
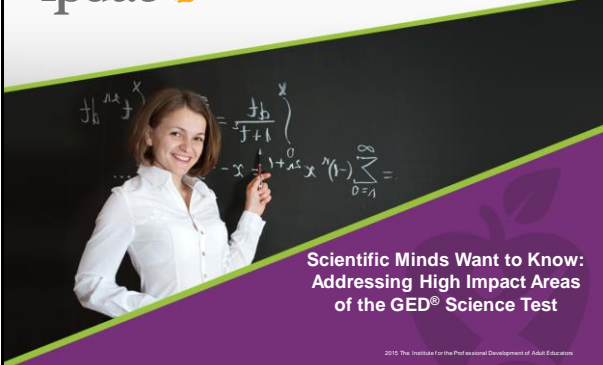




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**Scientific Minds Want to Know:  
Addressing High Impact Areas  
of the GED® Science Test**


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- Explore the High Impact Indicators for science
- Identify strategies, activities, and experiments for the classroom
- Review issues and concerns related to the science short answers

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**"If it's green or wriggles, it's biology.  
If it stinks, it's chemistry.  
If it doesn't work, it's physics..."**


*Handy Guide to Science*

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**HIGH IMPACT INDICATORS FOR  
THE 2014 GED® SCIENCE TEST**

**FOCUSING INSTRUCTION**




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### What makes indicators “High Impact”?

- Important skills that are widely applicable
- May currently receive coverage during GED® test preparation
- Lend themselves to straightforward instruction




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### Targets → Indicators → Application

- **Assessment targets** describe the general concepts that are assessed on the GED® test
- **Indicators** are fine-grained descriptions of individual skills contained within an assessment target
- **Application** describes what to look for in student work


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### How GEDTS identified these indicators

- Extensively analyzed test-taker performance on the operational GED® test
- Examined differences in performance between the 140 – 149 and 150 – 159 scaled scores in each content area
- Subjected the results to the filters indicated above

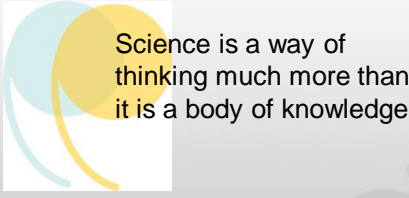
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- SP.2.b:** Identify and refine hypotheses for scientific investigations.
- SP.2.e:** Identify and interpret independent and dependent variables in scientific investigations.
- SP.4.a:** Evaluate whether a conclusion or theory is supported or challenged by particular data or evidence.
- SP.6.a:** Express scientific information or findings visually.
- SP.7:** Apply formulas from scientific theories.

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Science is a way of thinking much more than it is a body of knowledge

— Carl Sagan

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Science Sample Question

Environmental researchers hypothesize that increasing the number of watering holes will improve the health of a desert biome.

Which hypothesis would be better for the researchers to use?

- A. If the carrying capacity doubles, then the number of watering holes will double.
- B. If the number of watering holes doubles, then the life spans of desert animals will double.
- C. If the number of watering holes increases, then desert animals will adapt to use more water.
- D. If the number of watering holes increases, then the populations of desert animal species will increase.

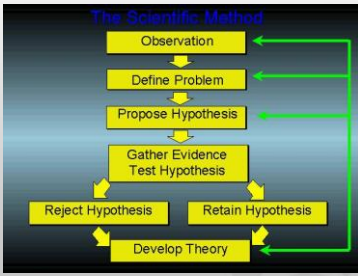
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### The Scientific Method

Teach experimental design through real-world application and reporting.



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### The Scientific Method


#### Key Points

**Observe/Research**

- Make observations and research your topic of interest.

**Define Problem**

Develop a question or problem that can be solved through experimentation.



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## Key Points

### Formulate a Hypothesis

- Predict a possible answer to the problem or question.

Example: If soil temperatures rise, then plant growth will increase.




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## Don't Forget the Vocabulary

- Independent**, or manipulated variable, is a factor that's intentionally varied by the experimenter.
- Dependent** or responding variable, is the factor that may change as a result of changes made in the independent variable.




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## Key Points

### Gather Evidence/Experiment

- Develop and follow a procedure.
- Include a detailed materials list.
- Make sure the outcome is measurable.
- Develop a procedure, list the needed materials and then, determine the control group.




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## Don't Forget the Vocabulary

- Control** – the group that serves as the standard of comparison.
- Constants** - the factors that the experimenter attempts to keep the same.
- Trials** – replicate groups that are exposed to the same conditions in an experiment.






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## Key Points

### Collect and Analyze Results

- Modify the procedure if needed.
- Confirm the results by retesting.
- Include tables, graphs, and photographs.


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## Key Points

### Conclusion

- Include a statement that accepts or rejects the hypothesis.
- Make recommendations for further study and possible improvements to the procedure.




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## Key Points

### Communicate the Results

- Be prepared to present the project to an audience.
- Expect questions from the audience.



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### Understanding the Scientific Method . . .

Provides students with background knowledge needed to respond to:

- Technology-enhanced questions
- Short Answer Type 2 prompts with an expectation that they can:
  - Design a scientific investigation based on a given hypothesis
  - Determine a method for collecting data
  - Explain how they would evaluate the hypothesis


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## BUILD STUDENT'S SCIENTIFIC REASONING SKILLS

One Experiment at a Time

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**5 Es**

Teach the Big Ideas of Science

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Physical Science

## ENERGY AND RELATED SYSTEMS


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## Engage


Activity which will focus student's attention, stimulate their think, access prior knowledge.

- Suggested activities
  - Demonstration
  - Reading
  - Brainstorming
  - KWL
  - Analyzing picture or graphic



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## Engage


What the teacher does	What the student does
<ul style="list-style-type: none"> <li>Creates interest.</li> <li>Generates curiosity.</li> <li>Raises questions.</li> <li>Elicits responses that uncover what the students know or think about the concept/topic.</li> </ul>	<ul style="list-style-type: none"> <li>Asks questions such as:                             <ul style="list-style-type: none"> <li>✓ Why did this happen?</li> <li>✓ What do I already know about this?</li> <li>✓ What have I found out about this?</li> </ul> </li> <li>Shows interest in the topic.</li> </ul>

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## Apply Learning – Use Experiments




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## Engage - All Objects Fall at the Same Rate



- Stand on a chair. Hold 2 oranges in each hand. Extend your arms straight out in front of your body so that each orange is the same height from the floor.
- Hypothesize which will hit the floor first.
- Let go of both oranges at the same time. What happened?
- Now stand in the same position but this time hold an orange in one hand and a grape in the other hand.
- Hypothesize which will hit the floor first? What happened? Why?

Guide – p. 6

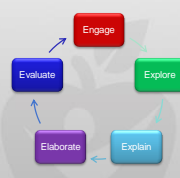
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## Explore

Activity which gives students time to think and investigate/test/make decisions/problem solve, and collect information.

- Suggested activities
  - Perform an Investigation
  - Read Authentic Resources to Collect Information
  - Solve a Problem
  - Construct a Model



Guide – p. 6

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Explore

## Explore

What the teacher does	What the student does
<ul style="list-style-type: none"> <li>Encourages the students to work together without direct instruction from the teacher.</li> <li>Observes and listens to the students as they interact.</li> <li>Asks probing questions to redirect the students' investigations when necessary.</li> <li>Provides time for students to puzzle through problems.</li> </ul>	<ul style="list-style-type: none"> <li>Thinks freely but within the limits of the activity.</li> <li>Tests predictions and hypotheses.</li> <li>Forms new predictions and hypotheses.</li> <li>Tries alternatives and discusses them with others.</li> <li>Records observations and ideas.</li> <li>Suspends judgement.</li> </ul>

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Explore

## Explore - Gravity and Air Resistance

### Analyzing Data

- How does air resistance affect the acceleration of falling objects?

Effects of Air Resistance	
Paper Type	Time
Flat paper	
Loosely crumpled paper	
Tightly crumpled paper	
Your paper design	

Guide – pp. 6 & 9

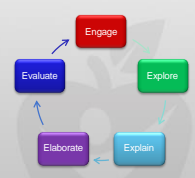
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Explain

## Explain

Activity which allows students to analyze their exploration. Student's understanding is clarified and modified through a reflective activity.

- Suggested Activities**
  - Student Analysis & Explanation
  - Supporting Ideas with Evidence
  - Structured Questioning
  - Reading and Discussion
  - Teacher Explanation



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Explain

## Explain

Guide – p. 6

What the teacher does	What the student does
<ul style="list-style-type: none"> <li>Encourages the students to explain concepts and definitions in their own words.</li> <li>Asks for justification (evidence) and clarification from students.</li> <li>Formally provides definitions, explanations, and new labels.</li> <li>Uses students' previous experiences as basis for explaining concepts.</li> </ul>	<ul style="list-style-type: none"> <li>Explains possible solutions or answers to others.</li> <li>Listens officially to others' explanations.</li> <li>Questions others' explanations.</li> <li>Formally provides definitions, explanations, and new labels.</li> <li>Listens to and tries to comprehend explanations the teacher offers.</li> <li>Refers to previous activities.</li> <li>Uses recorded observations in explanations.</li> </ul>


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### Explain - 1666 Newton's Three Laws of Motion

- Every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it.
- The relationship between an object's mass  $m$ , its acceleration  $a$ , and the applied force  $F$  is  $F = ma$ .
- For every action there is an equal and opposite reaction.



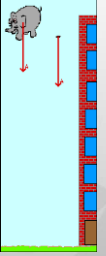
Best Idea Ever! <https://youtu.be/jwPc0kK9VHU>

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### Explain - 1666 Newton's Three Laws of Motion

- Suppose that an elephant and a feather are dropped off a very tall building from the same height at the same time. Suppose that air resistance could somehow be eliminated (no air drag).
- Which object will hit the ground first?



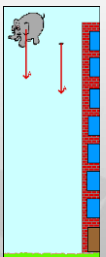
The Physics Classroom:  
<http://www.physicsclassroom.com/class/newtlaws/Lesson-3/Free-Fall-and-Air-Resistance>

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### Explain - 1666 Newton's Three Laws of Motion

- Suppose that an elephant and a feather are dropped off a very tall building from the same height at the same time. Assume the realistic situation that both feather and elephant encounter air resistance.
- Which object will hit the ground first?



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### Don't Forget the Vocabulary

- Force
- Object
- Mass
- Acceleration
- $F = ma$  (Force = mass x acceleration)

Forces are Balanced

$a = 0 \text{ m/s}^2$

Objects at Rest ( $v = 0 \text{ m/s}$ )

Objects in Motion ( $v = 0 \text{ m/s}$ )

Stay at Rest

Stay in Motion (same speed & dir<sup>n</sup>)

Forces are Unbalanced

There is an acceleration

The acceleration depends directly upon the "net force"

The acceleration depends inversely upon the object's mass.

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## Elaborate (extend)

Activity which expands and solidifies student thinking and/or applies it to a real-world situation.

- Suggested Activities
  - Problem Solving
  - Decision Making
  - Experimental Inquiry
  - Thinking Skill Activities: compare, classify, apply

Guide – pp. 6 & 7

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## Elaborate (extend)

What the teacher does	What the student does
<ul style="list-style-type: none"> <li>• Expects the students to use formal labels, definitions, and explanations provided previously.</li> <li>• Encourages the students to apply or extend the concepts and skills in new situations.</li> <li>• Reminds the students of alternative explanations.</li> <li>• Refers the students to existing data and evidence and asks, What do you already know? Why do you think . . . ?</li> <li>• Strategies from <i>Explore</i> apply here also.</li> </ul>	<ul style="list-style-type: none"> <li>• Applies new labels, definitions, explanations, and skills in new, but similar situations.</li> <li>• Uses previous information to ask questions, propose solutions, make decisions, and design experiments.</li> <li>• Draws reasonable conclusions from evidence.</li> <li>• Records observations and explanations.</li> <li>• Checks for understandings among peers.</li> </ul>

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## Elaborate (extend)

Would a tennis ball or bowling ball require more force to throw? Remember  $F = ma$

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## Evaluate Guide – p. 7

Activity which allows the teacher to assess student performance and/or understandings of concepts, skills, processes, and applications.

- Suggested Activities
  - Any of the Previous Activities
  - Develop a Scoring Tool or Rubric
  - Test (SR, BCR, ECR)
  - Performance Assessment
  - Produce a Product
  - Journal Entry
  - Portfolio


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## Evaluate

What the teacher does	What the student does
<ul style="list-style-type: none"> <li>Observes the students as they apply new concepts and skills.</li> <li>Assesses students' knowledge and/or skills.</li> <li>Looks for evidence that the students have changed their thinking or behaviors.</li> <li>Allows students to assess their own learning and group-process skills.</li> <li>Asks open-ended questions, such as: Why do you think...? What evidence do you have? What do you know about x? How would you explain x?</li> </ul>	<ul style="list-style-type: none"> <li>Answers open-ended questions by using observations, evidence, and previously accepted explanations.</li> <li>Demonstrates an understanding or knowledge of the concept or skill.</li> <li>Evaluates his or her own progress and knowledge.</li> <li>Asks related questions that would encourage future investigations.</li> </ul>


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## Evaluate

- Provide an example of Newton's 2<sup>nd</sup> Law of Motion. Explain why it's a good example of the law. You may wish to draw a picture, develop a summary, or demonstrate it to the class.
- How does the 2<sup>nd</sup> law of motion apply to everyday objects?


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Life Science

## HUMAN HEALTH AND LIVING SYSTEMS

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Watch a TED-Ed video on antibiotic resistance

- Ask for real-life experiences
- State the who, what, when, where, and why of the video


<http://ed.ted.com/lessons/how-antibiotics-become-resistant-over-time-kevin-wu>

Can't watch a video? Incorporate the video information into an introduction to the topic or access a short article on bacteria and antibiotics from the resources.


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- Read an article that has the pros and cons of using antibiotics for health issues such as colds and respiratory infections. Example: Antibiotics: Understanding the Pros and Cons [http://www.huffingtonpost.com/dr-caranatterson/antibiotic-drugs\\_b\\_784324.html](http://www.huffingtonpost.com/dr-caranatterson/antibiotic-drugs_b_784324.html)
- Compare the two sides. Construct an argument for or against prescribing antibiotics using evidence from the article.




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- Identify and summarize the major ideas in a narrative
- Define vocabulary terms such as synthesis, natural selection, mutations
- Identify the cause and effect of overuse of antibiotics
- Predict what you think will happen if a person takes the same antibiotic six times in one year




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Imagine that you have a farm and raise livestock. Using information that you learned from the video, as well as additional resources, decide whether you would give all of your livestock antibiotics as preventative measure.


Why or why not?



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Design an experiment that will measure when people begin to feel better after taking antibiotics. Conduct the experiment and report your results in narrative and graphic form.




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# INTEGRATE WRITING

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CR SA


## Science Short Answers

### Two Short Answer Responses

- **Short Answer Type 1**
  - Respond to textual stimulus material
  - Examine relationships
- **Short Answer Type 2**
  - Design a scientific investigation
  - Describe the experiment

**Remember! Each SA has its own Scoring Rubric and Scoring Tool!**

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Short Answer Scoring

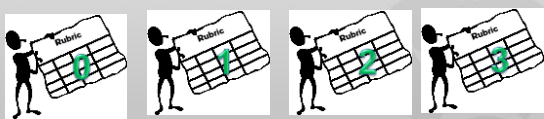
**Use the Scoring Tool!**

**3-Point Response** – well formulated and complete


**2-Point Response** – logical

**1-Point Response** – minimal

**0-Point Response** – illogical or does not exist



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Short Answer Type 1

### Prompt

Cite multiple pieces of data from the table that support why wind energy would be a preferred energy source over coal. Explain how a significant increase in the use of wind energy would affect the energy supply of coal.

Type your response in the box. This task may require approximately 10 minutes to complete.

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## My claim is . . .

Wind energy is far more resourceful compared to coal.

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## What's the Evidence?

What are the

- key words
- phrases
- ideas
- data

that support the claim from the excerpt or the hypothesis?



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## What's the Evidence?


Table	Article
<p>Wind</p> <ul style="list-style-type: none"> <li>• no ongoing fuel costs</li> <li>• zero CO<sup>2</sup> emissions</li> <li>• visible, noise factor (may harm birds)</li> </ul> <p>Coal</p> <ul style="list-style-type: none"> <li>• high CO<sup>2</sup> emissions</li> <li>• ongoing fuel costs,</li> <li>• Impacts our environment – strip mining, mercury contamination</li> <li>• non-renewable fuel source</li> </ul>	<p>Coal will last ~ 100 more years</p> <p>Fossil fuel burned to create energy negative environmental impacts</p> <p>Renewable energy (like wind) expected to increase in use</p>

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Wind energy is far more resourceful compared to coal. Coal has ongoing fuel costs, and has many more impacts to the environment as wind energy does not. Wind does not produce any CO<sub>2</sub> emissions, as where coal produces 200 pounds of CO<sub>2</sub> emissions per kWh. Coal has many impacts that will affect the environment in the long run, as to wind energy. simple inconveniences are the main issue. The effects of wind energy would help with the coal consumption. Projections show that coal resources will only last 100 years if we don't find alternate energy sources.

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Wind energy is better because it has zero emissions has no ongoing fuels cost. Coal is nonrenewable so one can be able to save coal only when needed plus coal mining is toxic to the environment.


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Guide – p. 13

**Three Key Elements**

1. Is the experimental design well designed and complete?
2. Is there a method provided for collecting data?
3. Is there an explanation of the criteria for evaluating the hypothesis?


  
Scientific Method

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The farmer would have to set up 3 experiments. The first would be a years worth of traditional farming methods (plowing and no cover crop) on 5 x 5 acres of land. He would have to measure the top soil in every month throughout the year and record it in a data table. For the second experiment the farmer would have to farm a plot of land 5x5 acres using a no-till plan. He would have to measure the top soil every month for a year and record it in a data table. Finally the farmer would farm a 5x5 acres of land with winter cover crop and measure the top soil every month and record it in a lab table. At the end of the year the farmer would have to compare the 2 methods against the traditional method and determine if he is correct

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The farmer could separate the land into two sections (15 acres each), and use one method on each section over a two season period. Over the two season period he would record how much soil was left after using each method, comparing the results to each other and the traditional farming method.

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To test his hypothesis the farmer should divide his land into three equal parts one for the first method, one for the second method and one for the control group. In the first part he divided he should test method one and keep a record of the process and the results. In the second part he divided he should test the second method and keep a record of the process and the results. In the third part that he divided he should have the control group where he would use the traditional method keep a record of the process and the results, then compare the records he has collected identify the different results, make an analysis and decide which method is the best way to prevent soil erosion.

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**Tip 1: Experimental Design**

- Identify the controlled variable in any experimental design.


**Tip 2: Reasoning and Evidence**

- Justify reasoning when citing evidence.
- Fully explain choices of particular pieces of evidence.

**Tip 3: Specificity**


- Responses should be specific to context provided in the item.
- Explaining relevant, generalizable scientific concepts is good, but explanations should be tied to the information provided.

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**Final Thoughts**


To increase science reading and writing skills...

**INVESTIGATE** 

“Each student needs to read like a detective...  
And write like an investigative reporter.”

 David Coleman  
Co-author of ELA Common Core State Standards

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**“The best professional development is ongoing, experiential, collaborative, and connected to and derived from working with students.”**

Edutopia 2014

*Stay Connected* **Always here to assist!**  
**The IPDAE Team**

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