

GED® Preparation Lesson Plan

Module: GED® Thematic Lesson

Lesson Title: Evidence is Everywhere! A Thematic Approach to High Impact Indicators, Target Assessments, and Content Standards

Standards

2014 GED® Assessment Targets High Impact Indicator Reasoning Through Language Arts	2014 GED® Assessment Targets Related Indicators from Other Content Areas: Social Studies, Science, and Mathematical Reasoning
Evaluate the relevance and sufficiency of evidence offered in support of a claim (RLA.8.3)	Distinguish among fact, opinion, and reasoned judgment in a primary or secondary source document (SSP.7b) Evaluate whether a conclusion or theory is supported or challenged by particular evidence (SP.4.a) Improve or correct a flawed line of reasoning (MP.3.c)

Objectives of the Thematic Lesson

Students will:

- Identify, assess, and analyze types of evidence in a claim or passage (RLA)
- Define fact, opinion, and reasoned judgment and evaluate sources in a document (Social Studies)
- Assess evidence and evaluate its sufficiency to support a conclusion or solution (Science)
- Identify a faulty line of reasoning and improve or correct it (Mathematical Reasoning)

Materials

- Prep Activity for RLA and Social Studies: Types of Evidence (5:42)
You Tube video: <https://www.youtube.com/watch?v=TuBk9yeuVHQ>
- Handout A: Types of Evidence to Support an Argument
- Handout B: Extended Response Stimulus Materials
- Handout C: Fact and Opinion Activity
- Handout D: Historical Thinking Chart
- Handout E: Evaluating Sources Activity
- Prep Activity for Science: How do we do Science? Scientific Method: Conclusions and Evaluation (5:03) You Tube video: <https://www.youtube.com/watch?v=9ri-dYjJum0>
- Handout F: Introduction to Scientific Method Worksheet
- Prep Activity for Mathematical Reasoning: Making Predictions with Probability (5:04) Khan Academy: <https://www.khanacademy.org/math/probability/probability-geometry/probability-basics/v/making-predictions-with-probability>
- Handout G: Are They Correct?
- Handout H: Card Set – True, False, or Unsure?

Instructional Plan

Overview

The GED® High Impact Indicators describe critical thinking skills essential to test-taker success in college, career training, and the workforce. Some of these indicators represent particular foundational skills that are the basis for the development of other skills covered in the GED® test and have broad usefulness that can be applied in multiple contexts. The following series of lessons are related to the central idea of evidence: identifying it, analyzing it, and evaluating it. The lessons also assist students in judging the relevance, sufficiency, and validity of what may be asked in a passage on the TABE® 11/12 or on the GED® test. The skill of assessing evidence is also imperative to earning points on a constructed response, so a High Impact Indicator from the Reasoning through Language Arts section has been included, along with related indicators from the Science, Social Studies, and the Mathematical Reasoning content areas. The following activities focus on utilizing graphic organizers and activities designed to identify types of evidence in a RLA passage and evaluate the relevance and sufficiency of evidence from sources focused on Social Studies topics. Continuing the evidence theme, since explaining and justifying are at the heart of Mathematical Reasoning, students will also practice improving a faulty line of reasoning in probability, while a lesson drawn from Science practices will ask students to evaluate evidence that supports a conclusion.

Process

Introduce the lesson by asking the following questions and discussing as a class:

- What is evidence? Can you list different types of evidence? What are the best types of evidence to use in a constructed response? How can you determine if evidence is relevant, sufficient, or faulty?
- After the review, write the following words/terms on the board:
 - Evidence
 - Fact
 - Opinion
 - Logical or reasoned judgment
 - Expert testimony
 - Anecdote
 - Emotional appeal
- Show the YouTube video on the *Types of Evidence* <https://www.youtube.com/watch?v=TuBk9yeuVHQ>
- Review the definitions on **Handout A: Types of Evidence to Support an Argument**. Briefly discuss and ask students to give examples of each type of evidence.
- After class discussion on types of evidence, give students **Handout B: Game-based Learning**. Have students read Source Material #2 and highlight types of evidence that they find. Using **Handout A: Types of Evidence to Support an Argument**, have students fill in as many types of evidence as they can on the chart. Share answers as a class, but remind students that not every type of evidence is always found in a passage.

Assessments/ Extensions

Throughout the lesson, be sure to monitor and check for student understanding for each new concept. Allowing students to work in pairs helps to build confidence and share knowledge. For an extension activity allow students to repeat the procedure with Source Material #1. As a follow-up, use the Extended Response prompt. Ask students to review the evidence from both samples and explain which side or argument is better supported by the evidence they found. To further extend the lesson, provide students with samples from

social studies or science and ask them to find different types of evidence on the chart. Real-world examples can also be found in newspapers, websites like Newsela – <http://www.Newsela.com>, or other informational texts.

Note: After students complete **Handout A** and **Handout B**, some students may need additional practice or review with differentiating between facts and opinions. Define each of the following terms:

A **fact** is a statement that can be tested by experimentation, observation, or research and shown to be true or untrue.

An **opinion** is a person's belief, feeling, or judgment about something. It is a subjective or value judgment, and it cannot be proven. Words such as perhaps, sometimes, probably, I feel, I think, or I believe are clues that the statement is an opinion.

Ask students to give examples from their own experiences. Then, have students complete **Handout C: Fact and Opinion Activity**.

Activities such as these will give students analytical skills that will also serve them in social studies, whereas facts, opinions, and reasoned judgment often appear in passages or documents from the content areas of history or civics and government. In order to evaluate the relevance and sufficiency of evidence found in passages containing this type of content, students need an organized way to assess and analyze statements. *The Historical Thinking Chart*, created by the Stanford History Education Group <http://sheg.stanford.edu>, gives students a comprehensive list of questions to guide them as they read and evaluate evidence in primary and secondary source documents. It also lists sample prompt responses for students to use in writing.

Evidence in Social Studies

Go over the Reading Skills, Questions, and Prompts on **Handout D: Historical Thinking Chart**. Then give **Handout E Evaluating Sources** to the students. Divide students into groups of three and have them complete the worksheet. Discuss and review student answers. Use the answer key to guide discussion.

Note: *The key takeaway from this activity is that historical understanding is intertextual. Though students are asked to choose one source over the other in this lesson, they would ultimately need to corroborate their sources with additional evidence in order to adequately answer these historical questions.*

Evidence in Science

Turning to a GED® Assessment Target in Science, show the YouTube video: *How do we do Science? Scientific Method: Conclusions and Evaluation*-(5:03) <https://www.youtube.com/watch?v=9ri-dYjJum0>

Discuss the following points with students, and then use **Handout F: Introduction to the Scientific Method** for practice with drawing conclusions from data.

- Tell **how** your research question/hypothesis was answered (a summary of the experiment or event).
- What were your major findings?
- How was your hypothesis or idea **supported or contradicted** by the data or evidence? (Let students know it's ok if their hypothesis was disputed.)
- What were your errors and how could this experiment be improved?

Modifications for Different Levels in Science

A quick review of the Scientific Method is a good follow-up to the video, particularly for ABE level students who are taking on the rigor of the TABE[®] 11/12. Review the vocabulary below and discuss each step of the process. Remind students that data and evidence serve the same function.

1. **Scientific Method:** An organized and sequential approach taken to try to solve a problem that involves the following:
 - a. stating the problem
 - b. forming a hypothesis
 - c. testing the hypothesis
 - d. analyzing the data
 - e. forming a conclusion
2. **Hypothesis:** A prediction about a problem that can be tested. What you think will happen?
3. **Independent variable:** The variable that is changed or manipulated.
4. **Dependent variable:** A variable that is measured or observed to see if change had an effect.
5. **Controlled variable:** A standard that is used to compare results in an experiment- no independent variable is applied.
6. **Qualitative data:** Observations that involve descriptions using your senses.
7. **Quantitative data:** Observations that are measured with numbers or amounts.
8. **Forming a Conclusion:** Statement or paragraph that responds to the hypothesis. Did the results support or not support the hypothesis? Discuss the data and experiment design; demonstrate that the experiment served its intended purpose effectively.

Evidence in Mathematical Reasoning

The science activity and discussion about the reliability and validity of evidence in an experiment will lead into another skill which will be useful in math. Students need to see how evaluating evidence/data to determine whether or not, a line of reasoning is correct or faulty in a mathematical problem can assist them with answering questions on either TABE[®] 11/12 or the GED[®] test. Show students the YouTube video *Making Predictions with Probability* from Kahn Academy:

<https://www.khanacademy.org/math/probability/probability-geometry/probability-basics/v/making-predictions-with-probability>

Discuss the video with students and pair students up to fill in **Handout G: Are They Correct?** After a whole-class introduction, have students work together to justify or refute mathematical statements. They do this using their own examples and counterexamples. Have students explain their reasoning to another group of students. Ask students to read through each statement and make sure they understand it. They should try to answer each question as carefully as they can.

Modifications for Different Levels in Math

To modify instruction, and provide additional practice, have students work in groups to fill in **Handout H: Card Set-True, False, or Unsure?** Try to include at least one member who is more advanced with probability skills and offer each team a set of dice. Have each member of the team select a card and decide whether it is a true or false statement. Ask students to try to answer the question first, and then use dice when appropriate. Then they should try to convince their team of each decision by explaining the reasons or rationale for their conclusion. If they are unsure of an answer or no one in the group is sure, put those cards to the side to discuss in class.

Sample Debriefing Questions

Complete the lesson by debriefing with students what they have learned. Sample questions to use include the following:

- Define different types of evidence.
- Give a real world example of a statement of factual evidence vs. one with emotional appeal.
- What is the difference between a fact and an opinion?
- Describe some evidence you can use to evaluate the validity or truthfulness of a claim.
- Describe the possible outcomes in evaluating evidence to form a conclusion.
- When analyzing evidence, what factors can affect the relevance and sufficiency of a claim?
- How can you correct a faulty line of reasoning or assess data in a math problem?

Types of Evidence to Support an Argument

Type of Evidence	Definition	Samples Supporting an Author's Claim
Factual	Truthful statements that cannot be denied. Statements that the average person may know or which can be proven.	
Statistics or Data	Numerical facts; can be presented in raw numbers, percentages, or fractions.	
Examples or Anecdotes	Real-life situations, events, or experiences that illustrate a position; anecdotal stories that help explain an author's claim.	
Expert Testimony	The observations or conclusions of someone who is considered highly knowledgeable because he/she is an expert in a particular field of study or occupation; someone who has first-hand knowledge and experience.	
Logical Reasoning	An explanation which draws conclusions that the reader can understand; a discussion which helps the reader understand or make sense out of facts or examples offered.	
Emotional Appeal	Use of sympathy, fear, loyalty, etc. to persuade; manipulates the reader's emotions – ethos, pathos, logos.	

Extended Response Stimulus Materials

Source Material #2

Game-based Learning: An Effective Training Strategy

Janette Morgan, Ph.D., Professor of Business, Saratoga State University

Innovative Trends in the Workplace

Already a multi-billion-dollar business, game-based learning in the corporate world continues to grow at a steady pace, and is here to stay. Executives are smart — they are not going to waste resources on training methods that don't work. Let's look at some of the advantages of "gamifying" workplace training.

First, many people are "gamers" in their non-work lives, so playing video games is something they are already comfortable with and enjoy. This makes game-based learning in the workplace more attractive and motivating than traditional instruction. And according to the Entertainment Software Association, despite the image of video-game players as teenaged boys, "the average gamer is now 37 years old." Further challenging the stereotype, nearly half of gamers are girls or women. Even 29 percent of those over age 50 are getting into the video-game habit. Teenagers and young men, in fact, make up only 15 percent of the over 190 million video-game users in the United States.

Evidence supporting the effectiveness of game-based learning is starting to emerge. Researchers point out that video games have "compelling storylines, attainable challenges, rewards, recognition and control," all of which stimulate learners. A 2012 report on game-based learning notes that "there is research evidence demonstrating positive impact on higher order skills such as decision making and problem solving." The report adds that using video games can also reduce training time, an advantage for both managers and employees.

Finally, unlike one-time training in a classroom, game-based learning is infinitely repeatable. If employees miss something or need more practice, they can always start the game again, using the feedback provided by the game to gauge their progress. This leads to a sense of accomplishment and creates a supportive learning environment, which is what we all want in an education strategy.

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Source Material #2 Sample Answers

Type of Evidence	Definition	Samples Supporting an Author's Claim
Factual	Truthful statements that cannot be denied. Statements that the average person may know or which can be proven.	Game based learning is a multi-billion dollar business and continues to grow in the corporate world. Many people are already gamers so that they are comfortable with it.
Statistics or Data	Numerical facts; can be presented in raw numbers, percentages, or fractions.	190 million gamers in US. Average gamer is 37 years old 29% of people over 50 play video games.
Examples or Anecdotes	Real-life situations, events, or experiences that illustrate a position; anecdotal stories that help explain an author's claim.	2012 report notes game based learning's positive impact on decision making and problem solving. Reduces training time.
Expert Testimony	The observations or conclusions of someone who is considered highly knowledgeable because he/she is an expert in a particular field of study or occupation; someone who has first-hand knowledge and experience.	Author has background in business so claims about the advantages of workplace training are credible and relevant.
Logical Reasoning	An explanation which draws conclusions that the reader can understand; a discussion which helps the reader understand or make sense out of facts or examples offered.	Research shows games stimulate learning. Game based learning is repeatable, and provides feedback and practice which gauges progress and leads to sense of accomplishment
Emotional Appeal	Use of sympathy, fear, loyalty, etc. to persuade; manipulates the reader's emotions – ethos, pathos, logos.	Video games have compelling storylines, challenges, and rewards. Game based learning is attractive and motivating.

Source Material #1

Game-based Learning Is Merely a Fad

Solomon Robles, Ed.D., Professor of Education at Winborne College

Workplace Training Journal

Electronic learning, or “eLearning,” was sold to many CEOs as the wave of the corporate future. There’s no need to hire human beings to train staff, managers were told. All the information you require can be accessed online — at a reduced cost for the company, and more flexible scheduling for employees. It sounded too good to be true — and it was. As one writer noted, “most eLearning is nothing more than online lectures or course notes.” To teach skills beyond basic facts, the person-to-person method is still more effective than any form of electronic learning.

And yet, along comes the next eLearning fad: “gamification,” which means using video games to teach. Video-game-based learning is already widely used in schools, and has spread to corporations as a tool for training workers and motivating customers. This approach is even used in the military. But does it work?

Most research on game-based learning has looked at schools. Results have been inconsistent but not especially encouraging. One 2013 study found that “students who completed the gamified experience got better scores in practical assignments and in overall score, but ... performed poorly on written assignments and participated less during class activities.” This makes sense: If you’re playing video games, you are not developing the so-called “soft skills” —also known as “people skills” — that are necessary for success in any job. In a traditional classroom, on the other hand, students can ask questions and engage with the teacher and with other learners.

In the workplace, game-based learning is yet another wedge driven between younger employees, who might applaud gamification, and older workers, who may now feel obsolete. What’s more, the prestigious magazine *The Economist* points out that “many of the aspects of gamification that do work are merely old ideas in trendy new clothes.” For example, the points and other rewards that are selling features of video games are just online versions of sales contests or “employee of the month” perks. Like other trends, game-based learning is likely to fade away as the next new teaching fad appears on the horizon.

Extended Response Prompt:

Analyze the arguments presented in the two journal articles. In your response, develop an argument in which you explain how one position is better supported than the other. Incorporate relevant and specific evidence from both sources to support your argument.

Remember, the better-argued position is not necessarily the position with which you agree. This task should take approximately 45 minutes to complete.

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Fact and Opinion Activity

A fact is a statement that can be tested by experimentation, observation, or research and shown to be true or untrue.

An opinion is a person's belief, feeling, or judgment about something. It is a subjective or value judgment, and it cannot be proven.

A writer may use factual statements to support his or her opinions. Opinion statements may occur even in what seems to be strictly factual material. A reader should look for words that are clues to statements of opinion.

Words such as **perhaps**
sometimes indicate the possibility of opinions.
probably
often

Words such as **I feel**
I think clearly point out that an opinion is being expressed.
I believe

EXERCISE I: Write **F** on the line in front of each factual statement.

- ___ 1. Harry S. Truman was a president of the United States.
- ___ 2. Truman was one of the best presidents the United States has had.
- ___ 3. Movies are generally more interesting than books.
- ___ 4. Non-poisonous snakes make delightful pets.
- ___ 5. *Time* is a better magazine than *Newsweek*.
- ___ 6. In Arizona, smoking in public places is against the law.
- ___ 7. Nicotine in cigarette smoke makes the heart beat faster.
- ___ 8. Gold was discovered in California in 1848.
- ___ 9. Charles Dickens' fascinating novel *A Tale of Two Cities* was published in 1840.
- ___ 10. Israel and Egypt will never have a permanent peace settlement.
- ___ 11. There is currently a shortage of science teachers in the state of Florida.
- ___ 12. In 1970, over 30,000 children were enrolled in day-care programs in Miami-Dade County

Adapted From Miami Dade College –

<http://www.mdc.edu/kendall/collegeprep/documents2/FACT%20AND%20OPINIONrevised819.pdf>

EXERCISE II:

Mark statements of **fact with an F** and statements of **opinion with an O**.

- ___ 1. In 1924, the Model T Ford could be purchased for \$290.
- ___ 2. The Model T was the most important invention of the first half of the century.
- ___ 3. By the end of this century, electric cars will be in common use.
- ___ 4. Couples should be acquainted for at least a year before getting married.
- ___ 5. Joining the Army is the best way to learn job skill.
- ___ 6. No symbol elicits fear as does the swastika.
- ___ 7. The core of a pencil is made of graphite and clay, not lead.
- ___ 8. It's better to plant masses of flowers all in one color than in two or three colors.
- ___ 9. The equator is 24,901.55 miles long.
- ___ 10. It's never too early to teach children how to behave.

EXERCISE III:

Mark statements of **fact with an F** and statements of **opinion with an O**.

- ___ 1. Hawaii is in the Pacific Ocean.
- ___ 2. The Krakatoa volcanic eruption was heard 1900 miles away.
- ___ 3. Only law enforcement officers should carry guns.
- ___ 4. Many private schools today provide a superior education to boys and girls.
- ___ 5. A family physician can provide most of the medical services which a family requires.
- ___ 6. Medsker discovered that 4-year colleges draw about $\frac{3}{4}$ of their freshmen from the upper 40% of the high school graduating classes.
- ___ 7. On the average, U.S. males can expect to live 7 years less than U.S. females.
- ___ 8. *Reader's Digest* is America's most popular magazine.
- ___ 9. Yosemite National Park is the oldest national park in the nation.
- ___ 10. Most TV commercials today are misleading and silly.

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Fact and Opinion Activity Answers

EXERCISE 1: Write *F* on the line in front of each factual statement.

- F 1. Harry S. Truman was a president of the United States.
- 2. Truman was one of the best presidents the United States has had.
- 3. Movies are generally more interesting than books.
- 4. Non-poisonous snakes make delightful pets.
- 5. *Time* is a better magazine than *Newsweek*.
- F 6. In Arizona, smoking in public places is against the law.
- F 7. Nicotine in cigarette smoke makes the heart beat faster.
- F 8. Gold was discovered in California in 1848.
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EXERCISE II:

- F 1. In 1924, the Model T Ford could be purchased for \$290.
- O 2. The Model T was the most important invention of the first half of the century.
- F 3. By the end of this century, electric cars will be in common use.
- O 4. Couples should be acquainted for at least a year before getting married.
- O 5. Joining the Army is the best way to learn job skill.
- O 6. No symbol elicits fear as does the swastika.
- F 7. The core of a pencil is made of graphite and clay, not lead.
- O 8. It's better to plant masses of flowers all in one color than in two or three colors.
- F 9. The equator is 24,901.55 miles long.
- O 10. It's never too early to teach children how to behave.

EXERCISE III:

- F 1. Hawaii is in the Pacific Ocean.
- F 2. The Krakatoa volcanic eruption was heard 1900 miles away.
- O 3. Only law enforcement officers should carry guns.
- O 4. Many private schools today provide a superior education to boys and girls.
- O 5. A family physician can provide most of the medical services which a family requires.
- F 6. Medsker discovered that 4-year colleges draw about $\frac{3}{4}$ of their freshmen from the upper 40% of the high school graduating classes.
- F 7. On the average, U.S. males can expect to live 7 years less than U.S. females.
- O 8. *Reader's Digest* is America's most popular magazine.
- O 9. Yosemite National Park is the oldest national park in the nation.
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Student Historical Thinking Chart

Historical Reading Skills	Questions	Prompts
Sourcing	<ul style="list-style-type: none"> Who wrote this? What was the author's perspective? When was it written? Why was it written? Is it reliable? Why? Why not? 	<ul style="list-style-type: none"> The author probably believes . . . I think the audience is . . . Based on the source information, I think the author might . . . I do/don't trust this document because . . .
Contextualization	<ul style="list-style-type: none"> When and where was the document created? What was different then? What was the same? How might the circumstances in which the document was created affect its content? 	<ul style="list-style-type: none"> Based on the background information, I understand this document differently because . . . The author might have been influenced by ____ (historical context) . . . This document might not give me the whole picture because . . .
Corroboration	<ul style="list-style-type: none"> What do other documents say? Do the documents agree? If not, why? What are other possible documents? What documents are most reliable? 	<ul style="list-style-type: none"> The author agrees/disagrees with . . . These documents all agree/disagree about . . . Another document to consider might be . . .
Close Reading	<ul style="list-style-type: none"> What claims does the author make? What evidence does the author use? What language (words, phrases, images, symbols) does the author use to persuade the document's audience? How does the document's language indicate the author's perspective? 	<ul style="list-style-type: none"> I think the author chose these words in order to . . . The author is trying to convince me . . . The author claims . . . The evidence used to support the author's claims is . . .

STANFORD HISTORY EDUCATION GROUP
READING LIKE A HISTORIAN
Evaluating Sources

Name _____

- 1. Historical Question:** Who was present at the signing of the Declaration of Independence?

Source 1: Hollywood movie about the American Revolution made 2001.

Source 2: Book written by a famous historian who is an expert on the American Revolution, published in 1999.

Which do you trust more? Why?

- 2. Historical Question:** What was slavery like in South Carolina?

Source 1: Interview with former slave in 1936. The interviewer is a black man collecting oral histories for the Federal Writers' Project.

Source 2: Interview with former slave in 1936. The interviewer is a white woman collecting oral histories for the Federal Writers' Project.

Which do you trust more? Why?

- 3. Historical Question:** What was the layout of the Nazi concentration camp Auschwitz?

Source 1: Interview with 80 year-old Holocaust survivor in 1985.

Source 2: Map of concentration camp found in Nazi files.

Which do you trust more? Why?

- 4. Historical Question:** Why were Japanese Americans put in internment camps during WWII?

Source 1: Government film explaining internment from 1942.

Source 2: Government report on Japanese Internment from 1983 based on declassified government documents.

Which do you trust more? Why?

5. Historical Question: Did American soldiers commit atrocities during the Vietnam War in 1969?

Source 1: Sworn testimony by American Sergeant in Congressional hearings in 1969.

Source 2: Speech by American General touring the United States in 1969.

Which do you trust more? Why?

6. Historical Question: What happened at the Battle of Little Bighorn?

Source 1: High school history textbook from 1985.

Source 2: Newspaper account from the day after the battle in June 1876.

Which do you trust more? Why?

Adapted from Stanford History Education Group <https://sheg.stanford.edu/>

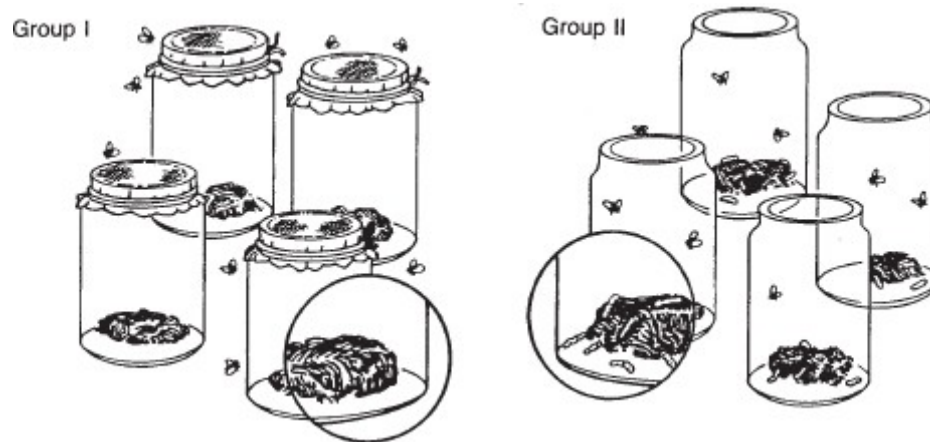
Evaluating Sources: Answer Key

1. Source 2: Historians base their accounts on multiple primary and secondary documents and extensive research. Hollywood films have no standards for historical accuracy.
2. Source 1: Audience shapes the stories we tell. We can imagine that even in 1936, a former slave would be wary of criticizing slavery to a white government official. That is not to say that Source 1 is necessarily accurate; we can imagine a former slave might exaggerate accounts or possibly not remember details so well. Of the two sources, however, Source 1 will probably be more trustworthy.
3. Source 2: Human memory is notoriously unreliable. A map of a concentration is technically an “objective” source. On the other hand, there is no guarantee that the map perfectly mirrored the layout of the camp.
4. Source 2: Any government film created in 1942 to explain internment would be propaganda. The declassified evidence in the Congressional report makes Source 2 more reliable.
5. Source 1: Sworn testimony is the gold standard of evidence. Although testimony can be corrupted by lying, coercion, and the shakiness of human memory, in this instance Source 1 is more reliable than a public speech by a General whose reputation is on the line.
6. Neither: Textbooks from the 1980s tended to overlook and/or neglect the experiences and accounts of Native Americans. On the other hand, a newspaper account from 1876 would likely have lacked credible evidence about the battle and/or have been biased towards Custer and his men.

Adapted from Stanford History Education Group <https://sheg.stanford.edu/>

Introduction to the Scientific Method Worksheet

Long ago, many people believed that living things could come from nonliving things. They thought that worms came from wood and that maggots came from decaying meat. This idea was called spontaneous generation. In 1668, an Italian biologist, Francesco Redi, did experiments to prove that maggots did not come from meat. One of his experiments is shown below.



Redi placed pieces of meat in several jars. He divided the jars into two groups. He covered the first group of jars with fine cloth. He left the second group of jars uncovered. Redi observed the jars for several days. He saw flies on the cloth of the covered jars, and he saw flies laying eggs on the meat in the uncovered jars. Maggots appeared only on the meat in the group of jars left uncovered.

Questions

- Which is not a step in the scientific method?
 - Problem or question.
 - Research.
 - Ask other people for their opinion.
 - Arrive at a conclusion.
- What was the problem in Redi's experiment?
 - How do maggots appear in meats?
 - How do worms appear in wood?
 - Is spontaneous generation a valid explanation for maggots in meats?
 - All of the above are examples of problems

3. What do you think his hypothesis was?
 - a. Maggots grow through spontaneous generation.
 - b. Maggots come from eggs laid by flies.
 - c. Maggots find their way into woods and meats.
 - d. The problem cannot be solved.

4. How did he test his hypothesis?
 - a. He placed food in two jars, covering one jar and leaving the other uncovered.
 - b. He placed food in two jars and left both jars uncovered.
 - c. He placed food in two jars and covered both jars.
 - d. He put food in one jar and no food in a second jar.

5. What was the variable in his experiment?
 - a. Covering both jars.
 - b. Covering one jar and leaving the other uncovered.
 - c. Leaving both jars uncovered.
 - d. There was no variable in this experiment.

6. What do you think Redi's conclusion was?
 - a. Living things come from other living things.
 - b. Living things are created through spontaneous generation.
 - c. He did not have enough data to arrive at a conclusion.

From: Florida IPDAE's Lesson Plans for GED® Preparation Science

Answer Key: Introduction to the Scientific Worksheet - <http://www.mrscienceut.net>

1. Which is not a step in the scientific method?
 - a. Problem or question
 - b. Research.
 - c. **Ask other people for their opinion.**
 - d. Arrive at a conclusion.
2. What was the problem in Redi's experiment?
 - a. How do maggots appear in meats?
 - b. How do worms appear in wood?
 - c. Is spontaneous generation a valid explanation for maggots in meats?
 - d. **All of the above are examples of problems**
3. What do you think his hypothesis was?
 - a. Maggots grow through spontaneous generation.
 - b. **Maggots come from eggs laid by flies.**
 - c. Maggots find their way into woods and meats.
 - d. The problem cannot be solved.
4. How did he test his hypothesis?
 - a. **He placed food in two jars, covering one jar and leaving the other uncovered.**
 - b. He placed food in two jars and left both jars uncovered.
 - c. He placed food in two jars and covered both jars.
 - d. He put food in one jar and no food in a second jar.
5. What was the variable in his experiment?
 - a. Covering both jars.
 - b. **Covering one jar and leaving the other uncovered.**
 - c. Leaving both jars uncovered.
 - d. There was no variable in this experiment.
6. What do you think Redi's conclusion was?
 - a. **Living things come from other living things.**
 - b. Living things are created through spontaneous generation.
 - c. He did not have enough data to arrive at a conclusion.

Are They Correct?

1. Emma claims:

Tomorrow it will either rain or not rain. The probability that it will rain is 0.5.



Is she correct? Explain your answer fully:

2. Susan claims:

If a family has already got four boys, then the next baby is more likely to be a girl than a boy.



Is she correct? Explain your answer fully:

3. Tonya claims:

If you roll a fair number cube four times, you are more likely to get 2, 3, 1, 6 than 6, 6, 6, 6.

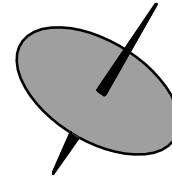


Is she correct? Fully explain your answer:

Are They Correct?

1. Andrew claims:

A spinner has 4 sections - red, yellow, green, and blue. The probability of getting the red section is 0.25.



Is he correct? Explain your answer fully:

2. Stephen claims:

In a group of ten students the probability of two students being born on the same day of the week is 1.



Is he correct? Explain your answer fully:

3. Madeline claims:

The school bus will either be on time or late. The probability that it will be on time is therefore 0.5.



Is she correct? Fully explain your answer:

Adapted from *Mathematics Assessment Project* <http://map.mathshell.org/stds.php?standardid=1163>

Answers: Are They Correct 1 and 2

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Assessment Task: *Are They Correct? 1*

1. This statement is incorrect. It highlights the misconception that all events are equally likely. There are many factors (e.g. the season) that will influence the chances of it raining tomorrow.
1. *Assuming that the sex of a baby is a random, independent event equivalent to tossing a coin*, the statement is incorrect. It highlights the misconception that later random events can ‘compensate’ for earlier ones. The assumption is important: there are many beliefs and anecdotes about what determines the gender of a baby, but ‘tossing a coin’ turns out to be a reasonably good model¹.
2. This statement is incorrect. This highlights the misconception that ‘special’ events are less likely than ‘more representative’ events.

Assessment Task: *Are They Correct? 2*

1. This statement is incorrect. It is not known whether the four sections on the spinner are in equal proportion. The probability of getting the red section would only be 0.25 if this were the case.
2. This statement is true. There are more students than days of the week.
3. This statement is incorrect. There are many factors that could affect whether or not the school bus is on time. There is also a chance that the bus is early.

Card Set: True, False or Unsure?

<p>A. If you roll a six-sided number cube and it lands on a six more than any other number, then the number cube must be biased.</p>	<p>B. When randomly selecting four letters from the alphabet, you are more likely to come up with D, T, M, J than W, X, Y, Z.</p>
<p>C. If you toss a fair coin five times and get five heads in a row, the next time you toss the coin it is more likely to show a tail than a head.</p>	<p>D. There are three outcomes in a soccer match: win, lose, or draw. The probability of winning is therefore $\frac{1}{3}$.</p>
<p>E. When two coins are tossed there are three possible outcomes: two heads, one head, or no heads. The probability of two heads is therefore $\frac{1}{3}$.</p>	<p>F. Scoring a total of three with two number cubes is twice as likely as scoring a total of two.</p>
<p>G. In a 'true or false?' quiz with ten questions, you are certain to get five correct if you just guess.</p>	<p>H. The probability of getting exactly two heads in four coin tosses is $\frac{1}{2}$.</p>

Answers: Card Set Activity

Collaborative Activity: *True, False or Unsure?*

- A. If you roll a six-sided number cube and it lands on a six more than any other number, then the number cube must be biased.
- False. This statement addresses the misconception that probabilities give the proportion of outcomes that **will** occur. With more information (**How many** times was the cube rolled? **How many** more sixes were thrown?) more advanced mathematics could be used to calculate the **probability** that the number cube was biased, but you could never be 100% certain.
- B. When randomly selecting four letters from the alphabet, you are more likely to come up with D, T, M, J than W, X, Y, Z.
- False. This highlights the misconception that ‘special’ events are less likely than ‘more representative’ events. Students often assume that selecting the ‘unusual’ letters W, X, Y and X is less likely.
- C. If you toss a fair coin five times and get five heads in a row, the next time you toss the coin it is more likely to show a tail than a head.
- False. This highlights the misconception that later random events ‘compensate’ for earlier ones. The statement implies that the coin has some sort of ‘memory’. People often use the phrase ‘the law of averages’ in this way.
- D. There are three outcomes in a soccer match: win, lose, or draw. The probability of winning is therefore 1 out of 3.
- False. This highlights the misconception that all outcomes are equally likely, without considering that some are much more likely than others. The probabilities are dependent on the rules of the game and which teams are playing.
- E. When two coins are tossed there are three possible outcomes: two heads, one head, or no heads. The probability of two heads is therefore 1 out 3.
- False. This highlights the misconception that all outcomes are equally likely, without considering that some are much more likely than others. There are four equally likely outcomes: HH, HT, TH, TT. The probability of two heads is 1 out 4.
- F. Scoring a total of three with two number cubes is twice as likely as scoring a total of two.
- True. This highlights the misconception that the two outcomes are equally likely. To score three there are two outcomes: 1, 2 and 2, 1, but to score two there is only one outcome, 1, 1.
- G. In a ‘true or false?’ quiz with ten questions, you are certain to get five correct if you just guess.

False. This highlights the misconception that probabilities give the exact proportion of outcomes that will occur. If a lot of people took the quiz, you would expect the mean score to be *about* 5, but the individual scores would vary.

Probabilities do not say for certain what will happen; they only give an indication of the likelihood of something happening. The only time we can be certain of something is when the probability is 0 or 1.

H. The probability of getting exactly two heads in four coin tosses is $\frac{1}{2}$.

False: This highlights the misconception that the same size is irrelevant. Students often assume that because the probability of one head in two coin tosses is $\frac{1}{2}$, then the probability of n heads in $2n$ coin tosses is also $\frac{1}{2}$. In fact the probability of two out of four coin tosses begin heads is $\frac{6}{16}$.

This can be worked out by writing out all the sixteen possible outcomes:

HHHH, HHHT, HHTH, HTHH, THHH, TTTT, TTTH, TTHT, THTT, HTTT, HHTT, HHTH, TTHH, THTH, HTHT, THHT.

This may be calculated from Pascal's Triangle:

			1						
2 coins		1	2	1			4 outcomes		Probability(1 head) =
		1	3	3	1				
4 coins	1	4	6	4	1		16 outcomes		Probability(2 heads)
	1	5	10	10	5	1			
6 coins	1	6	15	20	15	6	1	64 outcomes	Probability(3 heads)

Note: Students are not expected to make this connection.

Adapted from Mathematics Assessment Project Student materials *Evaluating Statements About Probability* <http://map.mathshell.org/stds.php?standardid=1163>