INSTRUCTIONAL AND ASSESSMENT STRATEGIES
NASA's BEST Educators

Addressing Student Misconceptions

Research has identified at least five types of scientific misconceptions that can interfere with learning:

1. Preconceived notions,
2. Nonscientific beliefs,
3. Conceptual misunderstandings,
4. Vernacular misconceptions, and
5. Factual misconceptions.

In each activity, we identify the most common misconceptions associated with the science content. We also provide specific suggestions for discussing misconceptions with students. More generally, we provide the following strategies to help students overcome their misconceptions.

- Be aware of the most common misconceptions about the content addressed in the activity.
- Identify possible misconceptions to students and help them become aware of their own misconceptions.
- Ask students to write down their pre-existing conceptions of the material being covered. The KWL chart is a simple way to begin this process. This allows you to overtly assess student preconceptions and provides them with an opportunity to see how far their understanding has come after learning the new concepts.
- Engage students in representing their thinking through interactive discussion and open exchange and debate of ideas. Think-Pair-Share is an effective strategy for such discussion.
- Address common misconceptions through the engineering design process and teacher demonstrations. Use model-based reasoning, which helps students construct new representations that vary from their intuitive theories. Elicit student predictions on the topic, followed by a teacher-led demonstration that tests those predictions. Discussion works towards arriving at a common observation and then reconciles differences between prediction and observation.
- Provide opportunities for reflective inquiry and assessment so that students may "self-repair" their misconceptions. Strategies for reflection including having students complete the discussion questions at the end of each activity, respond to one or more of the one-paragraph essay writing prompts provided in the *Teacher Pages* of each activity, and/or compose/present a technical report.
- Revisit common misconceptions before, during, and after the activity.

Remember that misconceptions can be corrected, but since they are individualized paradigms, their owners must be the ones to correct them.

READING AND WRITING LIKE AN ENGINEER

NASA engineers and scientists must read and write a significant amount of Informational text, which is defined as nonfiction written with the primary purpose to inform the reader about the natural world. NASA engineering design activities offer many opportunities to help students develop skills in reading and writing informational text. Strategies below are organized from simple to complex.

Vocabulary Development

- **Frontloading -** This strategy works well with a KWL Chart and also helps address student misconceptions. When introducing the activity to students, ask them to list words they associate with the content to be studied. Discuss definitions of these words and place them in either the *K* column (if all students seem to agree on an appropriate definition) or the *W* column (if many students do not seem familiar with the term). Add to and revise the list of content words as you study the material. Revisit words and definitions when you complete the *L* column of the chart.
- **Comparison/Contrast Technical Context -** Examining similarities and differences is an effective critical thinking strategy that will increase student vocabulary by creating a *Technical Context Worksheet*, where students are asked to provide a definition and sentence for the technical and the non-technical use for vocabulary words. A sample ***Technical Context Worksheet*** is provided in *Assessment Handouts, Tools, and Resources.* This vocabulary development strategy may be used with any set of STEM vocabulary words.
- **Concept Cubes** - In this activity, students receive a six-square cube template on cardstock (which will eventually be folded into a three dimensional cube). On each of the squares students are instructed to write down one of the following: vocabulary word, antonym, synonym, type of speech or other category it belongs to, essential characteristics, and example. Students cut, fold and tape the cube to make a square. Then, with a partner, they roll their cube and must tell the relationship of the word that lands on top to the original vocabulary word. Student teams then exchange cubes and repeat the activity.
- **Digital Flashcard Applications** - There are many digital flashcard applications that may be used to support student vocabulary development. Some include games that may be played individually or as a whole class. The flashcards may be created by the teacher or by students, and it is also possible for teachers to have students submit their flashcard sets to a class account so that everyone may access.

Reading Comprehension

- **Talking to Text -** *Talking to Text* is when students record their thoughts and/or draws mental pictures while reading. It is important that students actually write on the text, so that the association is clear and there is a record for later reflection. The following symbols may be used as a way of labeling thoughts: smiley/sad face for agree/disagree; star or underlined text to identify key facts; circled text to identify big idea; question mark for a question; and arrow to draw a connection between two different parts of the text.
- **SQ3R -** SQ3R is a reading comprehension strategies that has students begin by reviewing headings and subheadings, bold or highlighted words, sidebars, and study images, tables, charts, graphs, and diagrams. A handout on ***SQ3R (Skim, Question, Read, Reflect, and Relate)*** is provided under *Assessment Handouts, Tools, and Resources*).

- **Dialectic Journal** - A dialectical journal, also known as a double-entry journal, is a journal that allows students to create detailed annotations in order to interrogate a text. The journal allows students to pair quotes from the reading with their specific analyses, essentially creating a dialogue between the ideas of the reading and the ideas of the reader. This journaling format will help students understand the informational text included in the activity Introduction. A sample ***Dialectic Journal*** is provided in *Assessment Handouts, Tools, and Resources*).

Technical Writing Fluency

- **Engineering Notebooks** - Encourage students to monitor progress in their Science/Engineering Notebook. We recommend the following requirements:
    - Reserve the first several pages of the notebook for a table of contents that is created in an ongoing process.
    - Require students to begin each activity with a title and identification of the challenge.
    - Students should glue or staple worksheets, foldables, and other materials into their notebooks.
    - Require students to keep a daily log for multi-day activities.
    - Require that students are not allowed to erase or delete.
    - If possible, encourage students to take pictures of their final product and to print and include images in their notebooks.
- **Final Design Summary -** A great place for students to practice writing descriptive text, illustration with text, and/or summary text is in the ***Final Design Summary*** in each activity.
- **One-Paragraph Essay** - This writing assignment requires students to respond to a prompt and compose a one-paragraph essay. Several writing prompts are provided in the *Teacher Pages* for each activity. Prompts typically ask students to make links between their designed model and NASA's research, address changes in their conceptions of scientific concepts, and/or summarize what they have learned. The ***Directions and Scoring Guide for the One-Paragraph Essay*** is provided in *Assessment Handouts, Tools, and Resources.* Prompts usually require students to compose one of the following types of informational text:
    - <u>Descriptive Text:</u> The water clock was made of plastic, with a small hole in the bottom from which the water dripped.
    - <u>Comparison/Contrast Text</u>: Before I completed this activity, I thought that the seasons were due to differences in the distance between the sun and the earth. Now I understand that seasons are caused by the tilt of the earth on its axis.
    - <u>Illustration with Text:</u> When the drag device is deployed, air resistance will slow the descent of the spacecraft. [caption below the drawing of a design for a drag device and spacecraft].
    - <u>Summary Text:</u> In this design process, we first measured the volume of the fuel and then calculated the mass/volume.
- **Technical Report** - This writing assignment requires students to compose a technical report for their design process. A technical report documents the steps of the engineering design process and includes description of the design challenge, proposed solution, evaluation process, and final outcome. At the end of every activity, students are directed to summarize their solution in a Technical Report; the ***Technical Report Scoring Guide*** is provided in *Assessment Handouts, Tools, and Resources*.
- **NASA Spinoff Report -** Each year, NASA inventions that benefit life on Earth are highlighted in an annual publication called *Spinoff*. NASA spinoffs demonstrate the wider benefits of

America's investment in its space program. NASA has profiled nearly 2,000 spinoffs since the publication began in 1976. The ***Directions and Scoring Guide for NASA Spinoff Report*** is provided under *Assessment Handouts, Tools, and Resources*.

What does a Technical Report Include?

NASA engineers write technical reports for many reasons, including the documentation of experiments and designs. A typical technical report that documents the steps of the engineering design process includes the following sections:

- *Statement of design challenge, constraints and requirements;*
- *Solution proposed, including summary of design features, measurements, and capabilities;*
- *Summary of evaluation results, including improvements made and tested; and*
- *Final outcome, lessons learned, and recommendations for next steps.*

Technical Speaking/Listening Fluency

- **Improving Students' Listening Comprehension -** NASA offers many videos that recount missions and present STEM content; many of these are included in activity introductions or as enrichment resources. Listening is an important way for students to gain understanding, but this is a skill that is rarely emphasized in classrooms. To help students improve their listening skills, explain that there are at least three different types of listening, and then ask students to focus on one or more of these goals. After viewing, promote technical speaking fluency by encouraging small group or partner discussion and then whole-class sharing.
    - Listen for the Main Idea: Students focus on identifying the main idea of the text.
    - Listen for Specific Information: Students focus on specific details, such as five important vocabulary words, or the answer to a few specific questions.
    - Listening for Detailed Understanding: Students focus on being able to summarize the text and/or to answer a broad question such as "How does this video help me understand the importance of keeping accurate time in outer space?"
- **Think/Pair/Share -** This collaborative speaking strategy may be used for both reading and listening to technical information. Students are assigned as pairs or triads and work together to solve a problem, answer a question, or clarify understanding. This technique requires students to first think individually about a topic or answer to a question; then share ideas with their partner(s) and agree on an answer. Finally, selected teams are asked to share ideas with the whole class.
- **Oral/Video Reports** - Oral presentations of the One-Paragraph Essays, Technical Reports, and NASA Spinoff Reports are wonderful ways to develop students' technical speaking and listening fluency. Oral reports may be converted into short videos and stored/accessed online. To further build technical speaking and listening fluency, each reading may be followed by a Think-Pair-Share.

ROLE SIMULATIONS AND CAREER CONNECTIONS

NASA supports the development of future employees through career education. One opportunity for career exploration is through role-playing within design team assignments for the engineering design activities. Role-playing is an instructional strategy where students work through a problem by assuming roles and practicing what to say and do in a safe setting. This kind of learning experience has several benefits and advantages. Benefits include the following:

- Students immediately apply content in a relevant, real world context.
- Students see the relevance of the content for handling real world situations.
- Students engage in higher order thinking and learn content in a deeper way.
- Students learn about NASA careers and opportunities.

Although any of the activities may be delivered through role-playing, several have been designed specifically for role-playing. One of the biggest challenges of role-playing is fully engaging all students. The task must be carefully structured and students should have specific responsibilities tied to their roles. We provide examples of how role-playing may be supported through additional handouts and delineation of each role during the engineering design process. For the other activities, the following general roles/responsibilities may be adapted. ***Roles and Responsibilities Name Cards*** (which may be cut and laminated) and ***Role Responsibilities and Research Questions Sample and Template)*** are included in *Assessment Handouts, Tools, and Resources*.

- **Project Manager**
    - Completes written/oral *Technical Report*
    - Manages project development and supports team members
    - Submits budget proposals
    - Secures teacher approvals and communicates with other teams as needed
    - Delivers progress reports, proposals, and presentation
- **Mechanical Engineer**
    - Completes *Design Plan* and *Final Design Summary*
    - Draws detailed illustrations of prototype
    - Leads creation of prototype
    - Resolves design adjustments as testing dictates
    - Works with team to resolve project malfunction
- **Data Analyst**
    - Completes *Testing Data Table* worksheet
    - Collects, organizes, and analyzes data
    - Documents development with pictures/video
    - Makes data-based recommendations for design improvement
    - Prepares data reports for final presentation
- **Materials Engineer**
    - Completes *Quality Assurance Form* for peers during review process
    - Access materials bin
    - Selects materials to use
    - Creates the prototype
    - Considers implication of waste and environmental pollution

ASSESSMENT STATEGIES

There are multiple tools and resources provided within each activity and/or in this section to help educators assess student learning in formative and summative ways.

ASSIGNMENTS

- **KWL Chart** - In each activity, educators are encouraged to use a KWL chart (tracked by individual students, teams, or as a whole class) as a formative assessment to monitor student progress and understanding.
- **EDP Worksheets** - As students move through the engineering design process, they are expected to track their progress through the completion of worksheets, which are provided within the Student Pages, and also as separate Word documents to facilitate student use in technology-rich environments.
    - ***Design Plan, Testing Data Table, and Final Design Summary*** - Three worksheets to help students monitor their progress through the engineering design process. (Provided in Word and PDF for student access.)
    - ***Quality Assurance Form*** - A peer review worksheet that requires students to critique and receive feedback from another team's solution. (Provided in Word and PDF for student access.)
    - ***Discussion Questions*** - This worksheet focuses on the outcomes of the engineering design process and provides a summative experience for students to reflect back on learning. Selected answers are included in the *Teacher Pages* of each activity. This worksheet may be completed individually, in teams, or as a whole-class. (Provided in Word and PDF for student access.)

- **Written/Oral Reports -** Two written report assignments are noted at the end of each activity to provide students the opportunity to reflect on learning and to practice writing informational texts.
    - ***Technical Report*** - This assignment requires students to compose a 1-2-page report on the design challenge, constraints and requirements, solution proposed, summary of evaluation results, final outcome, lessons learned, and recommendations for next steps. Simple directions are provided as in each activity; scoring guide is provided under *Assessment Tools* in this document. Further information on NASA Technical Reports is included under *Strategies for Reading and Writing like an Engineer.*
    - ***One-Paragraph Essay*** - This assignment requires students to compose a one-paragraph essay in response to activity-specific prompts. Prompts are provided in the *Teacher Pages* for each activity. Detailed directions and scoring guide are included under *Assessment Tools* in this document.
    - ***NASA Spinoffs Report*** - This assignment requires students to compose a written or oral report on a NASA Spinoff. Further information on is included under *Strategies for Reading and Writing like an Engineer.*

ADDITIONAL ASSESSMENT OPPORTUNITIES

Activities presented in the following sections may also be used to assess student progress and achievement:

- *More Fun with Engineering* - This section is found at the end of the *Student Pages* in each activity and includes ideas for extending study of the engineering challenge and further exploration of related STEM content and NASA missions. These activities may be assigned for enrichment purposes.
- *Strategies for Reading and Writing Like an Engineer* - This section includes sample worksheets to support vocabulary development and reading informational text.
  - ***Vocabulary Comparison/Contrast Technical Context Worksheet***
  - ***Dialectical Journal Directions and Rubric***
- *Role Simulations and Career Connections* - This section includes a sample worksheet for role-playing within design teams.
  - ***Role Responsibilities and Research Questions***

LIST OF ASSESSMENT HANDOUTS, TOOLS, AND RESOURCES PROVIDED IN WORD®

NASA's BEST Activity Guides provide multiple assessment handouts, tools, and resources to help educators assess student progress and achievement. Below is a list of resources are provided in Word® so that educators may modify to meet the needs of their learners.

- *Vocabulary Comparison/Contrast Technical Context (Sample and Template)*
- *SQ3R Handout*
- *Dialectical Journal Directions and Rubric*
- *Roles and Responsibilities Name Cards*
- *Role Responsibilities and Research Questions (Sample and Template)*
- *One-Paragraph Essay Directions and Scoring Guide*
- *Technical Report Scoring Guide*
- *NASA Spinoffs Report Directions and Scoring Guide*
- *Engineering Design Process Scoring Guide*
- *Design Team Collaboration Scoring Guide*

GREEN PROPELLANT VOCABULARY COMPARISON/CONTRAST TECHNICAL CONTEXT				
For each of the following words, compose a sentence that uses the word in a technical context and a sentence that uses the word in a non-technical context. Circle the word in the sentence. Provide the type of speech (noun, adjective, verb, or adverb) and appropriate definition. The first one is done for you.				
Word	**Technical Context**		**Non-Technical Context**	
	Sentence	**Type of Speech, Definition**	**Sentence**	**Type of Speech, Definition**
Reaction	*The chemical reaction produced a gas.*	*(Noun) chemical change that occurs when two substances combine to form new substance*	*The puppy reacted to the balloon by barking loudly.*	*(Verb) action performed in response to event*
Green				
Environment				
Thrust				
Gas				
Formula				
Law				

NASA's BEST ACTIVITY GUIDES

SQ3R: Skim, Question, Read, Recite, and Relate

SQ3R is a strategy that helps readers process and increase retention of informational texts, such as technical reports, scientific writing, and instruction manuals.

Informational texts are nonfiction and are written with the intention of informing the reader about a specific topic. Special text features allow the reader to easily find key information and understand the main topic. Three of these special features are (1) the use of headers and sub-headers to organize information, (2) use of bold or italics to identify important vocabulary, and (3) including visuals (such as images, tables, timelines, diagrams, and charts) to demonstrate ideas. Some informational text includes a table of contents, glossary, index, or sidebar. Informational text available on the Internet may also include video and interactive features.

SQ3R takes advantage of these unique features. During the SQ3R process, the reader gives close attention to headings, words in bold, and visuals. Like the Engineering Design Process, however, these steps aren't just linear. You may need to cycle back into previous steps in order to fully understand the informational text you are reading.

- **S = SKIM** *(approximately 3 minutes per ½ hour of reading)*
    - Skim the informational text to determine the main ideas. Read headings and subheadings and bold or italicized print. (If you see a word you don't know, check the Glossary.)
    - Look at images and graphics; read captions.
    - Read the first and last paragraph of the document.
    - If included, skim the Table of Contents and Sidebars.

- **Q = QUESTION** *(approximately 3 minutes per ½ hour of reading)*
    - Turn each subheading into a question: What is the question that this informational text is trying to answer? Or make the reading more meaningful by answering this question: What question do I have that this information might help answer?

- **R = READ** *(approximately 20 minutes per ½ hour of reading)*
    - Now it is time to read the text and search for answers.
    - Make notes and highlight main ideas related to the main question for the text.
    - Read one section at a time and find answers to the questions you created from subheadings.

- **R = RECITE** *(approximately 2 minutes per a ½ hour of reading)*
    - Review your notes and identify a few of the most important or interesting points. Summarize them in your own words. Speak them out loud or write them down.

- **R = RELATE** *(approximately 2 minutes per ½ hour of reading)*
    - Connect your knowledge to what you already know. Complete this sentence: What I learned about ____ is related to what I already know about ___ because ____.
    - Look for connections between key points and organize ideas into your own mind-map.
    - Answer this question: How does what I learned impact my personal life and society?

NASA's BEST Dialectical Journal

Dialectic means "the art or practice of arriving at the truth by using conversation involving question and answer." The "dialectic" was the method Socrates used to teach his students how to be actively engaged in the struggle to obtain meaning from an unfamiliar and challenging work. A dialectical journal is a written conversation with yourself about a piece of literature that encourages the habit of reflective questioning. You will use a double-entry form to examine details of a passage and synthesize your understanding of the text.

Basic Directions

- Divide your paper by folding the page vertically or drawing a vertical line down the middle.
- Label the top of each column: left TEXT and right REFLECTION
- Select at least five passages from the reading.
- In the TEXT column cite passages verbatim from the novel, including quotation marks and page numbers (or Location, if an e-book)
- In the REFLECTION column, present your reaction to the passage.

Tips for Selecting a Passage to Include

- When the details seem important
- When you learn something significant or find an interesting significant quotation
- When you recognize a pattern (overlapping images, repetitions of idea, details, etc.)
- When you agree or disagree with something

What should your reflection include?

- Questions about the content
- Personal reactions to the passage or situation
- Explanation of what it reminds you of in your own experiences
- Comparisons to other passages in the text
- Connections to scientific theories or concepts

Example

Text	Reflection
Throughout history, humans have used several options for this: • *A natural astronomical phenomenon,* • *An artificial, human-made device, and* • *A combination of both natural phenomena and artificial devices.* *(Atomic Clock Introduction, page 1)*	*When was the first clock was ever used and for what purpose? Maybe they needed to cook food or measure how long it took to do something.*

Rubric for Dialectical Journal	
A	• Excellent effort • Meaningful selection of passages • Thoughtful interpretation and commentary about the text • Makes insightful personal connections and asks thought-provoking questions • Addresses all parts of reading assignment. • Journal is neat, organized and professional-looking • Student has followed directions in creation of journal
B	• Significant effort • Less detailed, but good selection of passages • Some intelligent commentary; addresses some thematic connections • Some personal connections; asks pertinent questions. • Adequately addresses all parts of reading assignment. • Journal is neat and readable • Student has followed directions in the organization of journal
C	• Minimal effort • Few good passages selected • Most of the commentary is vague, unsupported, or plot summary /paraphrase • Limited personal connection; asks few, or obvious questions • Addresses most of the reading assignment, but is not very thorough • Journal is relatively neat, but may be difficult to read
D	• Poor effort • Poor details from the text; missing page numbers • All notes are plot summary or paraphrase • Limited personal connections, few good questions • Limited coverage of the text; way too short • Difficult to follow or read • Did not follow directions in organizing journal
F	• Did not complete or plagiarized

O

Project Manager

- Completes written/oral *Technical Report*
- Manages project development and supports team members
- Submits budget proposals
- Secures teacher approvals and communicates with other teams as needed
- Delivers progress reports, proposals, and presentation

O

Mechanical Engineer

- Completes *Design Plan* and *Final Design Summary*
- Draws detailed illustrations of prototype
- Leads creation of prototype
- Resolves design adjustments as testing dictates
- Works with team to resolve product malfunctions

O

Materials Engineer

- Completes *Quality Assurance Form* for peers during review process
- Access materials bin
- Selects materials to use
- Creates the prototype
- Considers implication of waste and environmental pollution

O

Data Analyst

- Completes *Testing Data Table*
- Collects, organizes, and analyzes data
- Documents development with pictures/video
- Makes data-based recommendations for design improvement
- Prepares data reports for final presentation

GREEN PROPELLANT ROLES AND RESPONSIBILITIES		
Role	**Responsibilities**	**Questions to Research**
NASA Aerospace Engineer ***(Insert image)***	• Designs/draws illustrations of spacecraft propulsion system. • Collects materials for spacecraft propulsion system • Contributes to budget for spacecraft propulsion system. • Builds system and adjusts design based on test results. • Completes/delivers *Technical Report.*	• What is a propulsion system and why does a spacecraft need one? • What should be included in your propulsion system? • What are the best options for materials to construct the spacecraft propulsion system?
NASA Scientist ***(Insert image)***	• Designs green propellant. • Creates list of materials and identifies possible combinations. • Collects, measures, mixes ingredients for propellant • Identifies chemical formulas, equations, and descriptions. • Estimates gas production during trials. • Based on test results, adjusts propellant formula. • Completes *Design Plan* and *Final Design Summary.*	• What is a chemical reaction? How may a chemical reaction be used to propel a spacecraft? • What is a propellant and why does a propulsion system need it? • What ingredients can be combined to form a gas? • What is the most important ingredient in increasing the amount of gas produced?
Air Force Pilot ***(Insert image)***	• Pilots spacecraft. • Designs/draws plan for attaching spacecraft to fight system. • Conducts evaluation study; measures distance spacecraft travels. • Develops and monitors budget with support from Aerospace Engineer and Chemist/Scientist. • Completes *Testing Data Table.*	• Where will your spacecraft be expected to fly? • What is thrust? • How will you attach the spacecraft to the straw? • How much do materials and rental space cost? • What is Newton's Third Law of Motion and how does it apply to this challenge?
Government Agency Environmental Impact Officer ***(Insert image)***	• Identifies environmental impact of spacecraft, propulsion system, and propellant. • Reviews Safety Data Sheets (SDS) for propellant ingredients. • Observes evaluation study to estimate environmental impact. Records images/video of spacecraft, propellant, and tests. • Monitors clean up. • Completes *Quality Assurance Form* for team review.	• What are some of the environmental impacts of hydrazine? • Based on the STS, what are the health, flammability, and physical hazards associated with vinegar and baking soda? • What cleanup is required to insure that propellant ingredients are not dangerous to the environment? • What are the environmental concerns when flying your spacecraft with your propulsion system? How will your team minimize environmental impact?

NASA's BEST ACTIVITY GUIDES

ONE-PARAGRAPH ESSAY

As a concluding activity to each engineering design activity, students are encouraged to compose a one-paragraph essay in response to a writing prompt. This will help them reflect on learning, synthesize their understanding, and make connections between their problem-solving process and those used by NASA engineers. Specific writing prompts are found in the Teacher Pages for each activity.
A one-paragraph essay is made up of three key components:

1. Thesis/Topic Sentence - The topic sentence presents the main idea. It is sometimes also referred to as a thesis statement, as it is here that you present your position or thesis that the rest of the paragraph will support.

2. Supporting Sentences - The body of the paragraph contains supporting evidence and ideas to defend the topic sentence. Information provided would depend on what is needed to prove the thesis. It may include one or several of the following:
    - Examples of events or facts that support the thesis
    - Quotes from authoritative texts or individuals
    - Descriptions of people, places, or events
    - Statistical evidence and/or numerical data
    - Personal stories or experiences
    - Comparison and contrast summaries
    - Description of cause and effect relationships
    - Outline of steps in a procedure

3. Conclusion/Closing Sentence – The last sentence is an effective summary and ending that helps the reader reach a conclusion

TIPS FOR WRITING A GREAT ONE-PARAGRAPH ESSAY

- Use transition words like *first*, *then*, *after*, and *next* to lead the reader from your topic sentence through body of the essay and on to the logical conclusion that you are putting forward. It should be easy for your reader to follow your train of thought.
- Be sure to provide supporting description and evidence! Focus on the facts and evidence that supports your topic sentence.
- Be concise, and choose your words carefully when composing a one-paragraph essay. It is a short piece and you have neither time nor words to waste!

SCORING GUIDE FOR ONE-PARAGRAPH ESSAY		
CRITERIA	**POSSIBLE**	**EARNED**
Topic Sentence • Introduces the essay argument or thesis • Is clear and coherent • Restates the question or writing prompt	**2**	
Supporting Sentences (3-5 sentences) • Provides important details about essay argument or thesis (such as facts, quotes, descriptions, statistics, and stories) that support essay argument or thesis • Is organized logically and meaningfully; uses transition words	**5**	
Closing Sentence • Summarizes the essay in a convincing and reasonable manner • Leads the reader to an appropriate judgment or decision	**2**	
Paragraph Format • Is organized with a beginning, middle, and end • Uses proper grammar, including punctuation, spelling, subject and verb usage	**1**	
Oral Presentation • *Speech is articulate.* • *Presentation is well organized.* • *Visuals are effectively used to support presentation.* • *Audience questions are addressed appropriately.*	***5***	
TOTAL (10 for Written Report/15 for Written + Oral Report)		

SCORING GUIDE FOR WRITTEN/ORAL TECHNICAL REPORT			
CATEGORY	**CRITERIA**	**POSSIBLE**	**EARNED**
Statement of Design Challenge, Constraints and Requirements	• Design challenge is clearly articulated • All constraints and requirements are included.	**4**	
Solution Proposed	• Design solution is fully described with at least two facts each for design features, measurements, and capabilities. • A drawing is included when possible.	**4**	
Summary of Evaluation Results	• Evaluation results are summarized. • Design improvements are justified with evidence.	**4**	
Final Outcome, Lessons Learned, and Recommendations for Next Steps	• Final solution is summarized and solution is rated for its overall effectiveness when compared to peers. • At least one lesson learned is explained. • At least one recommendation each for next steps in terms of research (what should be tried next), policy (what should NASA do), and practice (how should we use what we designed).	**4**	
Format of Technical Report	• Science and technical terms are used accurately and appropriately. • Subheadings, images, graphs and tables are used to organize and present information.	**4**	
Presentation Quality	• *Speech is articulate.* • *Presentation is well organized.* • *Visuals are effectively used to support presentation.* • *Audience questions are addressed appropriately.*	***5***	
TOTAL (20 for Written Report/25 for Written + Oral Report)			

NASA SPINOFF REPORT

Each year, NASA inventions that benefit life on Earth are highlighted in an annual publication called *Spinoff*. NASA spinoffs demonstrate the wider benefits of America's investment in its space program.

There's more of the cosmos in your life than you think! NASA has profiled nearly 2,000 spinoffs since the publication began in 1976. There are spinoffs related to almost every activity in the BEST Educator Guide. See below for some examples of NASA spinoffs that you may have seen in your own life! Consider assigning this activity for your students.

Image of SPINOFF	***Space Blanket-Inspired Cases Protect Expensive Devices*** *In the 1960s, NASA was preparing for early forays into space and worked to devise thin, reflective, metallic material to protect spacecraft from the dangers of solar radiation. This material, metallized polyethylene terephthalate (MPET), is strong and not only reflects radiation but also serves as powerful insulation to protect electronics from large swings in temperature.* *The flexible, highly efficient, and plastic material has been back to Earth as a main component of the lightweight "space" blankets used by runners to maintain their body temperature after finishing a race. One recent use of the material is in cases for iPhones, iPads, and MacBooks to protect them from heat.*
Image of SPINOFF	***Portable Nanomesh Creates Safer Drinking Water*** *Providing astronauts with clean water is essential to space exploration to ensure the health and wellbeing of crewmembers away from Earth. NASA constantly seeks to improve the process of filtering and reusing wastewater in closed-loop systems.* *In 2003, a commercial company used NASA technology to design a carbon Nanomesh (named WaterStick) for filtering impurities from drinking water. Testing in EPA-certified facilities showed that the filters removed more than 99 percent of bacteria, viruses, and chemical contaminants. The WaterStick filters about 5 gallons (200 milliliters) of water a minute simply using water pressure and gravity--without electricity, heat, chemical additives, or environmental impact.*

ASSIGNMENT

- Find an interesting spinoff by searching the database at NASA Spinoff https://spinoff.nasa.gov/. You may enter a topic such as "heat shields," or "mobile phones." You can search the spinoff database by year or topic. Find a spinoff that interests you and review the article.
- Compose a written or oral report on your spinoff technology and be prepared to share in front of the class. Review the *NASA Spinoff Report Scoring Guide* to be sure you have included all requirements.

SCORING GUIDE FOR NASA SPINOFF REPORT			
CATEGORY	**CRITERIA**	**POSSIBLE**	**EARNED**
Title/URL of Spinoff Article	• Title and URL are provided and are accurate.	**3**	
Explanation of Challenge NASA Encountered	• Challenge or problem is described in detail.	**4**	
Description of NASA's Solution	• Design solution is fully described with at least two facts each for design features, measurements, and capabilities. • At least one image is included.	**4**	
Description of how NASA's Solution Addresses Challenge(s) on Earth	• Description of Earth-based challenge is summarized. • How NASA product addresses challenge is described in detail. • At least one (additional) image is included.	**4**	
Student Reflection, Opinion, Questions for Further Study	• Reflection, opinion, and questions for further study are appropriate and relevant.	**3**	
Writing Quality	• Science and technical terms are used accurately and appropriately. • Subheadings, images, graphs and tables are used to organize and present information.	**2**	
Presentation Quality	• *Speech is articulate.* • *Presentation is well organized.* • *Visuals are effectively used to support presentation.* • *Audience questions are addressed appropriately.*	***5***	
TOTAL (20 for Written Report/25 for Written + Oral Report)			

SCORING GUIDE FOR ENGINEERING DESIGN PROCESS			
STEP	**CRITERIA**	**POSSIBLE**	**EARNED**
ASK	• Team members identified the problem, requirements that must be met, and constraints that must be considered.	**6**	
IMAGINE	• Team members generated multiple ideas and conducted research on what others have done to solve the problem.	**6**	
PLAN	• Team members determined the best idea. The final choice was justified based on design constraints and requirements. • Team members collaborated to make a detailed sketch of the design, label the sketch with dimensions, and list materials needed to build a model.	**6**	
CREATE	• Team members collaborated to build a model and record the process. While the model was built, detailed procedures for building the model were recorded (if required). • A list of materials used to construct the model was compiled and budget considerations were noted. Measurements of model dimensions were carefully noted with appropriate units.	**6**	
TEST	• Team members collaborated to evaluate the model and record the process. Calculations were rechecked to insure accuracy. • Team members designed several tests for the model and used time efficiently to conduct as many tests as possible while observing safety requirements. Data was collected carefully.	**6**	
IMPROVE	• Team members worked collaboratively to interpret results of tests, identify improvements to be made, make the improvements, and retest the revised design. • Improvements were justified with evidence.	**6**	
SHARE	• Team members worked collaboratively to present findings to another team for feedback; review another team's design and provide feedback; and summarize findings in the final report.	**6**	
OVERALL	• Team members followed all safety requirements. • Team area was cleaned up and all materials returned. • Team members were professional and courteous. • Assignments were completed in a timely manner.	**8**	
TOTAL		**50**	

SCORING GUIDE FOR DESIGN TEAM COLLABORATION			
STEP	**CRITERIA**	**POSSIBLE**	**EARNED**
ASK	• All team members contributed appropriately to group discussion and decision-making.	**4**	
IMAGINE	• Each team member contributed to the brainstorming session, and all ideas were noted and considered.	**3**	
PLAN	• The best solution was determined through consensus and deliberation. The decision was informed by team dialogue in which all members participated. • A work plan was developed, with work divided reasonably among the team. Roles were assigned according to team member strengths and interests.	**4**	
CREATE	• All team members contributed to the creation process. • Team member actions were coordinated and interdependent. Tasks completed separately were brought to the team for critique and revision.	**3**	
TEST	• All team members contributed to the evaluation process. • Team member actions were coordinated and interdependent. Tasks completed separately were brought to the team for critique and revision.	**4**	
IMPROVE	• All team members contributed to decisions regarding design improvement. • Responsibilities for improvement and retesting efforts were divided and coordinated effectively.	**4**	
SHARE	• Work was divided reasonably among the team, and roles were assigned according to team member strengths and interests.	**3**	
TOTAL		**25**	