OUR TOWN

TEACHING ALTERNATIVE ENERGY SOURCES AND DECISION-MAKING THROUGH A TOWN HALL MEETING

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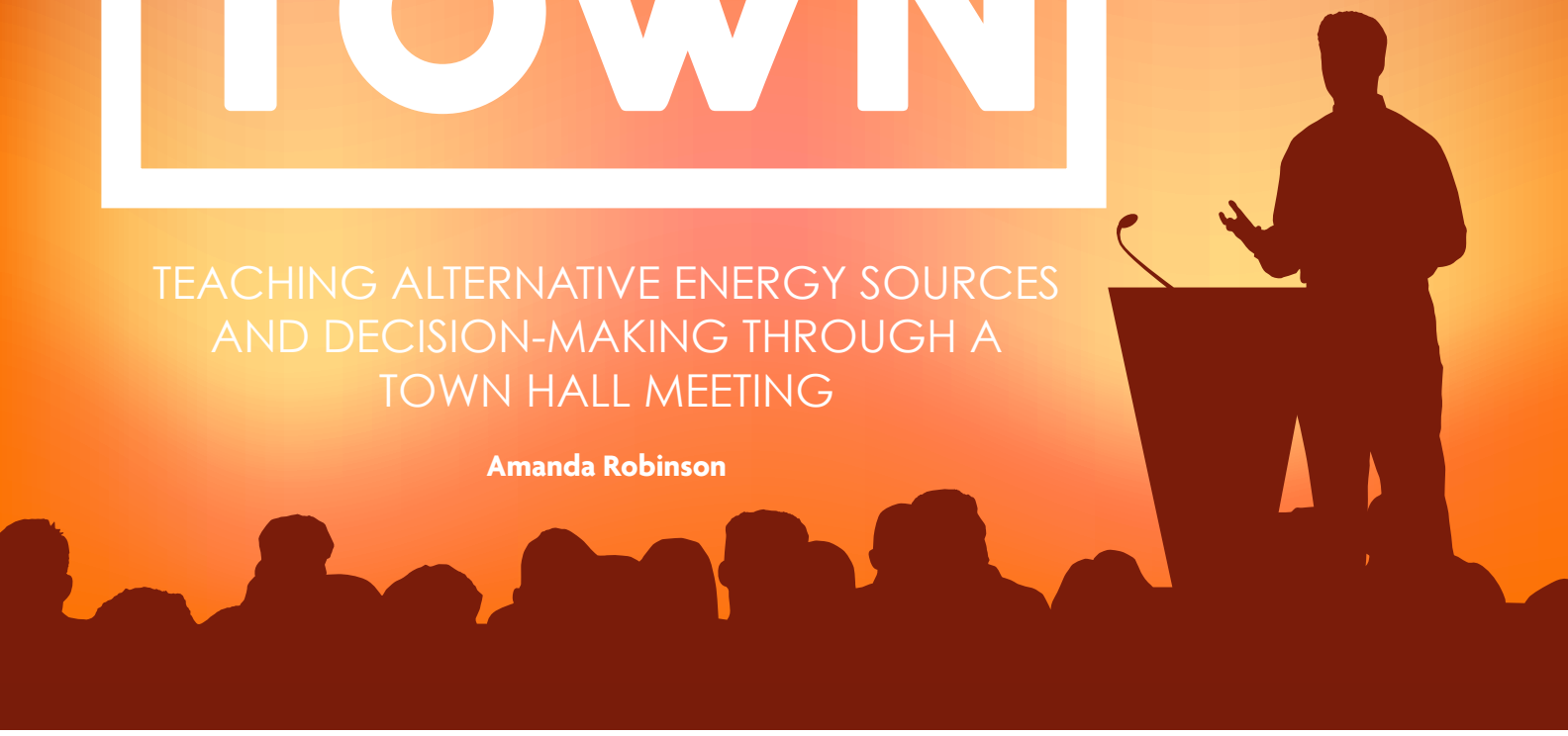

This article outlines an issue-based lesson for a physical science course in which students investigate potential alternative energy sources for Alternatown, a fictitious city. Students are randomly selected to serve as town council members or as representatives of different alternative energy source options put before the council. The representatives make presentations that promote their energy source, then the class discusses those sources and community involvement in decision-making.

Students gain a general understanding of various alternative energy sources and recognize that deciding among them is complex with no one right answer. Students learn that groups of people must work together and often compromise with those who have opposing views. (The lesson requires six class periods of about 50 minutes each.)

Issues-based science provides students a context for learning science content in practical and relevant societal applications that help students develop scientific literacy and that increase student engagement (Wilmes and Howarth 2009). "Scientific literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed" (NSTA 2000).

One goal of environmental education (EE) is to prepare students to be global citizens and decision-makers (Keinonen and Kärkkäinen 2010; Levintova et al. 2011; Wilmes and Howarth 2009). Yet, EE holds a peripheral position in science education, often limited to informal lessons and supplements to the required science curriculum and based on teacher interest (Campbell et al. 2010).

The *Next Generation Science Standards* (NGSS Lead States 2013) emphasize addressing questions about the natural world in social contexts. This theme is found throughout the *NGSS,* especially in the Earth and human activity standard (HS-ESS3) and the disciplinary core ideas of natural resources (ESS3.A), human impacts of Earth systems (ESS3.C), and developing possible solutions (ETS1.B): "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" (NGSS Lead States, 2013, p. 288) (see Figure 1 for more connections to the standards).

Fluctuating oil prices and concerns over climate change have driven the development of alternative energy sources globally (Toolin and Watson 2010). It is important for students to recognize that they can participate in community and global discussions and effect change in the world (Toolin and Watson 2010).

Informed citizens should be able to present their arguments with evidence to support their claims and have the ability to refute other claims (Keinonen and Kärkkäinen 2010). Students must be able to clearly present their evidence to help others understand and make decisions (Wilmes and Howarth 2009).

This lesson offers teachers the opportunity to evaluate students' ability to analyze, reason, and communicate and to assess students in both content and process while connecting them to a real-life scenario (Figure 2, p. 48).

Instructional context

The lesson described in this article was part of a unit on heat, temperature, and energy, which covered the origination of energy and natural resources, pros and cons of current uses of natural resources, energy transfer, and alternative energy sources available. We also incorporated a two-day discussion on fracking (i.e., hydraulic fracturing for natural gas) as part of the engagement component at the beginning of this unit.

The lesson plan

The lesson begins with explaining the Alternatown scenario: "Alternatown is at a crossroads for its energy future. The city currently gets ample power from the Ameribucks power plant but has been suffering from the air pollution created as the plant burns coal and oil to produce electricity. The city has been searching for alternative energy options to replace all or part of the power provided by Ameribucks."

Students receive additional details in the project handout (see "On the web"). Students then draw slips of paper out of a hat to receive their assignment as an alternative energy source representative or town council member. There are six alternative energy sources in the activity: nuclear energy, solar energy, hydropower, wind energy, geothermal energy, and biomass energy. Representatives of the same energy source work together, while the council members work independently. (Or, council members can choose to work collaboratively to come up with questions to be used during the town council meeting.) Students use the remainder of Day 1 to brainstorm their research plan.

Days 2 and 3 are devoted to researching the alternative energy sources on the internet. Several recommended websites are given to the students, and they are encouraged to use search engines to find more resources. (Note that internet safety must be practiced by limiting or monitoring website use.) Alternative energy source representatives must create a presentation for the town hall meeting. Meanwhile, the town council members research all six alternative energy sources and prepare three to five bullet points to show a general understanding of each source plus two to three questions about each source to ask during the presentations.

The town hall meeting happens on Days 4 and 5. The classroom is set up before students arrive. Town council members and the mayor (teacher) sit in the front, facing the class. Presenters sit together in their respective groups. Nametags are waiting at each student's seat along with a town hall meeting agenda. As the meeting is called to order, alternative energy source presenters are reminded of the presentation format (i.e., time limits, and questions and answers to follow each presentation).

Our experience

In our class, students serving as alternative energy source representatives used PowerPoint to create their presentations and had the option to submit the files to the teacher for prior review. That would have benefited many of the groups. Although students were given specific questions to help them prepare their presentations, students sometimes wandered in the information they presented. A checklist also might have helped in preparing the presentations.

With the varying depth of information presented by each group, it was difficult to compare the six energy sources with each other. Despite students being very experienced in constructing PowerPoint presentations, I noted on several grading rubrics that students needed to reduce the number of words on each slide, presenting information more concisely. Also, several students noted that they felt rushed by the five-minute time limit for their presentations. Giving them up to eight minutes would still allow the lesson to be completed within the original time frame.

The students in the role of town council members were well prepared and asked intriguing questions with prompting from the teacher. The presenters did a good job of responding to these questions. Both groups remained in character and poised during the question-and-answer component of the town hall meeting. Most students demonstrated a strong commitment to the authenticity of the exercise in their role-playing skills.

FIGURE 1

Connections to the standards.

Next Generation Science Standards (NGSS Lead States 2013)

HS-ESS3 Earth and Human Activity
The materials/lessons/activities outlined in this article are just one step toward reaching the Performance Expectation listed below. Additional supporting materials/lessons/activities will be required.

Performance Expectation
- HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

Science and Engineering Practice
Engaging in Argument from Evidence
- 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).

Disciplinary Core Ideas
ESS3.A: Natural Resources
- 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.

ESS3.C: Human Impacts on Earth Systems
- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.
- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.

ETS1.B: Developing Possible Solutions
- 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.

Crosscutting Concepts
Cause and Effect
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Connections to Engineering, Technology, and Applications of Science
Influence of Engineering, Technology, and Science on Society and the Natural World
- Engineers continuously modify … technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.
- Analysis of costs and benefits is a critical aspect of decisions about technology.

Connections to Nature of Science
Science Addresses Questions About the Natural and Material World
- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.
- Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.
- Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

After the town hall meeting ended on Day 5, students were assigned the Alternatown Reflection Analysis Questions for homework (see "On the web"). Students could express their own thoughts and opinions in their answers, rather than staying in character, but they were required to provide evidence for their views.

Day 6 was used for a debriefing and class discussion of the town hall meeting. Students were also allowed to express their individual thoughts during the debriefing and could refer to their analysis questions homework, as several did.

We considered student participation and oral responses in class as we graded the Alternatown Reflection Analysis Questions, using their project rubric (see "On the web") as a guide.

FIGURE 2

Instructional outcomes.

At the end of this lesson students will be able to:

- Defend a position on alternative energy sources to replace all or some of current practices that use nonrenewable resources such as coal, oil, and natural gas while also considering issues such as operation, maintenance, and other costs.
- Compare and contrast alternative energy sources and communicate their questions, thoughts and/or ideas.
- Understand that there is no one right answer to complex environmental issues and that oftentimes a combination of options may prove to be the best solution to the problem.
- Make comparisons between the role-playing activity and their own life and/or experiences.

Conclusion

Keinonen and Kärkkäinen's (2010) research demonstrates that these types of lessons cannot stand alone. Initial attempts at argumentation may lack evidence-based reasoning; clear and precise arguments come only after continued practice.

As a variation of this activity, the teacher could invite other teachers, administrators, or even parents and other adult community members to participate in the town hall meeting. Students could dress for their roles. Showing students that their learning matters to people outside the classroom can change the dynamics of learning (Toolin and Watson 2010). This may require more preparation time and a longer town hall meeting but would enhance the experience, creating a more authentic setting in which students, teachers, and other adults could work together in a decision-making process. The lesson could then promote the discussion of alternative energy sources, perhaps even energy consumption and climate change, beyond the classroom to the broader community. ■

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On the web

Project explanation, rubrics, Alternatown reflection analysis questions, meeting agenda: *www.nsta.org/highschool/connections.aspx*

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