THE OHIO DEPARTMENT OF EDUCATION L10H23 "CRITICAL ANALYSIS OF EVOLUTION"; INNOVATIVE LESSON PLAN OR STEALTHY ADVOCACY TOOL?

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Abstract:
This paper will discuss the ongoing controversy surrounding a particular Ohio Department of Education tenth grade lesson plan titled "Critical Analysis of Evolution" (Ohio Department of Education identification L10H23). The lesson professes to encourage students to "critically examine" evidences for and against evolution and invites them to discuss definitions of some common evolutionary terms and concepts. Proponents insist that this lesson is a thought-provoking exercise in critical thinking and scientific objectively. Critics claim that the lesson is at best, unscientific and at worst, a thinly-veiled attempt to introduce creationist ideas into the classroom in accordance with the so-called "wedge" strategy of certain pro-creationist organizations. A complicating factor is that this lesson plan has been used as the subject of graduate level research on the effect of teaching "the evolution controversy" to Ohio students, and subsequently, this research has been used to support similar initiatives in state hearings outside of Ohio. We will present the findings from a series of surveys conducted with life-science high school teachers, college faculty, and graduate students intended to establish whether or not practicing scientists and science educators agree with the Ohio Board of Education's assessment that "there is no ID [intelligent design] there". We will look for trends in the opinions of different sub-populations, identify key differences of opinions between participants and Ohio Board of Education members and suggest possible reasons for any apparent conflicts of opinion.

Ohio Academic Content Standards

Prior to the adoption of the current standards in 2002, Ohio's science standards were last revised in 1996 under the title "*Science: Ohio's Model Competency Based Program"* (OMCBP). In the year 2000, a review of OMCBP by the Thomas B. Fordham Foundation states that:

> "Evolution is treated as if it were not proper conversation in polite company. The E-word is avoided and the evolutionary process occupies a near-negligible part of an extensive document" (Lerner, 2002, p.15).

The report goes on to say that a number of states, including Ohio "fail so thoroughly to teach evolution as to render their standards totally useless" (Lerner, 2002 p.16).

The process of adopting the current state-wide academic content standards began in 1997. The Ohio State Board of Education and The Ohio Board of Regents created a "Joint Council" to oversee the implementation of recommendations made by the Secondary and

Higher Education Remediation Advisory Commission. A Science Standards Advisory Committee (SAC) was selected from nominations submitted by stakeholders throughout the state. Nominations were solicited from school districts, professional organizations, colleges and universities, community leaders, Educational Service Centers (ESCs), Regional Professional Development Centers (RPDCs), teachers' unions, parents, industry and the business community. A Science Writing Team (SWT) was also formed, made up mainly of K-12 educators and university science professors.

There have been some accusations that certain appointments to these two committees may have been influenced by political considerations. Board member Michael Cochran, quoted in the Cleveland plain dealer, claimed that "the team put together to write the science standards was stacked with pro-evolutionists" (Stephens, 2002) Conversely, Ohio Citizens for Science claim that "the Cochran-led science standards subcommittee appears to have packed the 2003 writing team with "intelligent-design" creationists". (Ohio Citizens for Science, no date).

Many organizations, individuals and groups submitted comments and concerns to ODE during the preparation of the standards. Generally, the SAC and SWT followed the model content standards produced by the National Academy of Science's "*National Science Education Standards*" (1996) and The American Association for the Advancement of Science's "*Benchmarks for Science Literacy*" (1993). Both of these documents strongly emphasize evolution in the life science sections and make no reference to alternative ideas. One notable dissenting voice was science writing team member Robert Lattimer. Lattimer is an analytical chemist in private industry and is active in creationist organizations including "Science Excellence for All Ohioans" (SEAO). SEAO has links to other ID and creationist organizations such as The National Intelligent Design Network (IDnet) and the Ohio Valley Creation Education Association. (Snyder, 2002) SEAO was primarily established as an advocacy group intent on influencing the content of Ohio's science standards. Lattimer and SEAO argued that there should be some discussion of the alternative theory of intelligent design in the standards. The majority of the committee disagreed. The disagreement triggered a debate that eventually led to the now infamous 10th grade-level indicator 23 "compromise" and the associated lesson plan. Clearly, there is a political component to this debate. In November 2003, Lattimer himself noted (Ohio Citizens for Science, no date):

> "This is basically a political struggle. ... Science will have very little to do with the arguments on what science standards will look like. Education will have little to do with it. It's basically how the politics will work in a particular state."
>
> "….and the Governor was twisting some arms. He appoints 8 of those members [of the Ohio Board of Education], but he has pretty much influence on the whole Board."

Opposing camps involved in this controversy have become bitterly polarized and occasionally hostile. The nature of this polarization was examined by Zalar (2005).

Zalar's study used Q methodology to examine the subjectivity of the various stakeholders and found that they appear to fall into two opposing camps with radically differing ideologies and world-views. Zalar also found that neither the Ohio Department of Education, nor past legal precedent appeared to give a clear legal direction as to how teachers should implement the new standards. This is perhaps not surprising given the polarization and lack of consensus of the various stakeholders. It appears then that by default, the interpretation of standards and ultimately the content of the curriculum becomes the responsibility of individual teachers, who are presumably influenced by their own world-view.

The current version of the Ohio Science Academic Content Standards was adopted in 2002 and distributed to schools in 2003. (Ohio Board of Education, 2004a). The Ohio Academic Content Standards document consists of an overview containing general statements about what students should learn in each discipline followed by more specific descriptions of standards, benchmarks and grade-level indicators arranged by discipline and grade level. Standards are short, general statements specific to a single discipline defined as "the knowledge and skills that students should attain - often called the "what" of "what students should know and be able to do." They indicate the ways of thinking, working, communicating, reasoning and investigating, and important and enduring ideas, concepts, issues, dilemmas and knowledge essential to the discipline." Benchmarks are defined as "specific components of the knowledge and skills identified by an Academic Content Standard. The benchmarks serve as checkpoints of cumulative knowledge and skills over a band of grades." Grade-level indicators are defined as "statements of what students should know and be able to do at each grade level. The indicators are the checkpoints that monitor progress toward the benchmarks."

The Ohio Academic Content Standard for Life Sciences read as follows:

> "Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences."

Several benchmarks and grade-level indicators for various grade levels mention concepts such as adaptation, survival, heredity and extinction that are certainly connected to biological evolution, but only in grade 10 do the benchmarks and indicators specifically mention evolution by name. The relevant entries read as follows:

Grade 9-10 benchmarks:

E. Explain how evolutionary relationships contribute to an understanding of the unity and diversity of life.

H. Describe a foundation of biological evolution as the change in gene frequency of a population over time. Explain the historical and current scientific developments, mechanisms and processes of biological evolution.

I. Explain natural selection and other evolutionary mechanisms account for the unity and diversity of past and present life forms.

Relevant grade-level indicators that specifically mention evolution are as follows:

Grade 10 grade-level indicators:

20. Recognize that a change in gene frequency (genetic composition) in a population over time is a foundation of biological evolution.

21. Explain that natural selection provides the following mechanism for evolution; undirected variation in inherited characteristics exist within every species. These characteristics may give individuals an advantage or disadvantage compared to others in surviving and reproducing. The advantaged offspring are more likely to survive and reproduce. Therefore, the proportion of individuals that have advantageous characteristics will increase. When an environment changes, the survival value of some inherited characteristics may change.

22. Describe historical scientific developments that occurred in evolutionary thought (e.g., Lamarck and Darwin, Mendelian Genetics and modern synthesis).

23. Describe how scientists continue to investigate and critically analyze aspects of evolutionary theory. (The intent of this indicator does not mandate the teaching or testing of intelligent design. (Hereafter referred to as "H23") **(DELETED, FEBRUARY 14th 2006)**

24. Analyze how natural selection and other evolutionary mechanisms (e.g. genetic drift, immigration, emigration, mutation) and their consequences provide a scientific explanation for the diversity and unity of past life forms, as depicted in the fossil record, and present life forms.

Ohio Model Curricula and Instructional Management System (IMS)

The Ohio Department of Education has implemented an Instructional Management System (IMS) as a way of delivering the Model Curriculum and other standards-based materials to educators and interested parties. (Ohio Board of Education, no date a)

One important component of the IMS is a collection of standards-aligned model lesson plans. These lesson plans are freely available from the ODE web site. The lesson plans

are searchable by discipline, grade level and benchmark, indicator or keyword. L10H23 was available from this site from March 2004 until February 2006.

Involvement of the Ohio Board of Education.

It is an interesting feature of the US education system that state boards of education are made up largely of elected or appointed officials who have final say in the approval of resolutions and adoption of policy and curricula. There has been some discussion of the fact that in Ohio, there was little or no chance for any kind of external review of the Academic Content Standards between the time that they were written and when they were finally adopted (Ohio Citizens for Science, no date). This means that by default, the Board of Education has final say over the content of the Academic Content Standards. There are no specific scientific or academic credentials required for board members. Biographic information about the current board members is available at the Ohio Department of Education web site. At this time, few of the board members appear to hold degrees in natural science related disciplines, and none hold advanced degrees from an accredited university life-science department. (Ohio Department of Education, no date b). There is some evidence that Ohio Governor Bob Taft initially exerted political pressure on the board to support his position that "intelligent design" should be taught alongside evolution in Ohio Schools (Candisky 2005). The disputed material was only rejected after the governor's political support was withdrawn following an influential lawsuit in Dover, Pa.

Introduction of Lesson Plan "Critical Analysis of Evolution" (L10H23)

The lesson plan titled "Critical Analysis of Evolution" has been subjected to considerable public attention and scrutiny. This lesson plan was adopted in winter of 2004 and addresses the Life Science Benchmark H, grade-level indicator 23. The primary author of this lesson is a biology teacher in an Ohio school district.

The lesson professes to encourage students to "critically examine" evidences for and against evolution and invites them to examine and discuss definitions of some common evolutionary terms and concepts. The lesson includes suggested reading material and internet resources but no actual empiric experimentation or lab work. Proponents insist that this lesson is a thought-provoking exercise in critical thinking and scientific objectivity. Critics claim that the lesson is at best, unscientific and at worst, a thinly-veiled attempt to introduce creationist (specifically intelligent design) ideas into the classroom, in accordance with the so-called "wedge" strategy of certain pro-creationist organizations:

> "The social consequences of materialism have been devastating. As symptoms, those consequences are certainly worth treating. However, we are convinced that in order to defeat materialism, we must cut it off at its source. That source is scientific materialism. This is precisely our strategy. If we view the predominant materialistic science as a giant tree, our strategy is intended to function as a "wedge" that, while relatively small, can split the trunk when applied at its weakest points." (Discovery Institute, Center for the Renewal of Science and Culture, 1998).

The most influential proponents of the lesson are certain conservative members of the Ohio Board of Education, Robert Lattimer and other SEAO members. This is the same alliance that pressured ODE to include the controversial H23 grade-level indicator. The majority of organized resistance to the lesson plan has come from a group called Ohio Citizens for Science (OCS). OCS is made up primarily of Ohio life-science university faculty members. OCS members have voiced their concerns about the lesson throughout the adoption process, and pointed out errors that led to revisions of the lesson before it was ultimately adopted. Both SEAO and OCS have maintained web sites where many of the relevant documents, transcripts, articles and opinion pieces related to the entire Ohio Academic Content Standards debate can be freely obtained.

Adoption of the lesson plan was not unopposed by OBE members. The SEAO website describes one incident:

> "The Standards Committee of the State Board of Education met on Feb. 9 to consider Science lesson Set A. Most of the discussion focused on the "Critical Analysis of Evolution" lesson. [Board of Education member] Martha Wise made a motion that the lesson be removed from Set A. She claimed that the lesson is (a) inconsistent with scientific inquiry, (b) not totally scientifically based, (c) full of errors, and (d) inconsistent with the Standard (Grade 10, Benchmark H). Mrs. Wise said she was uncomfortable with "all" of the lesson, and she claimed that the lesson reflected intelligent design theory (which is not mandated by the Standards). Committee Co-chair Michael Cochran refuted the claims made by Mrs. Wise and defended the process that was used to develop the lessons. He said the "Critical Analysis of Evolution" lesson was not just written by one or two persons, but many people gave input. He added that the credibility (of any specific lesson or author) is in the eye of the beholder. Deborah Owens Fink noted that there is no mandate for a teacher to use any particular lesson. The motion to eliminate the lesson was defeated by a 6-2 vote (YES - Richardson, Wise. NO - Brown, Cochran, Craig, Millett, Owens Fink, Ross)."

On February 10th, 2004 the Board passed a resolution of intent to adopt the first set of lesson plans (including the "Critical Evaluation" lesson plan) by a 13-4 margin.

In response to the adoption of L10H23 Bruce Chapman of the Discovery Institute stated that:

> "Ohio's science standards and this lesson will stand as a beacon to other states as they review their own approach to how evolution is presented in the classroom. This is a common-sense approach that avoids the extremes and focuses on teaching students about the scientific debates over evolution" (SEAO web site).

Content of the Lesson Plan

Two draft versions and a final version of the lesson plan are available as a .ZIP archive from:

http://www.ericse.org/evolution_study/L10H23.zip

The lesson plan is also available from the Ohio Citizens for Science web site and the Science Excellence for All Ohioans web site.

The lesson consists primarily of the following segments:

A **Pre-Assessment** consisting of 5 questions:

1. Describe anomalies and explain why they exist.
2. Are there any benefits to exploring scientific anomalies?
3. How do scientists make and test predictions?
4. How do scientists critically analyze conflicting data?
5. Define the following terms in your own words:

- Theory
- Critical analysis
- Natural selection
- Biological evolution
- Macroevolution
- Microevolution

Scoring guidelines (i.e. "model answers") for the pre-assessment questions.

Post-assessment questions:

- Describe why scientific critical analysis of evolution is important.
- Describe one major pieces of evidence used to support evolution and explain why it is important.
- Describe one piece of evidence used to challenge evolution and explain why it is important.
- Compare and contrast the supporting and challenging information regarding the aspect of evolution you studied.
- Evaluate the scientific data supporting and challenging areas of evolution in light of the scientific method. In other words, is the data that is used to support or challenge evolution consistent or inconsistent with the scientific method? Are there any limitations? (NOTE: steps of scientific method: Observation, hypothesis, test, retest and conclusion)

Instructional procedures section that includes an "explanation" of the rationale for the post-assessment questions and describes the procedure that teachers should follow for the presentation of the lesson.

Teachers are instructed to conduct the lesson as follows:

Student engagement. This presents the issue of anomalies to students and asks them to consider various examples, namely spontaneous generation vs. biogenesis and geocentric vs. heliocentric planetary models.

Teacher presentation. Teachers are told to present "supporting and challenging information" for five "aspects" of evolution that are described in an attachment.
Aspect 1: Homology (anatomical and molecular)
Aspect 2: Fossil Record
Aspect 3: Anti-Biotic Resistance
Aspect 4: Peppered Moths
Aspect 5: Endosymbiosis

Student Research. Students form groups and research one of the five aspects. Two groups are assigned to each aspect so that later, one group can argue in favor of the aspect while the other will challenge it.

This section is accompanied by an "instructional tip" which reads:

> "Attachment B, Investigative Worksheet, has questions that can be applied to all five aspects. This will help students become familiar with the data, and therefore be able to critically analyze the evidence for either the supporting side or the challenging side. As they complete the worksheet, the group members may all work together on each question, or divide the questions among themselves and then share their findings as a group."

Worksheet B, intended to guide students during this activity is included in the lesson as an appendix. It includes the following questions:

• Write a brief summary of what you have read and discovered regarding your particular aspect and how it supports evolutionary theory.

• Write a brief summary of what you have read and discovered regarding your particular aspect and how it challenges evolutionary theory.

• Were any scientific tools, instruments or other forms of technology used by scientists to support this evidence and how it supports a key aspect of evolutionary theory? Briefly explain your answer.

• Were any scientific tools, instruments or other forms of technology used by scientists to challenge this evidence and how it challenges the key aspect of evolutionary theory? Briefly explain your answer.

• How do scientists critically analyze this aspect of evolution?

• Is the information you found supported by using the scientific method? Are there any limitations?

• Are there any other type(s) of research that scientists need to do in order to critically analyze evolution? Briefly explain your answer.

Critical analysis activity. Student groups pick or are assigned one of the aspects of five evolution and construct arguments that either challenge or support the evolutionary ideas of that aspect.

Model answers for this activity are also included as an appendix.

Other short sections of the lesson plan cover deal with issues such as differentiated instructional support, extension, interdisciplinary connections, English language arts, research standard, materials and resources, and vocabulary, as well as technology connections and research connections. There are also additional instructional tips accompanying some sections.

General tips. This section includes a list of suggested published and online resources. This list has been subjected to numerous revisions resulting from criticisms by OCS and others. Initially the resource list included references to articles that OCS claimed were outdated, discredited, unavailable, incorrectly cited or blatantly pro-creationist. Many of the disputed citations were eventually omitted. Early versions also grouped references into "supporting" and "challenging" categories, while later versions included a revised collection of references in simple list format.

Critical Analysis of "Critical Analysis" by Ohio Citizens for Science

Ohio Citizens for Science has attacked the lesson, claiming that it has weaknesses in five areas: poor pedagogy, incorrect definitions, scientific inaccuracies, inaccessible references and inappropriate internet resources. The OCS web site describes each of these issues in detail on its web site but some of the most important criticisms are as follows:

1. It fails as an effective learning model; instead of promoting critical thinking and analysis skills, the lesson presents students with scripted arguments and rote copying of incorrect definitions. Then it turns them loose on the Internet with no guidance to find their own reference material - the implication being that all web sites are equally honest and accurate.

2. It fails in its depiction of the methods of scientific enquiry and the terminology used by scientists. By imposing upon students' definitions of terms out of the creationist literature, the lesson creates the impression that any idea has scientific validity (regardless of the evidence to support it). The debate format of the lesson inaccurately depicts how scientists actually evaluate competing hypotheses.

3. It fails to depict scientific knowledge correctly. All of the "challenge" topics listed in the reference come from the creationist literature instead of the world of current Biological research. Indeed, one of the key sources of the lesson's content appears to be Rev. Jonathan Wells' book Icons of Evolution, a text recommended by the Discovery Institute as a "must read" for Intelligent Design advocates.

4. It fails to provide accessible source material to support the topics contained in the lesson. Recommended sources are either out of date, out of print, irrelevant to the topic, inaccurate in their content, or material written at a level of scientific complexity far above that which the average 10th Grader can be expected to understand.

5. It fails to recommend quality resources (books and web sites) that are available from reputable scientific and educational organizations. Instead it recommends that students explore creationist web sites for their information (misinformation?)

The OCS critique goes on to say:

> "The Lesson introduces classic Intelligent Design arguments into 10th grade science classes through scripted debates and references to intelligent design materials The Lesson suggests five "aspects" of evolution for debate. Four "aspects" correspond to chapters in *Icons of Evolution* by Jonathan Wells, a Senior Fellow of the Center for Science and Culture, a prominent self-proclaimed Intelligent Design think tank. University scientists, some members of the Ohio board of education and others note that the lesson contains only pseudo-scientific arguments. In spite of claims to the contrary, the lesson contains no data or experimental results. Half-truths (e.g. noting that no one has ever seen a bacterium become a chloroplast) are presented as "evidences" against the endo-symbiotic origin of cellular organelles. This same group argues that the lesson follows outdated pedagogical methodology (debates), rote copying of questionable definitions (*e.g.* an anomaly as an *idea* rather than an observation or datum, and a theory as "a supposition"). The Lesson's grading rubrics award points for courtesy during presentation but no points for scientific validity. The Lesson Plan contains numerous other errors. For example, a *Nature* reference included in the resources exists in title only on a Creationist Web site. A paper on lateral gene transfer was cited as a resource for the Fossil Record "aspect." Many citations are identical to those in *Icons of Evolution*, including outdated material that has been superseded by research in the last decade. Among "Technology connections" recommended by the Lesson Plan are a Creationist Website (www.origins.org), and an Intelligent Design Website (www.arn.org). On February 9, 2004, the Standards Committee of the Board removed *Icons of Evolution* from the Lesson Plan resources. Other Intelligent Design Creationism material was retained. The Committee did not delete material

> that depends on *Icons of Evolution*, thereby violating its own (parenthetic) prohibition against the teaching or testing of intelligent design."

Response to Criticism of the Lesson Plan; "There is no ID There"

At a 2004 meeting where L10H23 was approved, several board members said they believed "there is no ID [intelligent design] there". The State Superintendent of Education made similar statements. Several Key Board members including Deborah Owens-Fink and Michael Cochran have subsequently repeatedly insisted that there is no intelligent design in either H23 or L10H23.

Robert Lattimer of SEAO and the SAC has made similar statements:

> "The hysterical professors say the lesson in question promotes intelligent design (ID). How so? Has anyone read it? You wont find the word design or any hint of ID concepts like irreducible complexity and biological information. The alleged ID connection is nothing but a red herring that has no basis in fact." (Lattimer 2004)

On February 27, 2004, Richard Baker, vice-president of the Ohio Board of Education, had this to say about the scientific community's objections:

> "We spend all this malarkey and baloney when 99 percent of all the people who are taught this have nothing to do with the rest of their lives ... These scientists, they don't care about wasting their own time or anybody else's time. In business we don't waste time ... To me, [the lesson] is not a big deal." According to Baker, the reason scientists oppose the lesson plan is that "[They] think [they] know everything. [They're] just a bunch of paranoid, egotistical scientists afraid of people finding out [they] don't know anything." (From The Observer, the student newspaper of Case Western Reserve University).

In response to opponent's claims that there is in reality no significant criticism of the basic tenets of evolutionary theory by mainstream scientists, and no debate as to whether or not it has, in some form occurred, some board members and members of SEAO have insisted that there is a legitimate scientific debate. Board member Michael Cochran for example has said: "Well-credentialed scientists think it should be part of the debate" (Clines 2002). To support this claim, board members have cited the opinions of a tiny number of fringe scientists such as Michael Behe.

Problems Continue to Mount for L10H23

The lesson plan is opposed by The Ohio Academy of Science, who wrote an open letter to Ohio Governor Bob Taft arguing that:

> "The model science lesson (L10H23 'Critical Analysis of Evolution') is defective because it is not science and has no place

> in the science curriculum." Adoption of the lesson, according to the OAS, would "advance the 'wedge' strategy of the Intelligent Design movement whose purpose is to inject fundamentalist Christian beliefs into education," and damage Ohio's "Third Frontier" program to "attract and retain high-level researchers." The OAS letter criticized the "opaque" writing and review process for the lesson plan, noting that it took the OAS five weeks and legal action to obtain the text of the lesson, and also complained that of the 55 members of the advisory group and writing committee, only three were scientists, and two of these were creationists" (National Center for Science Education, 2004)

On December 20th a legal decision in Dover, Pa made it clear that it would be legally untenable for Ohio to include intelligent design in its curricula. Scharf (2006) has described the implications of this decision for Ohio in detail. He also describes the response of the members of OBE that support "critical analysis". Essentially it is their position that H23 and L10H23 do not include any intelligent design ideas and therefore the Ohio standards are unaffected by the Dover decision.

On February 3rd 2006, The Columbus Dispatch reported that Governor Taft was apparently starting to have misgivings about H23 and L10H23, as well as some of his appointments to the Ohio Board of Education (Niquette, 2006). The article makes it clear that Taft has been strongly influenced by the December 2005 ruling in Dover Pa, which found that "any attempt to teach intelligent design violated the first amendment ban on government endorsement of religion". In regard to the state standards, Taft said that:

> "……although he's convinced the state's 10th grade biology teaching standards do not include intelligent design, there should be a legal review of the companion lesson plan to ensure Ohio is not vulnerable to a lawsuit."

In regard to the membership of the Board of Education Taft said:

> "There were cases in which I didn't ask the right questions, in some cases where I supported someone for election or appointment, I'll be asking that question now, I can assure you."

On February 7th, 2006 the ODE Science Standards Advisory Committee sent an open letter to Governor Taft that voiced continuing concerns about L10H23 (ODE Science Standards Advisory Committee, 2006). Included in the letter were objections to the fact that evolution seems to be singled out for special "critical analysis" and objections to proponent's claim that "there is no ID there". The letter was signed by 24 of the 32 SAC members. With regard to content of the lesson, the letter reads in part:

> "[The lesson is] pointed attempt to insert old and discredited creationist content in Ohio's science classrooms. The pedagogy is weak at best, of

> negative, misleading and debilitating educational value. This lesson is devoid of scientific thinking or the scientific method. It is wholly without merit. And while the lesson's authors assiduously avoided using the words "intelligent" and "design," the lesson embodies intelligent design creationism poorly concealed in scientific sounding jargon. Such cheap ploys are a disservice to Ohio's children and an insult to the intelligence of its good citizens. Nonetheless, this lesson, along with the associated science indicator, has passed because of overwhelming support by your appointees to the Ohio Board of Education."

Educational Research involving "Critical Analysis" L10H23

An additional complicating factor is the fact that the primary author of this lesson plan has used it as the subject of graduate level research on the effect of "teaching the evolution controversy" to Ohio students. Subsequently, this research has been used as evidence to support the pedagogic value of "teaching the evolution controversy" in state hearings outside of Ohio. Again, scientists have called "foul" because they say that this graduate research is in fact not research at all, but is in reality a form of advocacy for a particular viewpoint. Paper two in this paper set discusses some of the implications for graduate level research in this field and examines issues of research ethics related to the teaching of controversial science in the classroom.

Withdrawal of the Lesson Plan and Grade-Level Indicator 23

On February 14th 2006, The Ohio Board of Education voted 11 to 4 to delete L10H23 and grade level indicator H23 from the IMS system. After the vote, Board of Education member Deborah Owens-Fink made her disappointment clear:

> "… the vote was just another round in the culture war, not a knockout. There are no permanent victories in politics, you do not get paradigm shifts overnight. Whether the ultimate victory is today or it's tomorrow or it's two years from now, people demand that they get open discussion of this issue" (Rudoren, 2006).

John G. West, associate director of the Discovery Institute's Center for Science and Culture said of the decision:

> "It's an outrageous slap in the face to the citizens of Ohio. The effort to try to suppress ideas that you dislike, to use the government to suppress ideas you dislike, has a failed history. Do they really want to be on the side of the people who didn't want to let John Scopes talk or who tried to censor Galileo?" (Kaufman 2006)

It remains unclear whether or not the irony in this statement was intentional, or whether it was intended as part of some broader public-relations strategy.

Following the February 14th decision, SEAO and various board members have continued to call for the reinstatement of the deleted items (Science Excellence for All Ohioans, 2006).

Survey methodology

Two online surveys were created to explore the reactions, responses and beliefs of Ohio teachers and scientists to H23 and L10H23. The surveys are available at:

Teachers: **https://www.ccms.osu.edu/evolution_study/teacher_survey.php**

Scientists: **https://www.ccms.osu.edu/evolution_study/scientist_survey.php**

The surveys are stored on a secure server equipped with Version 3 MD5 RSA encryption. The connection has high-grade encryption of AES-256 (256 bit). The security certificate is of the server-signed X.509 type. The processing ("posting") of the completed surveys is handled entirely on this server and the survey responses are stored on a MYSQL database also held only on this server.

The teacher survey consists of 35 primarily fixed response questions with participants responding on a 5 point likert scale. The sample population was a convenience sample of teacher volunteers contacted via email lists, listservers and requests to district science coordinators.

The scientist survey consisted of 10 open questions requiring short text answers. The sample population for this survey was a convenience sample of graduate students and faculty, primarily at The Ohio State University, contacted via listservers and department-wide announcements. Emphasis was placed on attempting to reach as many life science specialists as possible since we felt that these individuals would be the best qualified to evaluate the disputed lesson plan.

Collection of data for these surveys is ongoing.

Preliminary Findings of our Survey; What do Scientists and Teachers Think of "Critical Analysis" L10H23?

Data collection is ongoing, but initial responses from three standards-related questions on the teacher survey are as follows:

This standard encourages me to talk about ID in my classroom.

agree / strongly agree = 57% , disagree / strongly disagree = 25%

I believe this standard is informed by religious but not by scientific standpoint.

agree / strongly agree = 54% , disagree / strongly disagree = 14%

This lesson plan is compatible with established norms of scientific research and ethics.

agree / strongly agree = 11% , disagree / strongly disagree = 68%

n=28

This suggests that some significant proportion of Ohio teachers believe that H23 and L10H23 do in fact ask them to teach intelligent design inspired by religious motivations in their classroom. The indicator and the lesson, for some teachers at least, do appear to contradict the assertion that "there is no ID there". We can also see that some teachers believe that that L10H23 is not compatible with established norms of scientific research.

It is perhaps just as important to note that there are apparently other teachers who do NOT believe that the indicator or the lesson encourages them to teach ID.

The scientist survey was designed to solicit the response of professional scientists to the lesson plan L10H23. It was our hypothesis that most professional scientists would respond in very similar, possibly unanimous ways. The model answers supplied for the lesson's "definitions of terms" in particular struck us as differing so widely from what most scientists typically mean when they discuss the concept of a "scientific theory" that we expected to see very similar criticisms and comments submitted by most of our respondents. We also expected to see respondents use similar language and objections to those publicly available from the Ohio Citizens for Science web site. If respondents did indeed use similar language and cite similar concerns and objections, then this would seem to reinforce existing objections to the lesson plan and undermine the assertion of OBE members that there is a legitimate scientific debate about evolution within the mainstream scientific community. We decided to try not to coach or lead the respondents with any background information other than the lesson plan itself. Unfortunately, at the time of writing, our response rate has been extremely low, especially compared to the number of Ohio teachers how have responded. It could be that the issue of teaching evolution in Ohio schools is one that is simply not on the radar for many practicing research scientists.

Nonetheless, those responses that we received revealed that there are some common issues with the lesson plan that some scientists are likely to comment on.

Several respondents commented on the lesson plan's definition of "theory":

"The definition of a theory is actually the definition of a hypothesis. A common, although frustrating, error."

"The definitions I find not to be completely accurate, especially Theory, Natural Selection, Biological Evolution. It seems as if these definitions are being used to set up

the argument for the critical analysis; of evolution. The critical analysis definition I have no idea where they came up with it."

However, to our surprise, other respondents seemed a little more flexible:

"The terms seem accurately defined"

"Theory- OK. Critical analysis is incorrect- it is not about poking holes in everything, it is about using quantitative and reasoned analysis to determine whether a set of observations reflects the truth. If macroevolution and microevolution truly represent the same thing, then there is no need for separate definitions, as this suggest separate processes, which is simply not the case."

Another interesting set of responses came from the question: "What do you think are the explicit and implicit educational goals of the lesson's authors?" Some typical answers include:

"Explicit: teach critical analysis. Implicit: Question the theory of evolution"

"To get students to doubt a very well known and well supported scientific theory about a life process. By presenting this as a critical thinking and analysis exercise they cover up the fact that they really want this theory not to be upheld in the students eyes. They could have easily picked another scientific hypothesis to do this critical anlysis exercise on, but they didn't"

"The explicit goal is to try and negate evolutionary science with unreasoned argument. The implicit goal to teach creation science."

"Explicitly, the goals are to develop critical thinking while educating the students about various aspects of evolution. Implicitly, the goals seem to be to show weak points in the theory of evolution. This opens up the possibility that other theories, like Intelligent Design, may be credible."

But again, we have an unexpected answer too:

"The educational goals of the lesson's authors seems to give an understanding about the concepts of evolution and the scientific methods that scientist use build up and theory and justify or reject observations, this will help the young students to be able to think critically which is the basis of every scientific revolution and progress"

Overall, most of the participant's comments mirror those of OCS and suggest that some scientists react by immediately concluding that this lesson plan has an ulterior motive. However, it seems like even within the Ohio State scientific community there is no such thing as a unanimous opinion.

Epilogue

On February 13th 2006, one day before H23 and L10H23 were removed from the Ohio Standards, WIS10 news in Columbia, SC reported that:

> "The Education Oversight Committee voted to reject curriculum standards for high school biology that deal with teaching evolution." ……. "The school reform panel wants the Board of Education to rewrite a portion of the standards to encourage high school students to critically analyze evolution." (Mursch, 2006)

On March 8th 2006, The SC State Board of Education defeated this initiative by an 11-6 vote.

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