How-To-Do-It

Enhancing Critical Thinking Through Structured Academic Controversy

Janell M. Mead Lawrence C. Scharmann

I am here to defend this man's right to think!

The statement above, taken from the original film version of *Inherit the Wind*, can be used to generate student interest and initiate excellent opportunities for teaching critical thinking skills in high school biology. Set in 1925 and starring Spencer Tracy, Gene Kelly and Fredric March, *Inherit the Wind* portrays a small Tennessee town caught up in the fanaticism and mob mentality associated with a trial modeled after the famous "Scopes Monkey Trial" in which a high school teacher was arrested for teaching evolutionary theory, an action contrary to Tennessee law. This film, however, is much more than either explosive courtroom drama or a science-religion historical documentary. Indeed, the religion against science backdrop is often overshadowed by human displays of greed, pride, notoriety, power, politics and even romance (Wagner 1989). Filmed in black and white, *Inherit the Wind* attempts to set a stark contrast of good versus evil; however, the concepts turn out to be not so simple. The film does not explicitly teach about evolutionary theory. Instead, it frames an opportunity to examine a societal response to it. Filled with symbolism, the drama has much to offer observant students and innovative teachers.

Context

Although the film does not directly teach biological concepts or scientific theories, evolution pervades as the theme of *Inherit the Wind*. As such, one cannot make use of this film and avoid the inevitable . . . questions about evolution and its relationship to values and personal belief systems. Among the many benefits of using *Inherit the Wind* as an instructional tool is the opportunity to discuss science in a more general and holistic context (i.e. using sociology, philosophy and history, etc. as perspectives). In fact, such a benefit is consistent with a campaign to more directly incorporate the history and nature of science within the biology curriculum (Bybee, Ellis & Matthews 1992; Silverman 1992).

In theoretical terms, these contexts establish a perspective recommended by recent researchers in teaching about the history and nature of scientific theories and their development (Duschl 1990; Hodson 1988; Nelson 1986; Root-Bernstein 1984; Scharmann 1990; Silverman 1992; Solomon et al. 1992). Hodson (1988), for instance, carefully constructed an argument that scientists and science teachers understand the nature of science little better than the students for whom they provide instruction because they tend to work with or teach science in circumstances that are traditionally expert-centered, factually verifiable, and teacher-directed. In other words, their research and/or instructional emphases reflect the logical and the empirical. Having had so much success working within the current scientific paradigms, those individuals often most intimate with science are also those who are remiss in accurately portraying how scientific knowledge claims are made, how they are justified, why they became accepted during a particular time in history, and how they are ultimately challenged and eventually replaced. Such an inadequate portrayal misrepresents how scientific knowledge gets generated and is inconsistent with both a contemporary understanding of the philosophy of science (Aicken 1991; Duschl 1990) and with an understanding for how science learning takes place among novices (Osborne & Freyberg 1985; Shayer & Adey 1981). Thus, historical, philosophical and sociological perspectives are important to consider in creating a more philosophically valid science curriculum.

In practical terms, however, such contexts can represent important criteria for the selection of science instructional materials. Historical, philosophical and sociological considerations, although often overshadowed by logical and empirical criteria, should not be construed as replacing but rather as complements to more traditional instructional selection criteria. Nevertheless, because values and beliefs are obviously quite dependent upon personal history, individual experiences and cultural diversity, the importance of including history, philosophy and sociology as frames of reference for the study of science should not be underestimated (Duschl 1990, 1988 & 1985; Hodson 1988; Silverman 1992).

To exemplify the application of history, philosophy and sociology in a science classroom, it would seem appropriate to characterize the contextual setting leading up to the Scopes trial. To delineate a historical context, Nelkin (1982) adequately summarizes the time frame from 1895 through 1920 in the following:

> *In the United States, Victorian culture absorbed the theory of evolution. In 1895, the National Education Association recommended a zoology course that was evolutionary in organization, and biology textbooks prior to 1920 began to introduce evolution theory to secondary schools and college students, often presenting it with extraordinary and perhaps self-conscious assurance. "We do not know of any competent*

Janell M. Mead is a secondary science teacher at Pratt High School, Pratt, KS 67124. **Lawrence C. Scharmann**, Ph.D., is Professor of Science Education in the Center for Science Education, Kansas State University, Manhattan, KS 66506.

naturalist who has any hesitation in accepting the general doctrine. There is no rival hypothesis to evolution, except the out-worn and completely refuted one of special creation, now retained by the ignorant, dogmatic, and the prejudiced."

(Nelkin 1982, pp. 29–30)

Nelkin goes on to imply, from a philosophical perspective, that even factions within the theological community had come to accept the language of evolution. Theologians from a variety of denominations began to recognize that perhaps science *as a way of knowing* did not speak to religious questions nor free one from them. Likewise, the logic inevitably led to a parallel inference that theology *as a way of knowing* did not speak to scientific questions nor necessarily free one from them (Kramer 1986; Nelkin 1982). Unfortunately, this reconciliation between science and theology as complementary *ways of knowing* did not last. In the 1920s the conflict between evolution and religion resurfaced as a public issue, initiated by a religious movement known as fundamentalism. Again, Nelkin aptly describes the sociological conditions that gave rise to fundamentalism as an American movement:

. . . that developed around the turn of the century as a defensive response to the threatening social changes brought about by the industrial revolution, and to the cultural diversity brought about by increasing immigration. Literal interpretation of the Bible became the bulwark against modern ideas.

By the 1920s, the issue of evolution divided Protestant churches; fundamentalists denied the validity of evolution, and modernists sought to reconcile their faith with science. Control over educational institutions was the arena for their battles.

. . . among Northerners who had reconciled religion and evolution, the old assumption about incompatibility of science and religion seemed almost absurd by the time the Scopes trial brought the issue to national prominence.

. . . [the existence of] hostility was due largely to the association of evolutionary theory with disturbing social problems of the day . . . [reflective of] a comparatively lawless period.

(Nelkin 1982, pp. 30–31)

Evolution theory has continued to be debated throughout the intervening decades between the Scopes trial and today. Thus, the teaching of evolution in the secondary classroom has been surrounded by periodic public controversy ever since its initial promotion in 1859. And although the teaching of evolution can be a complicated and time-consuming process, most biology teachers understand evolution to be the organizing theme upon which science *as a way of knowing* constructs an explanation for the diversity of the living world. In an often cited article entitled, "Nothing in Biology Makes Sense Except in the Light of Evolution," Theodosius Dobzhansky remarked:

Seen in the light of evolution, biology is, perhaps, intellectually the most satisfying and inspiring science. Without that light it becomes a pile of sundry facts—some of them interesting or curious but making no meaningful picture as a whole.

(Dobzhansky 1973, p. 129)

Instruction & Evolution

Because evolutionary theory continues to play out as a controversial issue with the general public, in actuality it presents unique opportunities for biology teachers. By making use of diverse public perceptions, historical or contemporary, teachers can engage students in constructive activities which require critical thinking. Research indicates that structured controversy, especially in the case of advanced students, dramatically enhances these skills (Johnson et al. 1985; Nelson 1986; Scharmann 1990; Silverman 1992; Solomon et al. 1992). Although the Johnson et al. model is intended to engage students in controversy that requires critical thinking and is appropriate for any issue in which at least two alternative positions exist, two authors, Nelson (1986) and Scharmann (1990), speak directly to the use of this instructional approach as it applies to teaching and learning evolutionary principles. According to Nelson (1986), teachers who have adopted small group, peer interactive discussions were freed from the need to be experts in evolutionary theory. He also suggested that, by making students discuss among themselves (in a structured manner) the dynamic and often uncertain nature of science, teachers could provide opportunities for their students to appreciate scientific theories on both a more adequate and honest level. In addition, Scharmann (1990) claimed that students possessing a strong and well-established rapport with their teacher will generate a sufficient level of conflict among themselves both within and between discussion groups. If frustrated by a lack of within or between group consensus concerning points of controversy, students must eventually turn to the "trusted" teacher to assist them in resolving their points of contention. Finally, it has been demonstrated that the use of structured controversy in instructional strategies results in higher student motivation and overall achievement in science (Johnson et al. 1985; Scharmann 1990).

Before returning to *Inherit the Wind*, it should be noted that the use of structured academic controversy is not advocated prior to students possessing *at minimum* a general awareness of the scientific evidence in support of evolutionary theory. It is likewise important that students receive information related to legal decision making with respect to the separation of church and state. With respect to the latter, it is critical for teachers and students to examine together the basic principles of a 1971 Supreme Court case known as Lemon v. Kurtzman. All prominent court cases associated with the evolution/creation controversy have made use of this ruling in rendering court verdicts (Wagner 1989). Known as the "Lemon test," this ruling is useful for assessing whether a statute violates the First Amendment rights of an individual to basic freedoms of religion, speech, press, assembly and petition (Rapp Educational 1984). Scott (1991) correctly summarizes this ruling as consisting of three criteria:

1. The statute must have a secular purpose.
2. Its principal or primary effect must be one that neither advances nor inhibits religion.
3. The statute should not cause any undue entanglement of religion and the state in attempting to enforce it.

By contrast, it is useful to note that as a result of the periodic public debates over what constitutes religion, the courts have also attempted to delineate what constitutes science. Science (at least legally), according to Hooker (1982), possesses the following essential characteristics:

1. It is guided by natural law.
2. It has to be explanatory by reference to natural law.
3. It is testable against the empirical world.
4. Its conclusions are tentative (i.e. are not necessarily the final word).
5. It is possible to falsify it.

The lists above make it possible to examine alternative theories, historical,

contemporary and even student-generated theories by comparing such theories against the above criteria. If performed properly, students can gain a sense of why one theory gains more favor among scientists over other alternatives.

Finally, as a preview to *Inherit the Wind*, students should be made aware of the highly energetic and emotional nature of some scenes. Students must keep in mind that the film is a play and not a factual documentary, even though it makes use of a great many representative quotes taken directly from the "Scopes" trial transcript upon which it is based.

Instructional Planning Suggestions

In the movie, five characters are most prominent: Bertrum Cates, the school teacher; Matthew Brady, the literalist prosecutor; Henry Drummond, the spirited defense attorney; Reverend Brown, the town's fundamentalist religious leader; and Rachel Brown, the meek daughter of the Reverend and fiancée of Bertrum Cates. Each student in the class can be assigned one of these characters to identify with during the trial. Since the film is divided into "days," each student should keep a journal/diary on his/her assigned character, making personal entries as well as answering specifically structured questions. Journals permit students to make observations about their character, inferences concerning their behavior, interpretations of their feelings, and predictions about their subsequent actions. Time should be given during class to complete these journal entries.

Pre-Activity

Discuss the purpose of the activity as an opportunity to be an observer-interpreter of one of the major characters in a movie. Assign each student a character with whom they should identify. Have students prepare their journals by predicting how their character might act in the upcoming showing of the film (after providing the brief sketches discussed above). (Note: Each day the film should be viewed for approximately 30 minutes).

Day 1

View the first 30 minutes of the film, through the argument between Rachel Brown and her father. Allow students time to briefly discuss what they have seen. Take the remaining class time to permit students to make a second entry in their journals (Note: Henry Drummond has not yet arrived). This entry should begin with a revision of student predictions, concerning their character, by writing a probable "summary" of their life as this character up to the "day" they have just witnessed in the film. The entry should also detail the events of the day from the perspective of their character—remind them that they are the character . . . tell them to describe how they feel, how they responded, and what they are thinking about.

Day 2

Today students will witness the arrival of the defense attorney, the selection of the jury, the conversation between Henry Drummond and Mrs. Brady, the tent meeting, and finally the conversation between Drummond and Matthew Brady. Once again, allow class time for journal entries. Have students relate what happened in the town during this second day, what happened to their character and why, how "they" responded to these events, and how "they" feel about their life now.

Day 3

During the film on this third day, students will watch the trial, Drummond withdrawing from the case, and a "turning point" conversation between Drummond and another character named Hornbeck. As a subsequent activity, have students again make journal entries similar to those requested upon the completion of the second day.

Day 4

Matthew Brady is called as a witness for the remainder of the trial. The scene is emotional and a complete surprise to students who were previously unfamiliar with the movie. Encourage students to carefully follow the events depicted in the film all the way to the end. The final conversation between Drummond and Hornbeck is very important, as is Drummond's exit. Again, students should be given sufficient time to reflect upon the film by writing personal entries in their journals, using themes or considerations like those of the previous two days.

Day 5

Bring the students back together to summarize the influence the trial had on their characters. Have the students assemble into character groups (i.e. all of the students identifying with Rachel Brown get together). Once together, students should share journal entries and discuss individual reactions to and reflections about their character. Character groups are to construct one final journal entry concerning their character of mutual identity. This entry should be made from the perspective of several years after the trial. The group must attend to and come to consensus regarding: 1. "Knowing what I know now, what would I have done differently?" and 2. "What was gained and/or lost in my life because of the events of that week?" Finally, each character group selects one member to represent their character in reporting back to the entire class.

Further Instructional Notes

During the instructional week, in between viewing the film and having students maintain their journal entries, opportunities present themselves for teachers to assist students to better understand the nature of science and how science differs from other ways of knowing the world. One key point that should be emphasized daily concerns the fact that science, as a way of knowing, is appropriate for answering many but not all questions. The same point needs to emphasized for religion and aesthetics. Teachers should therefore anticipate needing to deal with students' assumptions and inferences concerning issues implicitly treated in the film, and encourage students to think critically about questions such as:

- What were the arguments presented by each side in the trial?
- What was the nature of the evidence used by each side in the case?
- What are the assumptions made by each side regarding the nature of what constitutes knowledge?

In addition, although these issues are initially raised in a biology classroom, it would be highly appropriate to involve other teachers (i.e. social studies or English) in providing additional thematic instructional time. For example, English teachers might assist with the use of "stream-of-consciousness" writing techniques, or social studies teachers might introduce further insights concerning the historical context in which the film takes place. Essentially, in relation to the science classroom, it is important for teachers to promote a recognition among students that science has implications that extend beyond the biology classroom.

Final Thoughts

A rationale has been provided for considering the importance of history, philosophy and sociology as complements to more traditional logical and empirical criteria concerning the selection of instructional materials in high school biology classes. While past attempts to promote such a consideration were often quite vigorous, little was documented concerning how this could have or had been done (Solomon et al. 1992). By contrast, the authors in this paper describe not only an invitation to make use of such complementary criteria, they delineate suggestions for how to implement such an inclusive and more holistic approach.

The instructional approach described in this paper had part of its origins in connection with a summer institute conducted at Kansas State University and sponsored by the National Science Foundation (Grant TPE-8955245). This institute, attended by secondary science teachers, was titled "The Nature of Science and Instructional Role of Scientific Theories." As part of this experience, teachers were expected to design and implement an innovative instructional activity during the next academic year that focused student attention both on the necessarily uncertain nature of science and the presentation of science in ways that would transcend the traditional science curriculum. This paper is an attempt to characterize one such instructional effort at Pratt High School (Pratt, Kansas).

Although it was not the intention of the authors to describe the results of an experimental design comparing this instructional activity to a more traditional one or any other alternative approach to teaching evolutionary theory, it should be noted that students enjoyed the approach, and benefited from engaging in the use of critical thinking skills and in enhancing their knowledge about evolution theory. Students at Pratt High School, in general, have not historically felt threatened by more traditional treatments of instruction concerning evolutionary theory. It is the opinion of the classroom teacher, nonetheless, that students who engaged in the *Inherit the Wind* activity displayed a greater positive attitude toward biology in general and of evolution more specifically than students who studied evolutionary principles in previous years. Such an anecdotal report would require a more systematic investigation to determine the extent of the efficacy of this approach compared to alternative instructional strategies. Such a statement of positive influence is, however, consistent with the following statement made by Solomon et al. (1992) when they reported that:

> *. . . any stratagem that extends the short time span of pupils' attention is likely to improve learning, whether or not it includes history of science. . . . we found some evidence . . . that helping the pupils to focus on the* reasons *for accepting one theory rather than another was more effective than just teaching accepted theory. Using these historical materials does seem to have produced more durable learning.*
>
> *Finally, we acquired new and unexpected evidence from interviews that studying the history of a change in theory may make the process of conceptual change a little easier. It might have been encouraging for pupils to know that mature scientists have also had to struggle to see phenomena in a new way, at a time when a similar feat is being demanded of them at school.*
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> (Solomon et al., p. 419)

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