Decision Making

Modern life is filled with environmental and social issues that have scientific and technological dimensions. An issue is defined as a problem that has at least two possible solutions rather than a single answer. There can be many positions, generally determined by the values that an individual or a society holds, on a single issue. Which solution is "best" is a matter of opinion; ideally, the solution that is implemented is the one that is most appropriate for society as a whole.

The common processes involved in the decision-making process are outlined in the graphic below.

Even though the sequence is presented as linear, you may go through several cycles before deciding you are ready to defend a decision.

Process Description

Defining the issue

The first step in understanding an issue is to explain why it is an issue, describe the problems associated with the issue, and identify the individuals or groups, called stakeholders, involved in the issue. You could brainstorm the following questions to research the issue: Who? What? Where? When? Why? How? Develop background information on the issue by clarifying facts and concepts, and identifying relevant attributes, features, or characteristics of the problem.

Identifying alternatives/positions

Examine the issue and think of as many alternative solutions as you can. At this point it does not matter if the solutions seem unrealistic. To analyze the alternatives, you should examine the issue from a variety of perspectives. Stakeholders may bring different viewpoints to an issue and these may influence their position on the issue. Brainstorm or hypothesize how different stakeholders would feel about your alternatives. Perspectives that stakeholders may adopt while approaching an issue are listed in Table 2 **(p. 614).**

Researching the issue

Formulate a research question that helps to limit, narrow, or define the issue. Then develop a plan to identify and find reliable and relevant sources of information. Outline the stages of your information search: gathering, sorting, evaluating, selecting, and integrating relevant information. You may consider using a flow chart, concept map, or other graphic organizer to outline the stages of your information search. Gather information from many sources, including newspapers, magazines, scientific journals, the Internet, and the library.

Example: The Issue of Pesticide Use

In recent years, the use of pesticides (herbicides, insecticides, fungicides) on lawns has increased despite reports of health and environmental risks. Several attempts are being made to deal with the increased use, including publicity campaigns by various groups, and attempts to ban or limit use of pesticides at municipal and other government levels. A list of possible stakeholders in this issue is started in **Table 1** (p. 614).

Develop background information on the issue by clarifying information and concepts, and identifying relevant attributes, features, or characteristics of the problem, for example:

- While more research is needed on the health risks, many lawn chemicals currently in use are known carcinogens and there are numerous other less serious symptoms (e.g., headaches, nausea, fever, breathing difficulties) associated with pesticide poisoning.
- Manufacturers point out that the pesticides they manufacture have been approved for use by the federal government. Pesticides considered unsafe, such as DDT and fenitrothion, have been banned.

One possible solution for people concerned about pesticide use is to ban its production. A solution for government might be to enforce stricter regulations governing its use.

Think about how different stakeholders might feel about the alternatives. For example, citizens may be affected by the use of pesticides in their neighbourhood. What would be their perspective? What would be the perspective of a parent of small children? A farmer? A pest-control business owner? A chemist? A gardener? Employees and owners of the company that produces the pesticides? An environmentalist? (See **Table 1** for a start on this process.) Remember that one person can have more than one perspective. It is also possible that two people, looking at an issue from the same perspective, might disagree about the best solution or even the available information. For example, scientists might disagree about the degree of risk associated with pesticide use.

Begin your search for reliable and relevant sources of information about the issue with a question such as, "What does the research say about the risk associated with pesticide use?", or "What are the established positions of various groups on the issue?"

In this stage, you will analyze the issue and clarify where you stand. First, you should establish criteria for evaluating your information to determine its relevance and significance. You can then evaluate your sources, determine what assumptions may have been made, and assess whether you have enough information to make your decision.

Once the issue has been analyzed, you can begin to evaluate the alternative solutions. You may decide to carry out a risk–benefit analysis—a tool that enables you to look at each possible result of a proposed action and helps you make a decision.

There are five steps that must be completed to effectively analyze the issue:

1. **Establish criteria for determining the relevance and significance of the data you have gathered.**
2. **Evaluate the sources of information.**
3. **Identify and determine what assumptions have been made. Challenge unsupported evidence.**
4. **Determine any causal, sequential, or structural relationships associated with the issue.**
5. **Evaluate the alternative solutions, possibly by conducting a risk–benefit analysis.**

After analyzing your information, you can answer your research question and take an informed position on the issue. You should be able to defend your solution in an appropriate format—debate, class discussion, speech, position paper, multimedia presentation (e.g., computer slide show), brochure, poster, video.

Your position on the issue must be justified using supporting information that you have researched. You should be able to defend your position to people with different perspectives. Ask yourself the following questions:

- **Do I have supporting evidence from a variety of sources?**
- **Can I state my position clearly?**
- **Can I show why this issue is relevant and important to society?**
- **Do I have solid arguments (with solid evidence) supporting my position?**
- **Have I considered arguments against my position, and identified their faults?**
- **Have I analyzed the strong and weak points of each perspective?**

The final phase of decision making includes evaluating the decision itself and the process used to reach the decision. After you have made a decision, carefully examine the thinking that led to your decision.

Some questions to guide your evaluation include:

- **What was my initial perspective on the issue? How has my perspective changed since I first began to explore the issue?**
- **How did we make our decision? What process did we use? What steps did we follow?**
- **In what ways does our decision resolve the issue?**
- **What are the likely short- and long-term effects of the decision?**
- **To what extent am I satisfied with the final decision?**
- **What reasons would I give to explain our decision?**
- **If we had to make this decision again, what would I do differently?**

Analyzing the issue → **Defending the decision** → **Evaluating the process**

After reviewing government, chemical industry, and university studies, and by reading newspaper articles and papers by environmental groups, we concluded that research seems to indicate that the active ingredients in many common pesticides are carcinogenic and therefore pose a significant risk to health.

There are reports that contradict our view, and domestic pesticides have been approved for use by federal government agencies. There are many jobs, some of them based in our town, that rely on continued use of pesticides.

After performing a risk–benefit analysis of the various alternative solutions, we decided that we should attempt to reduce or eliminate the use of pesticides on lawns.

Table 3 (p. 615) shows a risk–benefit analysis of allowing pesticide use on lawns.

In our defence at the town hall meeting, we will concentrate on our evidence that there are alternative methods of pest control that are effective and safe. By concentrating on this, and on reasonable doubt about the safety of pesticide use, we hope to be able to counter arguments by opponents.

We tried to obtain information from a variety of reputable sources; however, some of the research is highly technical, and it is possible that we misunderstood its main points or misjudged its relevance.

In the town hall meeting, we created a bylaw to eliminate pesticide use on town property and to limit use on private property to exceptional circumstances. We realize that this decision will not satisfy all stakeholders, but we believe it is the best solution given the evidence at our disposal.

This decision may cause painful changes in industries that produce pesticides and for several service industries. We believe that after a transition period, these industries will survive to produce and market safe alternatives to conventional pesticides.

Table 1: Potential Stakeholders in the Pesticide Debate

Stakeholder	Viewpoint (perspectives)
parent	Children are more susceptible to pesticide poisoning than adults and should not be put at risk. (social)
scientists	1. Active ingredients in many pesticides are known carcinogens. 2. Levels of the active ingredient in pesticides pose no risk (or a risk) to humans with short-term exposure. (scientific)
doctor	Environmental factors that pose any risk to human health should be eliminated or severely restricted. (ecological/legal)
environmentalist	Pesticides from lawns are percolating into rivers, streams, and ground water and are affecting wildlife. (ecological)
pest-control business owner	Used properly, pesticides pose no risk to humans. Only trained persons should be allowed to use pesticides. The pest-control industry is a valuable contributor to the economy. (scientific/technological/legal/economic)
owners of chemical company	Pesticides have been tested and approved by the federal government. (legal) Jobs will be lost if these pesticides are banned. (economic/social)

Table 2: Perspectives on an Issue

cultural	customs and practices of a particular group
ecological	an interaction among organisms and their natural habitat
economic	the production, distribution, and consumption of wealth
educational	the effects on learning
emotional	feelings and emotions
aesthetic	artistic, tasteful, beautiful
moral/ethical	what is good/bad, right/wrong
legal	the rights and responsibilities of individuals and groups
spiritual	the effects on personal beliefs
political	the effects on the aims of a political group or party
scientific	logical or research based
social	the effects on human relationships, the community, or society
technological	the use of machines and processes

A Risk–Benefit Analysis Model

Risk–benefit analysis is a tool used to organize and analyze information gathered in research. A thorough analysis of the risks and benefits associated with each alternative solution can help you decide on the best alternative.

- Research as many aspects of the proposal as possible. Look at it from different perspectives.
- Collect as much evidence as you can, including reasonable projections of likely outcomes if the proposal is adopted.
- Classify every individual potential result as being either a benefit or a risk.
- Quantify the size of the potential benefit or risk (perhaps as a dollar figure, or a number of lives affected, or on a scale of 1 to 5).
- Estimate the probability (percentage) of that event occurring.
- By multiplying the size of a benefit (or risk) by the probability of its happening, you can calculate a probability value for each potential result.
- Total the probability values of all the potential risks, and all the potential benefits.
- Compare the sums to help you decide whether to accept the proposed action.

Table 3 shows an incomplete risk–benefit analysis of one option in the lawn pesticide issue—making no changes in regulations. Note that although you should try to be objective in your assessment, the beliefs of the person making the risk–benefit analysis will have an effect on the final sums. The possible outcomes considered for analysis, the assessment of the relative importance of a cost or benefit, and the probability of the cost or benefit actually arising will vary according to who does the analysis. For example, would you agree completely with the values placed in the "Cost" and "Benefit" columns of the analysis in **Table 3**?

Table 3: Risk–Benefit Analysis of Continuing Use of Pesticides on Lawns

Risks				**Benefits**			
Possible result	*Cost of result (scale of 1 to 5)*	*Probability of result occurring (%)*	*Cost × probability*	*Possible result*	*Benefit of result (scale 1 to 5)*	*Probability of result occurring (%)*	*Benefit × probability*
Pesticide use on lawns presents human health risks.	very serious 5	research is inconclusive (60%)	300	Pesticides eliminate pests, which also present health risk.	high 4	somewhat likely (60%)	240
Pesticide use on lawns affects other species.	serious 4	likely (80%)	320	Lawn-care business is a valuable part of local economy.	high 4	certain (100%)	400
Health-care costs will increase.	very serious 5	likely (80%)	400	Well-kept lawn increases property value.	medium 3	likely (80%)	240
Total risk value			**1020**	**Total benefit value**			**880**