Hydro-Electric Power Source *Task*



Did you know Niagara Falls is so powerful that it generates some of the least expensive electricity anywhere in the world? For generations, the Niagara River has fascinated camera-ready tourists and admiring visitors with its overwhelming power and strength. It's really no wonder why Niagara Falls is widely known as one of the great, natural wonders of the world.

Since the early 1900s, a hydro-electric power facility has captured that potential energy, becoming the largest electric producer in New York State. This natural, non-polluting, publicly-owned power source has existed in harmony with the beauty of Niagara for nearly a century. According to the New York Power Authority, this power plant generates 2.4 million kilowatts — enough power to light 24 million 100-watt bulbs at once! This low-cost electricity saves the state's residents and businesses hundreds of millions of dollars a year. In 2007, they predicted that the Niagara Power Plant will continue to produce steady supplies of clean, carbon-free hydroelectricity for another 50 years.

Are waterfalls an untapped natural resource in other places? Where could this massive energy potential be harnessed and used to create electricity? What about places that don't have a natural waterfall?

Marmore's Falls in Italy is the world's tallest *human-made* waterfall. Marmore's Falls is an incredible 165 meters high, compared to the world-renowned Niagara Falls, which is only 53.6 meters high! But even more amazing is that it was constructed by man during Roman times, dating back to 271 B.C.E.! So, there's no reason that we can't be constructing waterfalls today!

How could you strategically create man-made waterfalls in your area to supply local residents with clean, affordable hydro-electricity? Where and how could this be done? Develop a proposal to either construct a hydro-electric power facility on an existing waterfall or a new, man-made waterfall. Tap into the awe and majesty of waterfalls to advance renewable clean energy technology!

While developing your proposal, use the IDE Design Process to create a novel solution and explore the economic, social, environmental, and geopolitical costs, benefits, and risks. To ensure that you have the most feasible and optimal solution, consider a wide range of constraints to your proposal. Let's help to responsibly manage our natural resources!

© 2019–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only.

Student Material

Hydro-Electric Power Source *Rubric*

	Novice	*Apprentice*	*Practitioner*	*Expert*
Solutions Design	• includes a solution to a problem • demonstrates some use of the design process	• includes a solution to a problem, based on scientific knowledge • demonstrates some use of the design process and scientific method	• includes a solution to a complex real-world problem, based on a wide variety of scientific knowledge related to hydroelectric power • demonstrates effective use of the design process and scientific method • includes a wide variety of student-generated sources of evidence, including competing ideas and evidence • includes prioritization of criteria and tradeoff considerations	all of *Practitioner* plus: the solution offers alternative options to increase the persuasive value of the proposal
Explanation	• outline of the key points of the proposal • some textual evidence to support the need for either a waterfall or a hydro-electric power source	• detailed proposal • some cited textual evidence to support the need for a waterfall and a hydro-electric power source • includes proposal evaluation that considers some possible constraints, such as cost	• detailed proposal with maps, images, data tables, and/or other illustrative examples • ample, relevant, cited textual evidence to support the need for both the waterfall and the hydro-electric power source • includes proposal evaluation that considers a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts	all of *Practitioner* plus: includes evaluation of competing design solutions (such as dams) based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations)

© 2019–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only.

STEM Connections	includes use of science, technology, engineering, and math in solution design	• includes scientific knowledge to support both the need and the solution • includes some use of technology in the solution-finding process • includes a plan for an engineered 3-D prototype of solution • includes mathematical computations in the decision-making process	• includes scientific knowledge through sources and experiments to support both the need and the solution • includes use of technology for modeling and exploring what-if? scenarios • includes engineered 3-D prototype of solution • includes a mathematical analysis of costs and benefits as a critical aspect of decision-making	all of *Practitioner* plus: explains how STEM thinking helped in the development of the solution
Human Impacts on Earth Systems	offers some of the benefits of less pollution and waste with the use of hydro-electric power	• explains the responsible management of natural resources • highlights the possibility of less pollution and waste with the use of hydro-electric power	• details the sustainability of human societies and the biodiversity that supports them through the responsible management of natural resources • highlights the contribution the proposal makes to society by producing less pollution and waste and precluding ecosystem degradation	all of *Practitioner* plus: describes various predictions based on scientific evidence or empirical data for the long-term impact on the primary community that would profit from the proposal, as well as any secondary or tertiary community impacts

© 2019–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only.

Audience and Format	• writes to inform by including basic scientific procedures and some evidence or technical processes • includes visuals to support solution	• writes to inform and explain by including scientific procedures, evidence, and/or technical processes • uses domain-specific vocabulary to manage the complexity of the topic • presents arguments to support solution with some evidence • includes visuals and graphical data to support solution	• writes to inform, explain, and persuade by including scientific procedures, evidence, and/or technical processes • uses precise language and domain-specific vocabulary to manage the complexity of the topic • presents arguments to support claims in an analysis of substantive topics, using valid reasoning, as well as relevant and sufficient evidence • anticipates the audience's knowledge level and concerns	all of *Practitioner* plus: presents claims and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both

© 2019–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only.

Teacher Material

<table>
<tr><td>How-to Sheets
Cite from technical texts
Follow the Scientific Method
Paraphrase a piece of text
Quote from a text</td><td colspan="2">Interactive Websites
Identify Central Idea Online Tutorial
Vocabulary Builder for Science Content</td><td>Learning Centers
Compare/Contrast the Scientific Method and Design Process
Evaluate evidence for specificity and quality
Determine source credibility</td></tr>
<tr><td>Homework
Access relevant sources</td><td colspan="2" rowspan="2">Hydro-Electric Power Source
Scaffold for Learning
(Week 1 Sample)
</td><td>Peer Tutoring
Review Scientific Method
Cite sources accurately</td></tr>
<tr><td>Group Tasks
Evaluate evidence for specificity and quality
Trace text’s explanation of process/concept
Determine source credibility</td><td>Podcasts/Screencasts
Cite from technical texts
Determine central idea
Trace text’s explanation of process/concept</td></tr>
<tr><td>Benchmark Lessons
Design Process and Scientific Method
Writing for a specific audience</td><td>Small-Group Mini-Lessons
Evaluate evidence for specificity and quality
Trace text’s explanation of process/concept</td><td>Individual Tasks
Determine central idea
Determine source credibility</td><td>Technology Uses
Select technical texts for research</td></tr>
</table>

EDQUIDDITY
EDUCATION FOR YOUR WHATNESS

© 2019–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only.

Hydro-Electric Power Source *Facilitation Questions*

COMPREHENSION *Ask questions that ensure students understand content and skills needed to solve the problem.*	• What do you need to do to accomplish this task? • What are the different types of hydro-electric power sources? • What is the difference between a dam and a waterfall? • What are costs, benefits, and risks? • What is responsible management of natural resources? • What are the long-term benefits of energy conservation?
APPLICATION *Ask questions that ensure the ability of students to apply learning to new situations.*	• Why is clean energy important to the environment in your proposed location? • How are you the design process to solve this problem? • Why would someone oppose the production of a waterfall for energy here? • How can you increase the likelihood that your proposal would be approved? • How will you ensure the waterfall is safe for nearby residents and wildlife?
CONNECTION *Ask questions that ensure the ability of students to apply learning to their lives.*	• What concepts about the use of dams can be applied to waterfalls? • How did this research affect the way you view clean energy usage? • Who could you contact for more information? • How does your proposal build upon the municipality's current energy source? • Who might be your biggest opposition and why? • Who might be your biggest proponent and why?
SYNTHESIS *Ask questions that encourage students to create new information from existing data.*	• Given the research on dams, how might you advocate for more hydro-electric power sources? • What predictions might you make for energy usage over the next 10 years? • What capabilities might future hydro-electric power sources possess that they don't now possess? • How do you think the inventor of the turbine would respond to your ideas?
METACOGNITION *Ask questions that prompt students to think about their own thinking process*	• What was the hardest part of this task? • How did you use and re-use the design process to arrive at the solution? • What did you find most surprising about the research you conducted? • How might someone solve this problem differently? • What problems did you encounter while creating this proposal and how did you solve them? • What did you think when you encountered an unforeseen problem?

© 2019–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only.

Hydro-Electric Power Source *Facilitation Grid (Week 1 Sample)*

Students	Cites accurately from technical texts	Identifies similarities and differences of the Scientific Method and the Design Process	Explains why evidence is chosen; references quality and specificity	Identifies credible sources	Explains characteristics that make a source credible	Determines central idea of a text	Traces the development of an explanation of a process or concept	Explains the development of an explanation of a process or concept	Paraphrases correctly	Quotes text correctly		

M – mastery P – peer tutor level HW – needs homework for reinforcement

W – working on it ML – needs a mini-lesson

EDQUIDDITY
EDUCATION FOR YOUR WHATNESS

© 2019–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only.

Hydro-Electric Power Source *Transfer Task*

An animal rights group has reviewed your proposal to build a waterfall for hydro-electric power. They are planning to oppose your ideas and speak out against it! They acknowledge that your proposal provides for clean, pollution-free energy, but they are gravely concerned about the potential risks to the environment. Specifically, they are worried about species that use rivers to spawn, and they claim that these species are often hurt by the production of dams and would, therefore, be hurt by a waterfall as well. In the Northwest, for example, sockeye salmon and trout populations dropped from 16 million to 2.5 million since hydro-electric plants were built on the Columbia River with the use of dams.

How can you advance the approval and success of your proposal in the face of this opposition? Is there something that can be done to protect the wildlife that might be affected by the production of a waterfall for hydro-electric power?

As you develop your rebuttal to this opposition, be sure to do the following:

- ☐ Address the potential risks to the environment
- ☐ Propose at least one solution to address these environmental risks
- ☐ Offer several suggestions for wildlife protection

© 2019–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only.

Hydro-Electric Power Source *Teacher Notes*

Unit Overview
Through the development of a novel proposal for a hydro-electric power source, high school students will be able to explore the economic, social, environmental, and geopolitical benefits and risks to this natural energy source. Using the IDE Design Process to evaluate their proposed solution, students will use mathematical, scientific, and engineering concepts to persuade their chosen audience. The students will discover the importance of suitability and devise a solution to responsibly manage our natural resources!
Common Core State Standards Addressed:
CCSS.ELA-LITERACY.RST.9-10.1; CCSS.ELA-LITERACY.RST.11-12.1; CCSS.ELA-LITERACY.RST.9-10.2; CCSS.ELA-LITERACY.RST.11-12.2; CCSS.ELA-LITERACY.RST.9-10.3; CCSS.ELA-LITERACY.RST.11-12.3; CCSS.ELA-LITERACY.RST.9-10.5; CCSS.ELA-LITERACY.RST.11-12.5; CCSS.ELA-LITERACY.RST.9-10.7; CCSS.ELA-LITERACY.RST.11-12.7; CCSS.ELA-LITERACY.RST.9-10.8; CCSS.ELA-LITERACY.RST.11-12.8; CCSS.ELA-LITERACY.WHST.9-10.2; CCSS.ELA-LITERACY.WHST.11-12.2; CCSS.ELA-LITERACY.WHST.9-10.4; CCSS.ELA-LITERACY.WHST.11-12.4; CCSS.ELA-LITERACY.WHST.9-10.5; CCSS.ELA-LITERACY.WHST.11-12.5; CCSS.ELA-LITERACY.WHST.9-10.6; CCSS.ELA-LITERACY.WHST.11-12.6; CCSS.ELA-LITERACY.WHST.9-10.8; CCSS.ELA-LITERACY.WHST.11-12.8
National Standards/Content Addressed: Next Generation Science Standards
• HS-ESS3-1: Resource availability has guided the development of human society. • HS-ESS3-2: All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. • HS-ESS3-3: The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. • HS-ESS3-4: Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. • HS-ESS3-2, 3-4: When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. • HS-ESS3-4: Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. • HS-ESS3-1, 3-3: Modern civilization depends on major technological systems. • HS-ESS3-2, 3-4: Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. • HS-ESS3-2: Analysis of costs and benefits is a critical aspect of decisions about technology. • HS-ESS3-2: Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

© 2019–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only.

Enduring Understandings	Essential Questions
Energy conservation and energy efficiency saves money, reduces energy consumption, and prevents the pollution of air, water, and land. Energy and product choices have direct and indirect economic, social, and environmental consequences for everyone. Natural resources require responsible management and broad considerations; a sustainable future depends on personal choices and actions, the development of wise policies, the use of renewable energies, the development of new technologies, and the conservation of available resources.	What are the benefits of using clean energy? How can society be sustained through cost effective energy sources? How do you apply scientific knowledge and engineering design practices to increase benefits while decreasing costs?

21st Century Skills Addressed

Core Content and Interdisciplinary Themes

- Subject Area Mastery
- Global Awareness
- Civic Literacy

Learning and Innovation

- Critical Thinking and Problem Solving
- Creativity and Innovation
- Communication and Collaboration

Information and Media Literacy

- Information Literacy
- Media Literacy
- Information and Communication Technology

Life and Career

- Initiative and Self-Direction
- Productivity and Accountability
- Leadership and Responsibility

© 2019–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only.