

PEI created performance tasks designed to introduce middle school students to renewable and non-renewable energy resources. To date, these tasks include the following:

Renewable and Non-renewable Energy

Renewable Energy: Wind

Renewable Energy: Solar

Renewable Energy: Hydropower

Renewable Energy: Geothermal

Renewable Energy: Biomass

The tasks are designed to provide basic background knowledge about renewable energy including what it is, how it works and the advantages and disadvantages for the environment. Each task focuses on a type of renewable energy, including basic background knowledge, career information, and a variety of print and video resources. Students practice the research skills of locating information, selecting the best information and having enough information to explain or persuade.

The first task, *Renewable and Non-renewable Energy*, culminates in a speech. Teachers are provided with the SBAC Speech rubric for scoring the student presentations. A template is provided for planning speeches. Teachers may adapt these materials as desired.

The Wind, Solar, Hydropower, Biomass, and Geothermal energy tasks are written to culminate in an argumentative essay. Students present a strong argument for the renewable energy source researched, including providing at least one counter argument with rebuttal. Each task includes an essay organizer to support students in writing an argumentative essay. The SBAC Argumentative rubric is included for scoring student work.

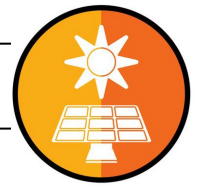
Teachers may want to assign additional research for the students prior to writing their essays. Otherwise, students can draw from the information provided in the performance task.

Each task includes a suggested field experience so that students may learn firsthand about the various renewable energy resources. If you are unable to conduct the field experience, you may want to create a virtual experience for the students where they investigate how the renewable energy resource is affecting their local communities.

Field Investigations are being developed for each task. These will be posted on the PEI website as they are created. The field investigations will focus on the science behind energy production and align with the NGSS standards.

Teachers should implement the performance tasks in a time frame that works best for them. The original model from SBAC has students completing Part 1 on day 1 and Part 2 on day 2. This may be inadequate for diving deeply into the research materials and ELA skills. Most likely, each performance task will fit into a three to five-day time period.

The main purpose of these tasks is to integrate ELA skills, including reading, writing, listening and speaking, with science content. Think of the tasks as a gateway into a more in-depth study of renewable energy and an opportunity to practice and apply a wide variety of ELA skills. Make the materials work for you and for your students. And do feel free to contact PEI for additional support!



PART 1: Research Student Directions

Your Assignment:

Your County Council is investigating renewable energy options for the future. The Council has asked middle school students to research the pros and cons of different types of renewable energy including energy from wind, water and sunlight. Your class will focus on solar energy. You will research this type of energy, determine the pros and cons, and share your findings with the Council in the form of an argumentative essay.

Steps you will follow:

To plan and compose your essay, you will do the following:

1. Read an article, view an infographic, read a pros and cons list and watch two videos.
2. Answer three questions about the sources.
3. Participate in a suggested field experience.
4. Write an essay.

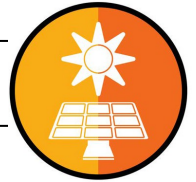


Directions for beginning:

You will read the article, view the infographic, read the pros and cons list and watch two videos, taking notes with the template provided. You may refer to the sources and your notes when writing your essay.

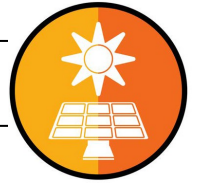
Source Information:

- Source #1:** Article: *Solar Basics: Energy from the Sun* Adapted from Energy Kids: Renewable Solar
https://www.eia.gov/kids/energy.cfm?page=solar_home-basics
- Source #2:** Article #2: *Solar Energy Pros and Cons*.
Adapted from <http://energyinformative.org/solar-energy-pros-and-cons/>
- Source #3:** Infographic: Solar Power Explained Quest Science
<https://ww2.kqed.org/quest/2014/11/14/how-solar-power-works/>
- Source #4:** Video #1: What is Solar Energy? (5:07) <https://youtu.be/inPfrWtvDaM>
Video #2 (Optional): Energy 101 Solar Power (3:30) <https://youtu.be/NDZzAlcCQLQ>
- Source #5:** Career Video: Solar Skills: IREC Solar Career Map (2:16)
<https://www.youtube.com/watch?v=WDvjkuqqZk>



Note-taking Template

Source	How Solar Energy Works	Pros of Solar Energy	Cons of Solar Energy
Source #1: Solar Basics: Energy from the Sun			
Source #2: Solar Energy Pros and Cons			
Source #3: Infographic Solar Power Explained			

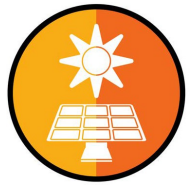


Note-taking Template

Source	How Solar Energy Works	Pros of Solar Energy	Cons of Solar Energy
Source #4: Video: What is Solar Energy?			

Career Video Note-taking Template

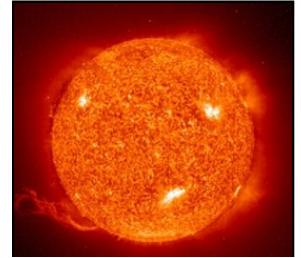
Source	Types of Jobs	Key qualifications	Benefits of working in this industry
Career Video: Solar Skills			



Source #1: Article

Solar Basics Energy from the Sun

The sun has produced energy for billions of years and is the ultimate source for all the energy sources and fuels we use today. People have used the sun's rays (solar radiation) for thousands of years for warmth and to dry meat, fruit, and grains. Over time, people developed devices (technologies) to collect solar energy and convert it into electricity. Here are five solar basics.



Radiant energy from the sun has powered life on earth for billions of years.

Solar Basic #1: Solar photovoltaic systems convert sunlight into electricity.



Solar photovoltaic (PV) devices, or solar cells, change sunlight directly into electricity. Small PV cells can power calculators, watches, and other small electronic devices. Arrangements of many solar cells in PV panels and arrangements of multiple PV panels in PV arrays can produce electricity for an entire house. Some PV power plants have large arrays that cover many acres to produce electricity for thousands of homes.

Solar Basic #2: Solar energy has benefits and some limitations.

The two main benefits of using solar energy are:

1. Solar energy systems do not produce air pollutants or carbon dioxide.
2. Solar energy systems on buildings have minimal impact on the environment.

The main limitations of solar energy are:

1. The amount of solar energy that the earth receives each day is many times greater than the total amount of all energy that people consume. However, on the surface of the earth, solar energy is a variable and intermittent energy source. The amount of sunlight and the intensity of sunlight varies by time of day and location. Weather and climate conditions affect the availability of sunlight on a daily and seasonal basis.
2. The amount of sunlight reaching a square foot of the earth's surface is relatively small, so a large surface area is necessary to absorb or collect a useful amount of energy.

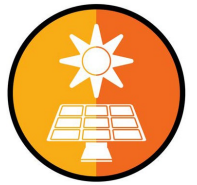
Solar Basic #3: Solar Energy is plentiful but varies from place to place and time of day.

The amount of solar energy that the earth receives each day is many times greater than the total amount of all energy that people consume. However, on the surface of the earth, solar energy is a variable and intermittent energy source. The amount of sunlight and the intensity of sunlight varies by time of day and location. Weather and climate conditions affect the availability of sunlight on a daily and seasonal basis.





Performance Task: Renewable Energy - Solar



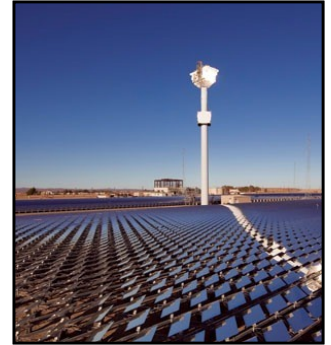
Solar Basic #4: There are a variety of ways to collect solar energy.

Solar thermal collectors

Low-temperature solar thermal collectors absorb the sun's heat energy to heat water or to heat homes, offices, and other buildings.

Concentrating collectors

Concentrating solar energy technologies use mirrors to reflect and concentrate sunlight onto receivers that absorb solar energy and convert it to heat. This thermal energy is used for heating homes and buildings or to produce electricity with a steam turbine or heat engine that drives a generator.



Photovoltaic systems

Photovoltaic (PV) cells convert sunlight directly into electricity. PV systems can range from systems that provide tiny amounts of electricity for watches and calculators to systems that provide the amount of electricity that hundreds of homes use. Millions of houses and buildings around the world have PV systems on their roofs. Many multi-megawatt PV power plants have also been built. Converting 4% of the world's desert areas with photovoltaics could supply the equivalent of all the world's daily electricity use.

Fun Fact:

Covering 4% of the world's desert areas with photovoltaics could supply the equivalent of all the world's daily electricity use.

Solar Basic #5: Solar energy affects the environment in both positive and negative ways.

Solar energy does not produce air or water pollution or greenhouse gases. It is clean and renewable. When solar energy replaces fossil fuels, the environment benefits.

However, some toxic materials and chemicals are used to make the photovoltaic (PV) cells that convert sunlight into electricity. These chemicals can be harmful to the environment. Also, large power plants can affect the environment by destroying habitat for some plants and animals.

We use solar thermal energy systems to:

- Heat water for use in homes, buildings, or swimming pools
- Heat the inside of homes, greenhouses, and other buildings
- Heat fluids to high temperatures in solar thermal power plants

Solar energy may have the most promise of all forms of renewable energy. The sun's energy can power the entire world once the systems are in place to capture and store the Sun's power.

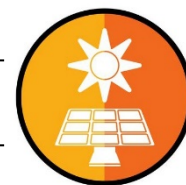


solar arrays
Ellensburg, WA

Now you know the basics!



Performance Task: Renewable Energy - Solar



Source #2:

Solar Energy Pros and Cons

Advantages of Solar Energy

Renewable - Solar energy is a renewable energy source. This means that we cannot run out of solar energy unlike we will with fossil fuels like coal and oil. We will have access to solar energy for as long as the sun is around-another 6.5 billion years according to NASA.

Abundant - The potential of solar energy is beyond imagination! The surface of the earth receives 120,000 terawatts of solar radiation (sunlight)-20,000 times more power than what is needed to supply the entire earth's demand for electricity.

Sustainable - An abundant and renewable energy source is also sustainable. Sustainable energy sources meet the needs of the present without compromising the ability of future generations to meet their needs. In other words, solar energy is sustainable because there is no way we can over-consume or use it up.

Environmentally Friendly - Harnessing solar energy does not generally cause pollution. However, there are emissions associated with the manufacturing, transportation and installation of solar power systems- almost nothing compared to the use of fossil fuels. Solar energy reduces our dependence on non-renewable energy sources. This is an important step in fighting climate change.

Low Maintenance - The majority of today's solar power systems do not require a lot of maintenance. Residential solar panels usually require cleaning a couple of times a year. Solar power systems should last on average 20 to 25 years.

Reduced Electricity Costs - Homeowners with solar power can "sell" their electricity, when they produce more than they use, to the power companies. They receive credit for this electricity on their energy bills, helping to pay for their solar system and saving money over time.

Disadvantages of Solar Energy

Cost - The cost of solar equipment can be very expensive. However, Federal government incentives have significantly reduced the costs by allowing a homeowner or business to deduct the cost of installing a system from their taxes. These incentives are subject to change each year.

Intermittent - Solar energy is an intermittent energy source. Access to sunlight is limited at certain times (e.g. morning and night). Predicting overcast days can be difficult. This is why solar power may not be the first choice when it comes to meeting basic energy demands. However, solar power has fewer problems than wind power when it comes to intermittence. Also, engineers are working on solar batteries that can store large amounts of solar energy for use when the sun is not shining.

Energy Storage is Expensive - Energy storage systems such as batteries will help to smooth out issues with demand and availability, making solar power more stable. However, these technologies are expensive. Fortunately, our greatest demand for electricity is during the day when the sun shines and our lowest demand is at night.

Associated with Pollution - Solar energy is clean and non-polluting; however, manufacturing solar panels can release greenhouse gases into the atmosphere. Transportation and installation of solar power systems can also indirectly cause pollution. However, solar power compares very favorably with all other technologies including wind and hydropower.

Requires Space - Solar panels take up space – on buildings or in the landscape. Power density is determined when looking at a site, if too much space is required to produce the energy desired it could limit the potential that solar is the right source.

References: NASA, U.S. Department of Energy, National Renewable Energy Laboratory (NREL), U.S. Energy Information Administration (EIA) European Union



Source #3

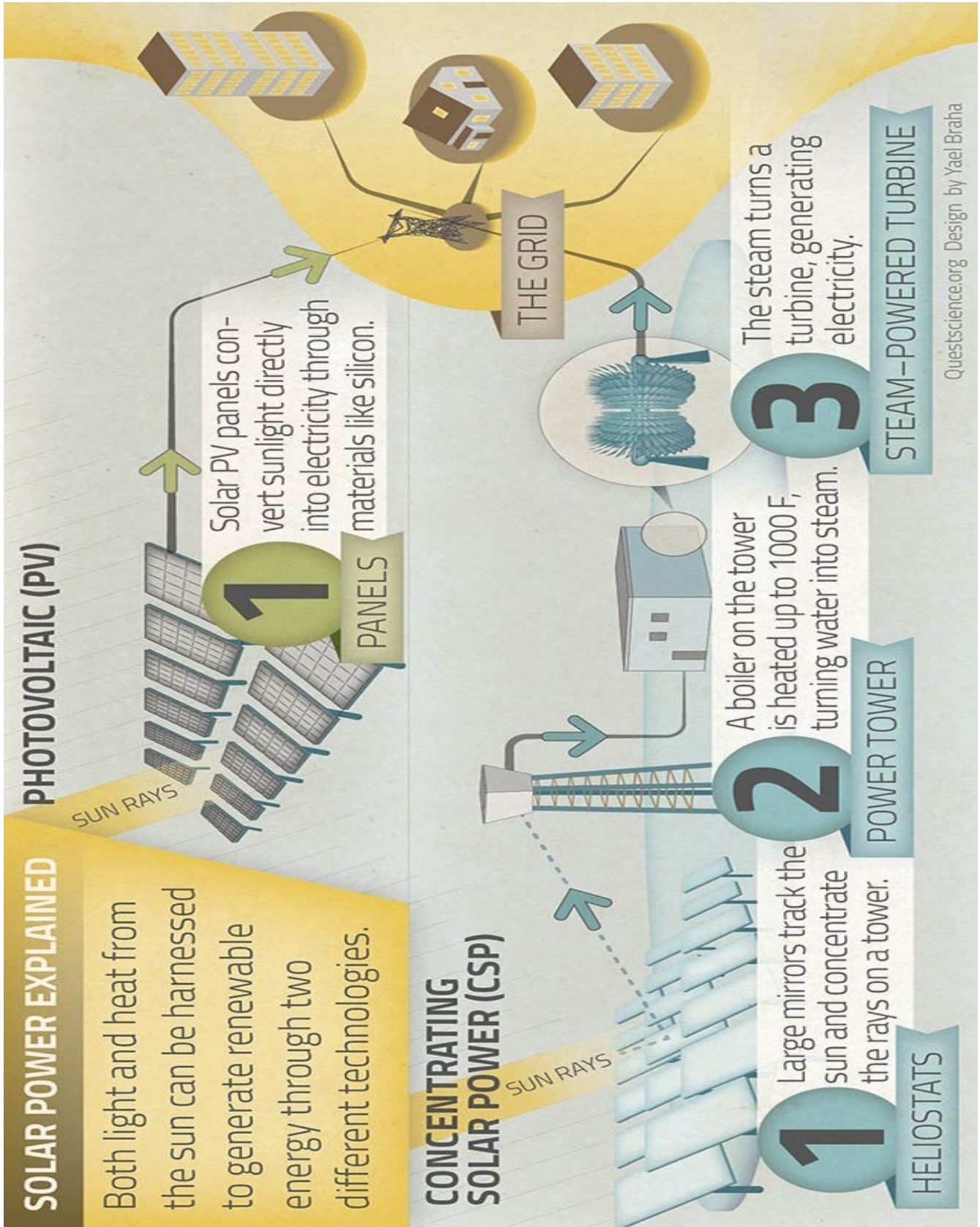
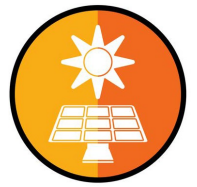


Image credit [KOED](#) Public Media for Northern California.



PART 2: Field Investigation

Arrange to take your students on a visit to a neighborhood where residents are using solar panels or to a place where solar panels are manufactured and/or installed. Plan the field investigation prior to the students writing their essays. Encourage the students to use information they learn about the benefits of solar energy, including employment opportunities, in their essays.

Field Investigation Note-taking Template

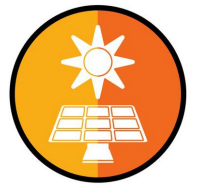
Site Visited: Date and Time:

Benefits of solar energy:

Challenges we face using solar energy:

How are these challenges are being addressed?

Career opportunities in the solar energy industry:



PART 3: Essay Student Directions

You will review your notes and plan your argumentative essay. You may use notes from the resources and from the field experience to write your essay. You may also refer to the sources. Read your assignment and the information about how your essay will be scored. Then begin your work.



Your assignment:

You have been asked by the County Council to research the pros and cons of solar energy and to make a case for continuing to use and expand this type of renewable energy. Your essay should persuade your reader to support solar energy production and include the following:

- Explain what solar energy is and why it is considered renewable.
- Identify at least three important pros and one significant con, providing a counter argument to the con.
- Convince the reader why it is important to make the shift to solar energy as a valuable renewable resource. Consider access to solar energy, impact of solar energy on the environment, and potential employment opportunities.

Use the planning template to help you to compose your essay.

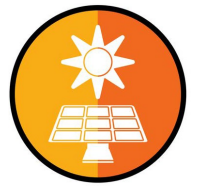
How your essay will be scored:

- Statement of Purpose/Focus** – how well you clearly state and maintain your claim including addressing counter arguments.
- Organization** – how well the ideas progress from the introduction to the conclusion using effective transitions and how well you stay on topic throughout the essay.
- Elaboration of Evidence** – how well you provide evidence from source about your claim and elaborate with specific information.
- Language and Vocabulary** – how well you effectively express ideas using precise language that is appropriate for your audience and purpose.
- Conventions** – how well you follow the rules of usage, punctuation, capitalization, and spelling.

Now begin work on your essay

- Review your notes
- Plan your essay using the template provided
- Write your essay
- Revise and edit for a final draft





Planning My Essay

Essay Components:

Introduction: Capture the reader's interest!

Explain what solar energy is and how it is a renewable resource.

State the argument for solar energy, including at least three strong pros. Consider limitations, impact on the environment, and employment opportunities.

1.

2.

Identify an important con of solar energy and provide a counter argument to this con:

Provide a persuasive conclusion:



Performance Task: Renewable Energy - Solar



Argumentative Writing Rubric (Grades 6–11) Scoring Version

Score	4	3	2	1
Statement of Purpose/Focus	<p>The response is fully sustained and consistently and purposefully focused:</p> <ul style="list-style-type: none"> claim is introduced clearly communicated, and the focus is strongly maintained for the purpose, audience, and task alternate or opposing argument(s) are clearly acknowledged or addressed* 	<p>The response is adequately sustained and generally focused:</p> <ul style="list-style-type: none"> claim is clear and the focus is mostly maintained for the purpose, audience, and task alternate and opposing argument(s) are adequately acknowledged or addressed* 	<p>The response is somewhat sustained and may have a minor drift in focus:</p> <ul style="list-style-type: none"> claim may be somewhat unclear, or the focus may be insufficiently sustained for the purpose, audience, and task alternate and opposing argument(s) may be confusing or not acknowledged* 	<p>The response may be related to the purpose but may provide little or no focus:</p> <ul style="list-style-type: none"> claim may be confusing or ambiguous; may be too brief or the focus may drift from the purpose, audience, or task alternate and opposing argument(s) may not be acknowledged*
Organization	<p>The response has a clear and effective organizational structure, creating a sense of unity and completeness:</p> <ul style="list-style-type: none"> consistent use of a variety of transitional strategies to clarify the relationships between and among ideas effective introduction and conclusion logical progression of ideas from beginning to end; strong connections between and among ideas with some syntactic variety 	<p>The response has an evident organizational structure and a sense of completeness, though there may be minor flaws and some ideas may be loosely connected:</p> <ul style="list-style-type: none"> adequate use of transitional strategies with some variety to clarify relationships between and among ideas adequate introduction and conclusion adequate progression of ideas from beginning to end; adequate connections between ideas 	<p>The response has an inconsistent organizational structure, and flaws are evident:</p> <ul style="list-style-type: none"> inconsistent use of transitional strategies and/or little variety introduction and conclusion, if present, may be weak uneven progression of ideas from beginning to end; and/or formulaic; inconsistent or unclear connections among ideas 	<p>The response has little or no discernible organizational structure:</p> <ul style="list-style-type: none"> few or no transitional strategies are evident introduction and conclusion, if present, may be missing frequent extraneous ideas may be evident; ideas may be randomly ordered or have unclear progression
Elaboration of Evidence	<p>The response provides thorough and convincing support/evidence for the argument(s) and claim that includes the effective use of sources (facts and details).</p> <ul style="list-style-type: none"> comprehensive evidence from sources is integrated; references are relevant, and specific effective use of a variety of elaborative techniques** 	<p>The response provides adequate support/evidence for the argument(s) and claim that includes partial or uneven use of sources (facts and details).</p> <ul style="list-style-type: none"> adequate evidence from sources is integrated; some references may be general adequate use of some elaborative techniques** 	<p>The response provides uneven, cursory support/evidence for the argument(s) and claim that includes partial or uneven use of sources (facts and details).</p> <ul style="list-style-type: none"> some evidence from sources may be weakly integrated, imprecise, or repetitive; references may be vague weak or uneven use of elaborative techniques**; development may consist primarily of source summary or may rely on emotional appeal 	<p>The response provides minimal support/evidence for the argument(s) claim that includes little or no use of sources (facts and details).</p> <ul style="list-style-type: none"> evidence from source material is minimal or irrelevant; references may be absent or incorrectly used minimal, if any, use of elaborative techniques**; emotional appeal may dominate
Language	<p>The response clearly and effectively expresses ideas, using precise language:</p> <ul style="list-style-type: none"> vocabulary is clearly appropriate for the audience and purpose effective, appropriate style enhances content 	<p>The response adequately expresses ideas, employing a mix of precise with more general language:</p> <ul style="list-style-type: none"> vocabulary is generally appropriate for the audience and purpose generally appropriate style is evident 	<p>The response expresses ideas unevenly, using simplistic language:</p> <ul style="list-style-type: none"> vocabulary use is uneven or somewhat ineffective for the audience and purpose inconsistent or weak attempt to create appropriate style 	<p>The response's expression of ideas is vague, lacks clarity, or is confusing:</p> <ul style="list-style-type: none"> vocabulary is limited or ineffective for the audience and purpose little or no evidence of appropriate style
Score	2	1	0	
Conventions	<p>The response demonstrates a command of conventions:</p> <ul style="list-style-type: none"> adequate use of correct sentence formation, punctuation, capitalization, grammar usage, and spelling 	<p>The response demonstrates partial command of conventions:</p> <ul style="list-style-type: none"> limited use of correct sentence formation, punctuation, capitalization, grammar usage, and spelling 	<p>The response demonstrates little or no command of conventions:</p> <ul style="list-style-type: none"> infrequent use of correct sentence formation, punctuation, capitalization, grammar usage, and spelling 	
NS	<p>Unintelligible, in a language other than English, off-topic, insufficient evidence (incomplete) or copied text. (Off-purpose writing will still receive a score in Conventions).</p>			

* Acknowledging and/or addressing the opposing point of view begins at grade 7

** Elaborative techniques may include the use of personal experiences that support the controlling idea