

Module 5

The investigations in Module 5 of the *Detectives in the Classroom* curriculum prepare students to answer the fifth of five Essential Questions:

Did the prevention strategy work?

When students understand how to answer this question, they will be developing the fifth and final of the five Enduring Understandings that provide the structural framework for this curriculum. The fifth Enduring Understanding is:

The effectiveness of the strategy can be evaluated by making and comparing the risks of an outcome in populations of people who were and were not exposed to the strategy. Costs, trade-offs, and alternative strategies must also be considered.

By completing the Module 1 investigations, students learned how health-related conditions and behaviors are not distributed uniformly in a population, that each has a unique descriptive epidemiology that can be discovered by identifying how it is distributed in a population in terms of person, place, and time. This descriptive epidemiology provides clues for formulating hypotheses. Students realized that descriptive epidemiology is only the first step and that formulating hypotheses is not the same as proving hypotheses.

By completing the Module 2 investigations, students learned that causal hypotheses could be tested by observing the exposures and diseases of people as they go about their daily lives. Testing is conducted by making and comparing risks and determining whether or not the exposure and the outcome turned up together, that is, whether or not the exposure and the outcome were associated with each other. This is called analytical epidemiology. Students learned about the methods used to test causal hypotheses and how the 2x2 table is used to numerically express the results of an analytical study.

By completing the Module 3 investigations, students developed their ability to interpret the results of analytical epidemiological studies, namely, the ability to evaluate why an association between an exposure and an outcome has been found. An association means that things are linked in some way that make them turn up together. When epidemiologists test hypotheses, they are interested in determining whether or not an exposure and an outcome turned up together. Students learned that a cause is something that produces an outcome and one reason why an exposure and an outcome turn up together could be because the exposure caused the outcome. However, causation is only one of several possible explanations for why an exposure and an outcome might turn up together in an epidemiological study. Other explanations that should be considered are chance, confounding, reverse time order, and selection bias.

By completing the Module 4 investigations, students learned that once epidemiological and other scientific evidence has been weighed and a judgment has been made that the association between the exposure and the outcome is causal, that is, it is theoretically possible to prevent the outcome by avoiding or eliminating the exposure. Students explored the role of epidemiology and other factors in the creation of disease prevention strategies. They learned about risk as a concept and as a reality by exploring their risk perceptions and those of their classmates and examining ways to judge the acceptability of risks. Students appreciated how differences in perceptions and judgments about the acceptability of risk may influence the allocation of resources (time, energy, and money) for disease prevention strategies. Students created various strategies for preventing a specific health problem and assessed the advantages and disadvantages of each strategy. In doing so, they uncovered that decisions about possible disease prevention strategies are based on more than the scientific evidence and that social, economic, and political factors must also be considered.

Module 5 continues with the important final step of evaluating risk management strategies. Despite good intentions, a risk management strategy might not work. When students complete Module 5 investigations, they should be able to justify the need for evaluations, describe various study designs for evaluation, understand the similarities with epidemiological designs they studied in Module 2, design the evaluation of a prevention strategy, and describe strengths and limitations of the approach.

It is important to evaluate whether or not a prevention strategy is working because it is both impractical and unethical to continue with a strategy that is ineffective. The only way to really measure success is with a scientifically sound evaluation. Although an evaluation costs money and other resources, failure to do so may be even more costly to society.

In **Investigation 5-1: Why Evaluate?**, students will discover the rationale for evaluating risk management strategies. First they will identify reasons for conducting such evaluations while appreciating that there are reasons why some people might not want to evaluate. Then each Epi Team will be given an example of an evaluation and identify the main reasons for conducting it and the possible pitfalls of the approach. Through this investigation, students will learn to think critically about health-related and cost-related justifications and their impact on a decision about how to evaluate a risk management strategy.

In **Investigation 5-2: How to Evaluate**, students will discover that the epidemiologic study designs they learned about in Module 2 can also be used to evaluate a risk management strategy. Different study designs will be considered and students will practice choosing the appropriate design for a specific evaluation.

For example, a cohort study design could be used to see if an anti-smoking campaign is working. The “exposed” group would be those who were exposed to the risk management strategy and the “unexposed” group would be those who were not exposed to the strategy. Everyone is followed through time, and the strategy is deemed to be effective if the “exposed” group, or those who received the risk management strategy, had a higher “risk” of not smoking compared to those who had not been exposed to the strategy.

In **Investigation 5-3: Evaluation Issues**, students will learn about two issues in the evaluation of risk management strategies. First, a risk management strategy should be efficient and provide positive results for the time, energy, and money expended. To evaluate this, a cost-benefit analysis may be done. However, it is often difficult to quantify the strategy's costs and, in particular, the benefits. (What is the dollar value of a life saved or a disease prevented?) The second is whether there are any counter productive "offsetting effects" produced by the risk management strategy such as adverse effects of a vaccine or increases in cigarette smoking among those participating in a weight-loss program.

In **Investigation 5-4: Evaluating an Actual Strategy**, students, in their Epi Teams, create and present a plan to evaluate the Eddie Eagle Program, a risk management strategy designed to prevent gun-related accidents among children. By doing this, students incorporate what they learned previously about risk, relative risk, the 2x2 table, and epidemiological study designs into the development and presentation of their evaluation plan. As background, students will read testimonials about the strategy and rewards the Eddie Eagle Program has received, as well as published evaluations of risk management strategies aimed at preventing gun-related accidents.

In **Investigation 5-5: Concept Connections**, students identify the important concepts that need to be understood in order to answer the fifth Essential Question: "Did the disease prevention strategy work?" Each Epi Team then creates a Concept Map that depicts and explains how the concepts connect to each other. At the conclusion of this investigation, students will realize that they have developed the fifth Enduring Understanding of *Detectives in the Classroom*: "The effectiveness of the strategy can be evaluated by making and comparing the risks of an outcome in populations of people who were and were not exposed to the strategy. Costs, trade-offs, and alternative strategies must also be considered."