



ACTIVITY 1

Vanwick's Energy Project

CARD-BASED INVESTIGATION

ACTIVITY 1

Vanwick's Energy Project

ACTIVITY SUMMARY

Students are introduced to concepts related to the decision-making process through a fictional town that is planning for a renewable energy project. To begin the town's decision-making process, students consider facts and values related to renewable energy. They are presented with statements, and they analyze each statement to decide whether each statement shows a fact, a value, or both. Students then consider how facts and values inform decisions.

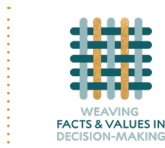
ACTIVITY TYPE
CARD-BASED
INVESTIGATION

NUMBER OF
40-50 MINUTE
CLASS PERIODS
1-2

KEY CONCEPTS & PROCESS SKILLS

- 1 Facts support informed decision-making by leading to more accurate predictions about the likely outcomes of different choices.
- 2 Values affect people's behaviors, opinions, and decisions. There can be disagreement within a community when people hold a variety of values.
- 3 Decision analysis is the process of breaking down a decision in a way that can help the decision-maker systematically consider elements related to a choice, such as facts and values.

CONCEPTUAL
TOOLS



VOCABULARY DEVELOPMENT

decision analysis

any process of systematically considering the information that might affect a decision

electrical power generation

(assumed prior knowledge)

the process of transforming a natural resource such as coal, natural gas, wind, or sunlight into electrical power

fact

information that has been verified by observation or data

opinion

(assumed prior knowledge)

views that an individual or group form about something that may not be based on facts

renewable energy

(assumed prior knowledge)

electricity generation that is fueled by a resource that has a continuing supply, such as sunlight, water, wind, and biomass

value

what an individual or group considers important

TEACHER BACKGROUND INFORMATION

Decision Analysis

Decision analysis is a way of making any decision more systematically by breaking it down into essential elements. It helps decision-makers avoid many common traps that can lead to bad decisions. Unsystematic decisions are often driven by intuition and past experiences, without sufficient consideration of the full range of options, the probabilities of success, and the pros and cons of each option.

Decision analysis is typically used for large, important decisions that will affect many people—for example, in making government policy or to help large companies decide what to invest in. However, many elements of decision analysis can also be useful for ordinary people trying to make better decisions for their lives. Since it is somewhat time consuming, it is not possible to subject every little decision to decision analysis. You wouldn't want to do it every time you were deciding what to wear or what to have for lunch. However, since most such everyday decisions are left to default habits, it can be usefully applied to decisions about what habits to take up. For example, you might not want to use it to decide what to have for a snack each day, but you could use it to support large personal decisions, such as which college to go to, what major to pick, or what career to pursue.

Facts and Values

Talk of values tends to involve terms such as *should*, *ought*, *right*, *wrong*, *moral*, *ethical*, *worthwhile*, *just*, *rights*, or *how the world should be* or *how we want it to be*. Talk of facts tends to consist of descriptions of the world as it is. The distinction between facts and values is important because they are often mixed up, although they must be investigated in different ways. The best sources for facts—scientific experts, evidence, and eyewitness accounts—are not necessarily the best sources for values. The most effective way to find true facts is through examination of the evidence or by asking experts who have examined the evidence more thoroughly than we may have time to. Indeed, a large part of the process of science is aimed at finding facts. However, science is not aimed at finding out what is really valuable. The study of ethics and religion often makes arguments about values.

For a statement to be a fact, it must be true and supported by observation and data. However, we can be mistaken about what is true, even when we are inferring from evidence. Partial evidence can lead to reasonable, but false, inferences of fact (see Unit 1: Evidence & Iteration in Science for examples). Since we can be mistaken about what is a fact, it is sometimes useful to talk about a “question of fact” or “claim of fact.” Statements of fact aim to describe the world accurately, even if it is not yet clear whether they really succeed in describing the world accurately. As such, claims of fact can be replaced with more accurate or relevant information when it becomes available.

Considering people’s values is an important part of group decision-making. The values of people with less power are often left unfulfilled, while people with power are more likely to get their values fulfilled. Thus, more equitable group decisions should elicit and consider the values of all people affected by a decision (the “stakeholders”), including those whose voices are not usually heard. Social science methods, such as polls and interviews, often ask people to report what they value and how they prioritize their values. Facts produced by these methods can help inform decision-makers how values are changing in a society and which values held by a population are not being fulfilled by current systems.

If you plan to do the extension and curate materials for students, do the research and put the materials together before instruction. Sources of information could be government offices, utility companies, and news media articles.

MATERIALS & ADVANCE PREPARATION

FOR THE TEACHER

- VISUAL AID 1.1
“Walking Debate:
Do You Agree?”
- VISUAL AID 1.2
“Developing
Communication Skills”
- VISUAL AID 1.3
“Understanding
Conceptual Tools”
(OPTIONAL)

FOR EACH GROUP OF FOUR STUDENTS

- SET OF ENERGY
STATEMENT CARDS
(13 CARDS)

FOR EACH STUDENT

- STUDENT SHEET 1.1
“Unit Concepts
and Skills”
(OPTIONAL)

TEACHING NOTES

Suggestions for **discussion questions** are highlighted in gold.

Strategies for the **equitable inclusion of diverse students** are highlighted in pink.

GETTING STARTED (10 MIN)

1 Elicit students' prior knowledge about energy use in everyday life.

- Elicit student prior knowledge about energy use by first brainstorming a list of words or ideas associated with it. Ask, **What words do you associate with energy when you think about the energy we use in everyday life? In science or in society?** Students may describe familiarity with daily activities related to energy use (e.g., using electronic devices and pumping gasoline), scientific ideas related to energy movement (e.g., transformation or generation), issues related to how energy impacts nature (e.g., wildfires or air pollution), and actions related to energy conservation (e.g., efficient appliances or reduction of use).
- Students may have personal experiences with and prior knowledge of issues related to the use of energy in society, such as a lack of reliable service or health problems related to living near a power plant. Engaging students about their experiences can create a stronger foundation for learning. Support students, particularly those with varied life experiences, in sharing their prior knowledge of and personal experiences with this issue. Specifically validate funds of knowledge—not just textbook knowledge, but also family or cultural insights, practices, and personal histories—by eliciting students' observations and experiences as assets to building understanding. Throughout this unit, encourage students to respond to any topics or questions that arise to which they feel a personal connection—during small-group or class discussions, when students respond to relevant Build Understanding items, and when they write reflections in their science notebooks.

2 Introduce main concepts of the unit.

- As the title of the unit implies, this unit investigates the process of group decision-making in a fictional scenario related to a community developing a renewable energy plan.
- After students read the introduction, answer any questions related to background information they need in order to understand the context of the unit. Namely, the burning of fossil fuel at electricity generation plants, in vehicles, and in buildings. This combustion releases harmful gases that are building up in the atmosphere and driving climate change. A basic review of this material is found in the Science Review section at the end of the Student Book activity.

- Likewise, if students are not familiar with the basics of how electricity is generated by renewable and nonrenewable sources of energy, review the process by referring them to the Science Review section.
- Let students know how the energy scenario they will explore in the unit is directly related to group decision-making. To successfully reduce the greenhouse gases in the atmosphere, decisions need to be made by groups of people. These groups include ordinary residents, companies, and the government.

3 Introduce weaving facts and values as the primary conceptual tool of the unit.

- Review the term *decision analysis* provided in the student introduction. The principle behind decision analysis is that decision-making benefits from taking the time to examine components of a decision in a systematic way that can support a good outcome. Although the process of decision analysis may look different for different situations, it is an effective conceptual tool for decision-making. In this unit, the primary way students engage in decision analysis is to evaluate facts and values, making it the primary conceptual tool of the unit.
- The scientific toolkit is intended to be a set of conceptual tools that can be applied to everyday life. With each new unit, students will add conceptual tools to their toolkits. Use the optional Visual Aid 1.3, “Understanding Conceptual Tools” to support the multiple contexts that are used with the word *tool*, which is defined as an implement used to carry out a particular function. The word is commonly used to refer to construction tools such as hammers, levels, and tape measures. In a science classroom, examples of scientific tools include beakers, graduated cylinders, and microscopes. In this unit, there is a digital analysis tool that is used to support decision-making. There are also many tools from the last category presented on the visual aid—conceptual thinking approaches that are used to analyze group decisions. In this course, students consider conceptual tools, such as weaving facts and values, as a way of exploring the application of science to everyday life.
- As students build understanding about the importance of weaving facts and values in the decision-making process, they will build a conceptual tool about this idea in their minds and develop skills to utilize it at various points in the unit. You may wish to use Student Sheet 1.1, “Unit Concepts and Skills,” to help students organize their learning. This course organizer is designed to help students reflect on their understanding of the conceptual tool, consider how they have used it to analyze problems throughout the unit, and how it may influence their decisions about unit topics.
- While a sample completed course organizer is provided in this activity, students will not be able to complete it at this time; the ideas in the sample response will be built over the course of the unit. At the end of this activity, students can add information about the role of multiple lines of relevant, accurate, and reliable evidence in supporting an explanation. The Vanwick scenario is an example of when students had an opportunity to analyze information related to this idea as well as make a decision.

4 Relate decision-making to facts and values.

- Introduce the idea that, as part of decision analysis, people use information (facts) and people's priorities (values). This activity will explore how to distinguish these two things.
- Do not define *fact* and *value* for students at this point in the activity. They will explore what each word means during the procedure so they may use an operational definition to get started. At the end of the procedure, they are asked to use their experience to come up with a formal definition.
- Ask, **Can you provide an everyday example when a fact informed a decision you made? How about a value that informed your decision?** A typical response might be: *The cost of chips is lower than an ice-cream, so I bought the less expensive item. I valued quantity of food over quality, so I bought the big-sized less expensive item instead of a more expensive small item.*

PROCEDURE SUPPORT (30 MIN)

5 Facilitate the student investigation of facts and values.

- The scenario presented in Step 1 can be shared with the class in multiple ways. Read it aloud to the class (using a storytelling approach), have individual students read a paragraph aloud while others follow along with the text, or have students read individually or cooperatively in their groups of four.
- Depending on your student population, use oral storytelling to support diverse learners in decoding scientific ideas and constructing meaning and ask questions about the main points of the scenario to ensure comprehension. Students can refer to the text in the Student Book as needed.
- Distribute a set of Energy Statement cards to each group of four. It may be helpful to preread the cards with emerging multilingual learners before diving into the procedure.
- Circulate during Procedure Step 3 to answer questions and note the common issues that may arise over the statements on the cards.

TEACHER'S NOTE: All claims of fact given in this activity are accurate and, therefore, facts. In the next activity, students will go further and learn techniques to verify claims of fact.

- Lead the completion of Procedure Step 4 as a class. Following is a complete and correct sample student response for the cards.

Sample Student Response, Procedure Steps 3–4

FACT

- 1 There are renewable generation methods that are less expensive to install than fossil fuel plants.
- 4 Some energy is always lost (as heat, sound, or vibration) when energy is transformed from one kind to another.
- 5 In 2023, most global energy generation was produced from oil, coal, and natural gas.
- 9 Wind and solar energy, unlike the process of burning fossil fuels, do not require water to operate.
- 11 Houses within a half mile of a big solar farm sell for, on average, 1.5% less than houses that are just a little farther away.
- 12 Most humans think human life matters more than other animals or plant life.
(This one is tricky because it's a fact about a value.)

VALUE

- 2 Energy sources that do not make noise are preferable.
- 3 It is better to produce energy locally than to transmit it over long distances.
- 6 It is essential that no one's electric bill increases.
- 7 Reducing air pollution to improve the environment is the most important outcome of renewable energy.
- 8 Power outages should be avoided at all costs.
- 10 The portability of fossil fuels makes them valuable to society.
(This one is tricky—*valuable* is subjective.)
- 13 Fossil fuel emissions are negatively impacting our world.
(This one is tricky because it can be argued either way.)

- If your students need more engagement with distinguishing statements, provide the following for additional practice:
 - a Science is the most valuable subject at school. *value*
 - b Dogs usually have four legs. *fact*
 - c The Sumatran tiger is a species worth keeping from extinction. *value*
 - d Electricity is valuable to society. *either, depending*
 - e Electronic devices affect social norms. *fact*
 - f The ocean needs protection from human impacts. *either, depending*
 - g Climate change is the most important crisis of our time. *value*

6 Facilitate a discussion by using a Walking Debate in Procedure Step 5.

- Use the literacy strategy of a Walking Debate in Procedure Step 5 to encourage students to discuss their opinions on statements about facts and values. See Appendix 1: Literacy Strategies at the end of the Teacher’s Edition for more guidance and information on using the Walking Debate with your students.
- Alternatively, instead of the Walking Debate, students could express their position with a thumbs up/down/sideways. For either approach, invite students who disagree to engage in discussion with one another. Record the tally of the votes before and after discussion. This process in Procedure Step 5 helps students reflect more deeply on what makes a claim a fact, what makes a claim a value, how we can learn about each, and the role each plays in decision-making.
- During the Walking Debate, use Visual Aid 1.1, “Walking Debate: Do You Agree?,” to reveal the statements, one at a time. For some students, it may help to provide the statements in advance and work in small groups (pairs or groups of four) to sort the cards into the categories before beginning the Walking Debate.
- To support students’ discussion, you may wish to use Visual Aid 1.2, “Developing Communication Skills,” to help guide student interactions. Visual Aid 1.2 is a tool to help students effectively participate in class discussions by providing sentence starters that students can use to initiate a conversation and express their ideas.
- In Procedure Step 6, ask students to use their experiences to develop a definition for the words *fact* and *value*. Since students are developing their conceptual understanding of these words during the activity, the definitions are not in the Student Book activity, although they can be found in the Glossary. Review the definitions students generate and compare them to the ones provided here:

A **fact** is information that has been verified by observation or data.

A **value** is what an individual or group considers important.

TEACHER’S NOTE: Since the definitions of *fact* and *value* are not in the Student Book activities, consider displaying the words and definitions prominently in the classroom for future reference. These two words are used throughout the unit.

7 Discuss some important characteristics of facts and values.

- Emphasize for students how facts and values are both part of decision-making. Values can help you compare facts related to those values and make a decision. Provide a simple example such as choosing a snack.

Value: Cost is important to me.

Fact: Of the options, the apple is the least expensive.

Decision: I will eat the apple.

It is important that students understand that the facts need to be closely linked to the value to be useful for decision-making. In the choosing a snack example, if the selected fact is that the color of the apple is green, the fact does not inform the decision.

- Ask, **What is the difference between an opinion and a value?** Students may have trouble distinguishing between these two words, so it is worth clarifying each. Look for responses that show that a value is a stated priority, such as low cost, to be beautiful, or to preserve the environment. Values are all about what we think is good or bad. On the other hand, opinions are about how we go about achieving those values. They are personal judgments that may or may not be true. Examples of opinions are *That costs too much.* or *That is ugly.* Many opinions are shaped by a value but are a different kind of statement.
- To reinforce the relationship between opinion and value, ask students to identify which of the following statements are fact, value, or opinion:
 - A soccer game takes about 90 minutes to complete. *fact*
 - Soccer games are too long to watch. *opinion*
 - Short playing time. *value*
- Ask, **Can facts change?** Facts can change because reality can change. For example, in 1900, it was a fact that the population of humans on Earth was less than 2 billion. Today, the population of Earth is over 8 billion. Our understanding of what is a fact can also change as we acquire new information and develop a more accurate and more complete understanding of the world. For example, a thousand years ago, it was reasonable for people to believe that Earth was flat. Nevertheless, they were mistaken; so it was not a fact, even though people thought it was. A thousand years ago, Earth was nearly round, as we know today. It would take a long time for humans to collect enough evidence to discover this fact.
- Ask, **Can values change?** The answer is yes, although not as easily or frequently as an opinion. For example, a student that is not working may value cost; when they become older and have a job, cost may not be as important to them. For others, low cost may always be a priority, regardless of their income. If values change, it is usually a result of an experience or insight.

8 Students use facts and values to make a simple decision.

- In Procedure Step 7, students are presented with conflicting values. In this case, the value of improving the schools as a priority over Project REV. This foreshadows Activity 3 in which students investigate weighted values.
- Provide an example of conflicted values related to renewable energy. When considering whether to build a wind turbine, the fact that wind turbines sometimes kill birds but are environmentally healthier than alternatives cause two values to conflict. We value environmental health, but we also value not accidentally killing birds (which is a small part of general environmental health). The facts about birds and environmental health inform how well the choice—to build the turbine or not—fulfills the values. Be clear that it is not the facts themselves that are conflicted but, rather, two values that are in conflict. This means we must make a trade-off when making decisions. Trade-offs are introduced formally in Activity 5 as part of the decision-making process.
- Support students, particularly emerging multilingual learners, in sensemaking and language acquisition by reviewing the words *accuracy* and *reliability* and supporting the construction of a word wall. You may want to model a sample response as a class to help scaffold student understanding. For this activity, record the terms *fact*, *value*, and *decision analysis*. Provide additional examples for each term as needed.

SYNTHESIS OF IDEAS (20 MIN)

9 Discuss the role of facts and values in decision-making.

- Discuss how an understanding of facts and values can inform the scenario in Vanwick. Begin by revisiting the goals stated in the scenario in Step 1: *The city hopes to achieve its goal of reducing greenhouse gas emissions, while powering the city into the future.* Then have students conduct a pair-share to answer the question, **What facts and values would be helpful to know for Project REV?** Students might respond that facts such as the number of solar panels needed, how much power they can generate, and how it can connect to their current system would be helpful facts. Values of the residents would be good to know to learn if Project REV aligns with them or not.
- Have students consider decision-making in the scenario further by considering if they would be able to make a good decision:
 - a based on facts alone, without thinking at all about values.
 - b based on values alone, without thinking at all about facts.

Students may feel that facts alone won't lead to a good decision because you need values to decide which outcomes are desirable. However, people bring inherent values to the facts when considering them, so it is impossible to make a decision based only on fact. While making a decision on values alone is possible, it is generally not a good idea because the facts inform which options will bring about the outcome you want.

- Use Build Understanding Question 3 as an example of bringing inherent values to a decision. When presented with facts and asked to make a choice, it is impossible to make a decision without including at least one value. In the biomass example provided in the Sample Response, the question did not mention the value of fresh air, but it was naturally part of the decision.
- Review the term *decision analysis* in the context of making decisions. While weighing facts and values is one method of decision analysis (which students will explore further later in the unit), there is no one way to analyze a decision. Be clear that the conceptual tools provided in this unit that support decision analysis are only a select few. However, emphasize that the point of decision analysis is to have a systematic approach that reduces or avoids irrational factors such as biases and informed beliefs.
- Review student responses to Connections to Everyday Life item 5. Point out that the process outlined in a–c, as simple as it is, is a form of decision analysis. Discuss with students how this process would be different for a group decision. When a group is involved, even a simple decision such as choosing a lunch gets more complicated. Use this question to foreshadow Activity 3 when students will create a survey as a way to gather values in a group.
- Help connect the scenario to decisions currently being made about renewable energy projects to students' own community. Most communities have information about energy projects on the city's or utility company's website. Share any recent news about upcoming projects that will help students relate to Project REV.
- To conclude the activity, evaluate whether your students are able to answer the Guiding Question, **How are facts and values connected to decision-making?** Use this as a chance to revisit and summarize the key concepts and process skills of the activity. Through this activity, students experienced that identifying important values and relevant facts are a first and fundamental part of decision analysis.

SAMPLE STUDENT RESPONSES

BUILD UNDERSTANDING

The Build Understanding and Connections to Everyday Life questions are intended to guide your understanding. Some of these may be discussed with a partner, be part of a class discussion, or require an individual written response. Your teacher will guide you as to how these questions will be used in your class.

- ① Provide an example from this activity where there are conflicting values about Project REV.

The City Council has prioritized getting the funding for Project REV, but some citizens would rather spend the money and effort to improve the schools.

- ② Which of the following statements about deciding to use renewable energy sources are facts and which are values?

- a Building a nuclear power plant is more expensive than other kinds of power plants. *fact*
- b The ecosystem damage caused by hydroelectric power is unacceptable. *value*
- c Burning biomass gives off a strong smell. *fact*
- d Geothermal energy can only be used in certain locations. *fact*
- e It is important to keep our hills clear of the ugliness of wind turbines. *value*
- f Renewable energy is the most important part of our future. *value*

- ③ If you were on a committee deciding which renewable energy source to use in your own community, which statement(s) in Question 2 would most influence your decision? Explain by using the words *fact* and *value*.

Answers can vary. One sample response follows.

The facts that would influence my decision are burning biomass gives off a strong smell, and building a nuclear power plant is expensive. These facts would influence my decision because they are new to me, and I had not considered them. These facts would influence my decision because of my values. First, I value fresh air and I would not want to live in a town with a strong odor, so I would not support burning biomass where I live. Second, I would be concerned about the high cost of a nuclear power plant as I value having enough money for the town to do many other things, so I would be less likely to support a nuclear power plant in my community.

④ **Explain how using facts and values can be part of a decision analysis.**

When faced with a decision, it could help make the decision by identifying values and then looking at all the choices to see how they fulfill the values. If it was done for all the choices, it could be a systematic way of comparing them. Also, having the right facts makes it easier to compare the choices.

CONNECTIONS TO EVERYDAY LIFE

⑤ **You are at the cafeteria deciding between a salad and a burger for lunch.**

- a What are two values you might consider in making this decision?

cost, environmental impact

- b Provide a fact for each value that relates to the decision and explain how it influenced your choice.

The burger is priced lower than a salad, and red meat has a higher environmental impact than a plant-based meal. It influenced my choice because I have to decide which of the values are more important.

- c How would the decision change if you had to make the choice for a group and you could only choose one kind of meal? Explain in terms of facts and values.

I would need to know facts about other people in the group, like if people had allergies or religious reasons for not eating certain foods. I would also have to figure out what their values were about those facts, like if they valued a plant-based diet over a meat one. It would be much more complicated to decide, and there would always be people who didn't like my decision that I made for them.

⑥ **Your friend Ota says she is looking for a job that is interesting work and provides a good paycheck. She looked into becoming an electrician and learned that it pays over \$30 per hour. She thinks electricity is an important part of everyday life, and that appeals to her.**

- a What are the values and related facts to her decision?

Value: She wants a good-paying job. Fact: Work pays over \$30/hr.

Value: The work should be interesting. Fact: Electricity is important to everyday life.

- b How do these facts and values inform her decision?

If she doesn't think the fact that \$30/hr. is enough pay, that value will be in conflict with the value that the work is interesting. Maybe this means that she won't want the job. If she didn't value electricity, she also wouldn't become an electrician.

UNDERSTAND		ANALYZE
CONCEPT	DESCRIPTION	UNIT EXAMPLE(S)
Decision Analysis	<i>Decision analysis breaks down a decision systematically to consider things related to a choice.</i>	<i>facts and values in Vanwick posts decision-analysis tool for weaving facts and values: Building Initiative decision and generation sites</i>
Facts	<i>Facts support more accurate predictions.</i>	<i>Option Ratings in the decision-analysis tool (comparing facts to options) renewable generation info to inform Vanwick sites</i>
Credible Sources	<i>First determine whether the source is credible before looking at the fact in more depth.</i>	<i>Vanwick posts battery storage research</i>
Values	<i>Values affect people's decisions.</i>	<i>stakeholder descriptions with weighted values survey responses from stakeholders' perspectives location plans from different stakeholder's perspectives</i>
Values	<i>Sometimes, people disagree because they have different prioritized values.</i>	<i>weighted values on stakeholder cards different plans from different stakeholders</i>
Scenario Planning	<i>Making optimal decisions includes envisioning a variety of possible futures.</i>	<i>stories about the future of Vanwick</i>
Group Decision-Making	<i>All stakeholders' values should be considered in the decision-making process.</i>	<i>generation location plan was done by multiple stakeholders</i>
Group Decision-Making	<i>Sometimes, compromise is necessary to find agreement.</i>	<i>went from multiple stakeholder plans to one recommendation</i>

WHAT DECISION(S) WERE MADE OR ACTION(S) TAKEN?

*What battery storage option is best for Vanwick,
What building initiatives are best for Vanwick,
Recommendation to City Council for type and locations of renewable generation.*

- a** When someone calls a claim a fact, they are saying it is true.
- b** Any belief is just as good as any other, if you really believe it.
- c** It's generally easy to tell what's true and what isn't.
- d** Scientists don't know any more about facts than anybody else.
- e** Anything someone believes with certainty is a fact for that person.
- f** There can be facts about what people value.
- g** Scientific experts are good sources of information about what's really valuable.
- h** An outcome that is likely to result from a given decision is a fact, not a value.
- i** You can't make a decision based entirely on facts without assuming at least one value.

COMMUNICATION	SENTENCE STARTERS
to better understand	<p>One point that was not clear to me was...</p> <p>What if we tried...?</p> <p>I have an idea. We could try...</p>
to disagree	<p>I see your point, but what about...?</p> <p>Another way of looking at this is...</p> <p>I'm still not convinced that...</p>
to challenge	<p>How do you reach the conclusion that...?</p> <p>What makes you think that...?</p> <p>How does it explain...?</p>
to look for feedback	<p>What would help me improve...?</p> <p>Does it make sense, what I said about...?</p>
to provide positive feedback	<p>One strength of your idea is...</p> <p>Your idea is good because...</p>
to provide constructive feedback	<p>The argument would be stronger if...</p> <p>Another way to do it would be...</p> <p>What if you said it like this...?</p>

CONSTRUCTION TOOLS



SCIENTIFIC TOOLS



SCIENTIFIC TOOLS + TECHNOLOGY



CONCEPTUAL TOOLS



FACT

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

VALUE

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

1

There are renewable generation methods that are less expensive to install than fossil fuel plants.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

2

Energy sources that do not make noise are preferable.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

4

Some energy is always lost (as heat, sound, or vibration) when energy is transformed from one kind to another.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

3

It is better to produce energy locally than to transmit it over long distances.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

5

In 2023, most global energy generation was produced from oil, coal, and natural gas.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

6

It is essential that no one's electric bill increases.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

9

Wind and solar energy, unlike the process of burning fossil fuels, do not require water to operate.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

7

Reducing air pollution to improve the environment is the most important outcome of renewable energy.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

11

Houses within one-half mile of a big solar farm sell for, on average, 1.5 % less than houses that are just a little farther away.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

8

Power outages should be avoided at all costs.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

12

Most humans think human life matters more than other animals or plant life.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 6: Group Decision-Making, Activity 1

10

The portability of fossil fuels makes them valuable to society.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
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Fossil fuel emissions are negatively impacting our world.

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