU? Knowing my family's health history to be better informed about my children's health; how my current health problems affect what I need to do.
- Question 4: In what ways has the information about DNA and inheritance impacted YOU? The impact of DNA on my health; better control over my own health because I have more information.

Activity timing: 15 mins (5 minutes to brainstorm their answers; 10 minutes for the whole group sharing)

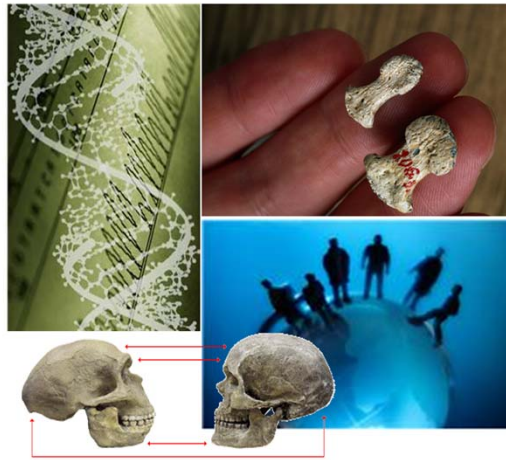
Allow for questions before ending the activity and going to the summary.

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.



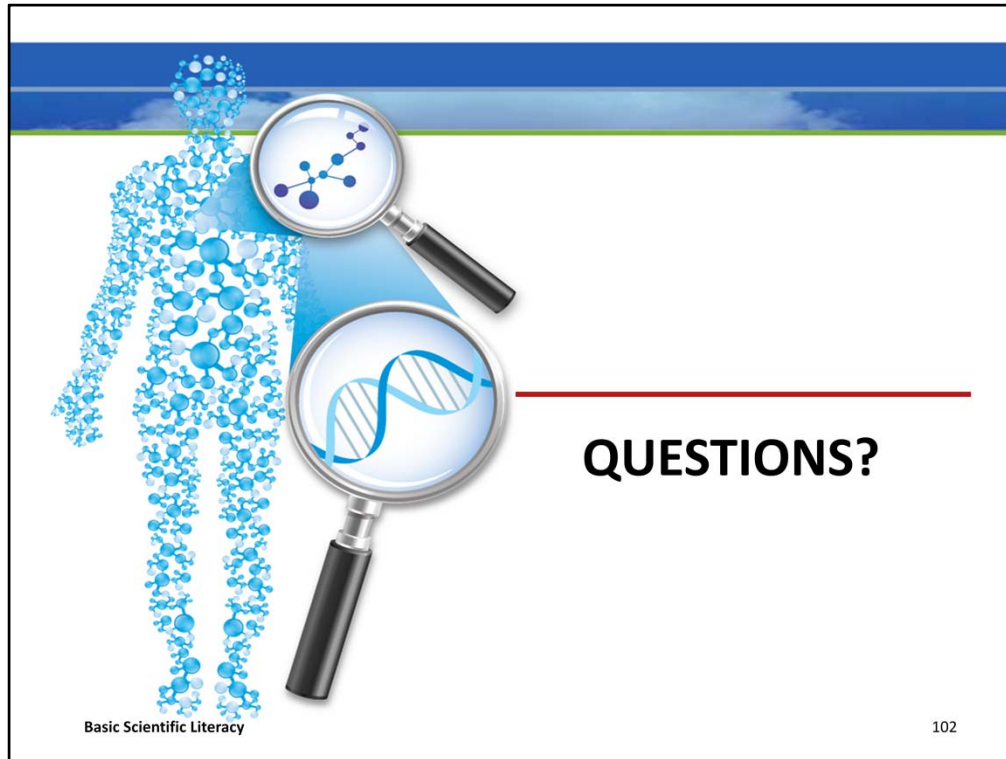
-Fingertip photo courtesy of IRA BLOCK/National Geographic Creative; skull photo from http://anthro.palomar.edu/homo2/mod_homo_4.htm

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Participant Guide page 56.

Review the content on the slide.



No Participant Guide page.

Review the content on the slide.

CONCLUSION

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)."

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Participant Guide page 61.

Review the content on the slide.

Estimated timing for this section is 45 minutes. Add 15 minutes if using the optional quiz.

Laws of Flight Activity



Follow the scientific process

Create a paper airplane experiment

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Participant Guide pages 61-62.

The activity provides an opportunity for participants to experience what scientists do every day.

The activity is approximately 30 mins.

This activity is an optional activity for the end of the day (before the conclusion).

This activity is simple and requires only paper and a tape measure or ruler. It is a practical experience of the module content and an introduction to the next topic. If tape measures/rulers are not practical, this activity can be done by marking on the floor where the planes land.

Break the class into 2-4 groups (3-4 people/group). Distribute 2 sheets of paper to each group and a tape measure/ruler to each group.

After everyone has completed the activity, each group will be asked about what they experienced.

In the debrief, the instructor will tell everyone that they just experienced in a small way what scientists do every day. Sometimes experiments work, and sometimes they do not. Ask everyone if they had fun as they gained knowledge in this activity. Most scientists agree that their jobs are fun.

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.

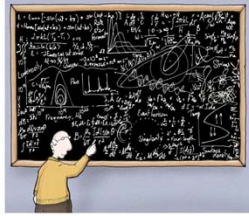
Research is conducted by ordinary and extraordinary people who have a passion to understand the world around them.

Participant Guide page 63.

- The optional quiz can be used again here (see quiz handout). There are 10 questions.
- Allow approximately 15 mins for participants to complete the quiz and review the answers as a group.

Then review the content on this slide and the next two slides to summarize the module.

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

Participant Guide page 64.

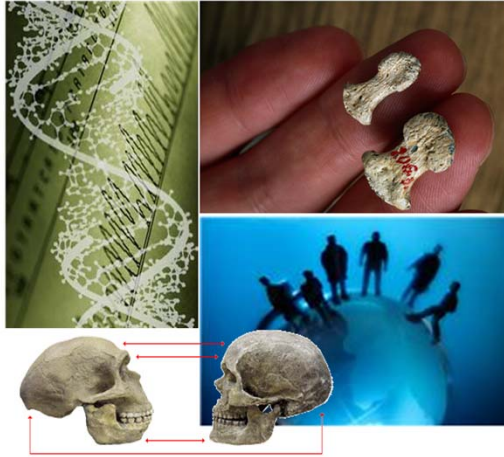
Review the content on the slide.

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.

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.



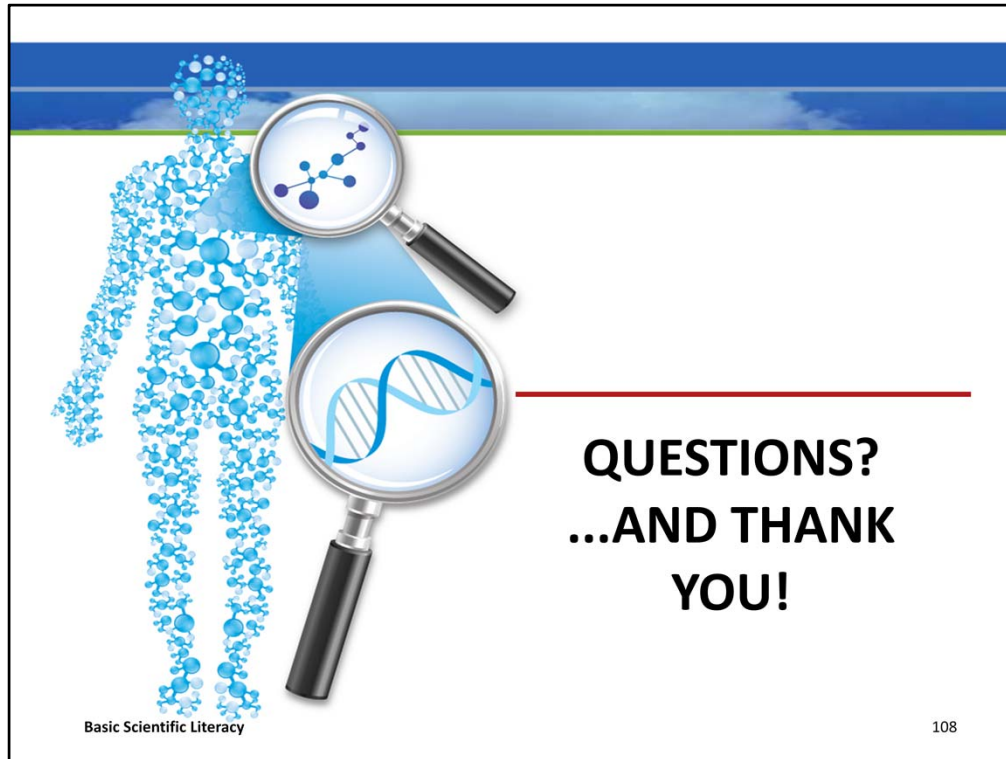
-Fingertip photo courtesy of IRA BLOCK/National Geographic Creative; skull photo from http://anthro.palomar.edu/homo2/mod_homo_4.htm

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Participant Guide page 65.

Review the content on the slide.



No Participant Guide page.

Distribute the workshop evaluation (if applicable).

Ask participants if they have any questions. Answer all questions, if possible. If not, make a note of these questions to prepare for the next training session.