The MAP teaching/learning framework consists of three phases—motivate, assess, and propose. These are approached sequentially. The intent of the design, and the manner student learning progresses through the sequence, corresponds with the best of what we know about what is important in understanding real issues in our society, and what it takes for students to develop the abilities required of them in their future roles as the principal decision-makers in our society.

The issue and the science: Where things really stand

Any socio-scientific issue, including each addressed in The Eyes of Nye series, confronts us (and students) squarely in the societal realm. Otherwise, we would not know them as issues. The science forms the basis for understanding both the empirical content related to the issue and the opposing scientific claims that are a normal part of the progression of the science-in-the-making—so prevalent in issues of this nature—to what may eventually be regarded as consensual science. The diagram below illustrates the “science as a part of society” philosophy and the progression of students’ learning from a big-picture perspective. The intermediate layer, addressing standards-based understandings all too frequently absent from the science curriculum, forms an integral link between society and the core science content, and moves deeply down into the central core concept science and out into the societal realm as dictated by the issue and the instructional needs. In The Eyes of Nye, the time and extent of focus in each is determined, for instance, by the concepts and issue coverage in each program.
The Framework Phases

The motivate phase in the teaching/learning framework is designed to capture and retain students’ interest in the issue. When employed correctly and with appropriate emphasis, each student should come away with a “need-to-know”—made explicit through discussion and verbalization—and a set of distinct learning goals that can be attained through structured tasks and teacher guidance. In the illustration provided, the motivate phase initiates the teaching and learning process where the issue resides—in the societal realm. This ensures students’ begin their investigations with a basic understanding of the issue itself in its realistic context. In this phase, teachers help clearly establish an overarching question that focuses on an appropriate aspect of the issue. Encourage and assist students in formulating their own well-worded questions that define upcoming investigations, and therefore set the precedent for ensuring those investigations are relevant and they continue to sustain students’ need-to-know.

It is difficult to establish a student-initiated need-to-know without some understanding of the issue itself and without students’ direct involvement in the design of the questions to be investigated. When it occurs, stagnation in learning is usually due to the separation of relevance (need-to-know) from the investigation that follows and can be largely attributed to the structure of questions to guide the investigation. Teachers cannot remedy the potential difficulty of question structure by simply providing the questions, other than possibly the first overarching question, and even then it is most effective when generated in whole-class discussions. The need for appropriately structured wording in the specific questions can be addressed through use of dialogic discussion. Following a prompt or other initiating experience, and subsequent guided assistance in categorizing, narrow the focus, by “wordsmithing” suggested questions in keeping with agreed-upon concepts and goals. “Class” instruction, and the teacher’s ability to realistically manage the progression, can then proceed intact.

In the assess phase of the MAP framework students investigate the questions identified in the motivate phase, analyze findings and associated claims, and evaluate the validity of claims (and claimants) and supporting evidence presented. In the earlier illustration, the phase begins prior to or upon entering the innermost circle and ends prior to or upon exiting the second circle back into the outlying societal realm. The phase should focus primarily on the scientific concepts related to the questions, and it should account for the largest portion of actual time spent working with issues within the overall framework.

Given the precedence of empirical science in this phase, recommendations from the National Research Council for implementing sequential scientific inquiry provide relevant guidance. The first recommendation (right) is addressed in the motivate phase of the framework, and the last will be addressed in the final “propose” phase. Recommendations two, three, and four are addressed in the “assess” phase as collection of evidence, organizing and sense-making, and evaluation of evidence and tentative explanations takes center stage. There are, however, two other

1. Learners are engaged by scientifically oriented questions.
2. Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions.
3. Learners formulate explanations from evidence to address scientifically oriented questions.
4. Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding.
5. Learners communicate and justify their proposed explanations.

Table 2-5. Essential Features of Classroom Inquiry. From Inquiry and the National Science Education Standards, NRC, 2000, p. 25.
important aspects of scientific inquiry recommended in the *National Science Education Standards* that should be addressed by a teaching/learning design focused on socio-scientific issues and decision-making.

1) Reliance on and awareness of the importance of scientific evidence is the key ingredient that must always be present in order for instruction to fuel appropriate science education practice.

2) As the science resides in a real world (and as depicted earlier, within the boundaries of society), instruction should not seek to suppress societal influences, either in arguments formed or decisions made.

Scientific inquiry demands a certain amount of direct experimental design, manipulation of materials, and use of data-collection instruments—often referred to as doing science. It is essential students understand it is also doing science to realize when an experimental arrangement in a classroom does or does not model a real investigation by scientists in the field, and when the ability to assess claims made by scientists and other experts is more important than attempting to conduct actual experimental investigations that prove or disprove scientists’ notions. In complex issues involving unique (often unproven) cutting-edge science, teachers must help students gain awareness of how science is done and how scientists arrive at certain claims, not seek to create miniature scientists who believe they have refuted or substantiated claims made by seasoned, highly educated research scientists. Assessing claims through realistic means goes a long way toward addressing the need to obtain and weigh information that can be used to make decisions regarding socio-scientific issues in a manner more consistent with what citizens must be able to do in the real world. Scientific literacy is, hopefully, one of the principal goals.

The propose phase of the MAP framework provides an opportunity for students to communicate arguments and claims, to experience open critical debate in their peer (“scientific”) community, and to revise and (if teachers wish) continue their investigation by further narrowing their focus or reinvestigating aspects of previous questions. There are several important learning expectations associated with the phase. First, students should enhance their abilities to communicate effectively. Though the previous phase allowed students to formulate arguments, the bar—and the need-to-know—is raised when they are required to deliver these arguments in a rational, understandable manner, and to defend and debate findings with their peers. The latter aspect relates to the second expected learning outcome—the ability to engage in self- and peer-critique, and through experience, gain an awareness of the role of critical inquiry in the scientific enterprise. As such, this phase provides the most powerful reflection of social and personal perspective an issue has to offer. Activities that emphasize these skills in social and personal contexts include, in part, group and individual oral presentation, development of written lines of argumentation, various structured debate arrangements, and role-play (meeting or hearing enactments, etc.). Not only do all of these types of engagement support the peer-review process—an essential part of inquiry whether or not we are dealing with an issue—but they offer opportunities for assessment on familiar ground, including written papers, maps, oral presentations, and so forth that allow teachers to gauge students’ understandings and abilities to explain concepts.
To some extent, students have been practicing for these challenges through the previous phase. This is especially true regarding lines of argumentation they have been developing in this final phase—organizing, shaping into a presentable format, and delivering. Students will, however, need ongoing assistance; though argumentation is an integral aspect of science, and is duly emphasized in the science education standards, its direct use will be a contrast with typical science classroom practice. Unfortunately, few opportunities are provided for students to engage in evidence-based argumentation practices or the decision-making that can result in or derive from argumentation. This serves to effectively magnify its importance in issues instruction utilizing MAP.

Understanding proper construction of science arguments—for purposes of assessing (as in the previous phase) or structuring a claim (this phase)—is inseparable from science norms we have discussed. Constructing valid scientific arguments require use of existing scientific knowledge and theory—the consistency norm—and are driven by open discourse (a part of all three phases of the MAP teaching/learning framework). Addressing these norms in the classroom presupposes we believe students can not only develop understanding of science ideas but also can develop the language of science more effectively through talk, both orally and in writing—a key in the scientist’s presentation of findings and proposal of claims and arguments to peers in the scientific community. This is because the question of how this necessary yet nebulous ability is acquired is far more difficult to address. One step toward that is helping students understand what it looks like when they see it.

Scientists’ argumentative writing, when most effective, tends to carefully progress from specific data or factual references to theoretical claims. Evidence gradually stacks one layer on another, each thought or claim tied closely in concept and language to previous thoughts and claims, each claim increasingly general and inferential in nature. Of language usage, terms and phrases descriptive of certain concepts are used consistently through all levels of an argument (e.g., they exhibit lexical cohesion), and the intent is not to mystify, but rather demystify. Befuddling readers may temporarily stymie rebuttal, but will not persuade recognition or progress of a claim. These are attributes students can look for in the claims and writings they assess in the second phase, and these are abilities students can progress over time as they work with new issues and gain confidence. A few practices that can positively contribute to students’ abilities to construct quality scientific lines of argument are outlined below.

In general, in developing solid lines of argument, students should:

- consistently and explicitly refer to specific, documented data that remains at all times relevant to the question(s) addressed and to claims made;
- in light of that data, discuss and relate specific issue and science aspects being investigated;
- explain how the claim can be substantiated by other case studies of similar issues or related science, or how the claim might inform studies that could or should take place;
- use consistent terminology, phraseology, and style across all levels;
- tether supporting findings and data with language such as “These data indicate...”
The Eyes of Nye and the MAP Teaching/Learning Framework

At a glance…

**Motivate**
Introduce issue in its social context.

Establish need to know.

Outline broad question that frames the issue, and underlying questions to structure investigation and assessment of claims.

- *The Eyes of Nye* preview introduces the issue, establishes the context of the program and lesson and identifies the broad question that addresses the issue and various aspects that must be considered to understand the issue.

**Assess**
Investigate claims, primarily scientific, and assess available information according to constitutive criteria (e.g., accuracy, validity, consistency).

- *The Eyes of Nye* program focus—the presentation of claims and accompanying research by selected experts along with accompanying explanation—provides students with an appropriate amount of detail to analyze the scientific aspects of the issue.

- The lessons approach the claims and information in coordination with several questions identified prior to entering the “assess” phase. The questions each address—and reside under the umbrella of—the central broad question.

- The teacher’s guide addresses each in detail, creates a flow and series of connections between claims and among the factors associated with each, and presents potentially refuting claims and/or research for students’ consideration.

**Propose**
Develop lines of argumentation based on assessment of prior claims, communicate/defend, and extend/refocus investigation. Internalize basis and process for making informed decisions.

- *The Eyes of Nye* challenges through social/societal content and posing questions and hypothetical situations. Features guided practice in developing/communicating lines of argumentation through approaches such as role-play, structured debate, persuasive writing, and oral presentation and critique.