

FINDINGS FROM AN INDEPENDENT EVALUATION OF THE AMNH'S ONLINE SEMINARS ON SCIENCE COURSE: *EVOLUTION*

Inverness Research studied the AMNH Seminars on Science program for eight years, from its inception in 1998 to 2006. In 2008, Inverness Research conducted additional studies of the AMNH's new online course, *Evolution*. Below we present teacher survey ratings for *Evolution*, along with profiles of four teachers who took the course.

SURVEY RATINGS FOR *EVOLUTION*

Course takers report on our annual follow-up surveys that *Evolution* has benefited them personally and professionally, and that their students also profit. We present below a small sample of our findings based on the responses of the 56 learners from 19 states who have completed our follow-up survey about the quality and value of the course. The majority of survey takers (82%) are K-12 teachers, but informal science educators and preservice teachers have also provided feedback about how the courses have benefited them personally and as educators.

What do teachers gain for their own learning from *Evolution*?¹

- *"a bank of resources for my own learning"* (84%)
- *"additional background knowledge of science"* (79%)
- *"a deeper insight into the work of scientists"* (67%)
- *"motivation to continue learning about the course topics on my own"* (64%)

How do teachers apply the course directly to their classrooms?²

- *"I used what I learned to create a unit for my students"* (86%)
- *"I made some course resources available to my students"* (66%)

How does the course help strengthen teaching?

- *"It introduced me to new kinds of materials and media such as simulations and websites that I can use in science"* (78%)
- *"It provided me with hands-on inquiry learning experiences that can serve as a good model for the kind of work that I can have students do"* (65%)

¹ Unless noted otherwise, percentages represent teachers who marked 4 or 5 on a 5-point scale where 1 = Not at all, 3 = Somewhat, and 5 = A very great deal.

² For questions regarding student impacts, percentages represent teachers who checked "yes."

- *"I am better able to assist students in meeting our state or district standards" (44%)*

How do teachers say that this course helps their students?

- *"Students have better access to and knowledge of latest research" (70%)*
- *"Students now better appreciate the natural world" (69%)*
- *"The work of scientists is more understandable to students" (64%)*
- *"Students better connect science in school with the real world" (62%)*

How does the course compare with other professional learning opportunities?

- *"The course was more valuable than other professional development available to me locally" (86%)*
- *"The course is more valuable than other distance learning courses I have taken" (60%)*

Do teachers recommend the course?³

- *"I have recommended the course to colleagues" (68%)*

TEACHER PROFILES FOR EVOLUTION

On the pages below, we have profiles for the following four teachers:

A high school teacher who never took a college course in evolution finds that current information in evolutionary biology boosts her content knowledge, teaching practice and student test scores

A knowledgeable, experienced high school science teacher provides authentic science explorations for her honors students using content, activities, and strategies from this SoS course

A rural fifth grade teacher gains confidence and enhances her curriculum, including her prescribed reading and literacy program

An experienced, discerning teacher gains resources and inspiration to motivate her advanced high school students

³ Percentages represent teachers who checked "yes."

A high school teacher who never had a college course in evolution finds that current information in evolutionary biology boosts her content knowledge, teaching practice and student test scores

Susan Estes teaches high school Biology and Earth Science in a suburban high school in Virginia. Her school is quite diverse, with almost 40 countries represented. The students are mostly low SES, and many of them are English language learners or special education students.

Ms. Estes has been teaching for 20 years. She has a Bachelors degree in Biology, and has taken many courses and trainings since she earned her degree to keep her knowledge current. Over the last two years, Ms. Estes has taken three AMNH Seminars on Science. She enrolled in the Evolution course because:

The topic fascinated me and I never took a class in evolution in college. It was a chance to learn the material without having to enroll in a semester-long class... I would say that in terms of professional development, this is by far better than anything else I've had... I felt good about the fact that I understood it, and it's up-to-the-minute science.

Exploring and sharing current content and resources with students

Ms. Estes explored the many web-based resources referred to and recommended by the Evolution professors, both as an adult learner and with her students. Simply having access to current information in evolutionary biology, and to a variety of ways to share it with her students, was a great boost to Susan's teaching practice.

Until I took that class, I had never heard of a cladogram—which is the latest thing in discussing evolutionary relationships. I have used that, and have done clad activities in the classroom. We discuss evolutionary relationships using sites I was directed to during the Evolution class—for example UC Berkeley has an evolution outreach program. We did an activity that sent us to their website and I used that a lot. We had two computer-animated activities—I use them in my class too. I used them a lot—I can't imagine how I taught evolution before!

The students have to pass standards-based minimum competency exams. The kids said there were several questions on evolutionary relationships and cladograms, and they all were able to answer those questions

Sharing with colleagues: Helping her school meet science standards

Ms. Estes shared what she learned about cladograms with her fellow biology teachers, who were interested in how the activities would help them meet their Standards of Learning.

This course adds value to my existing, required curriculum. It has given me more background knowledge so I can answer questions, so that I can be creative in my lessons. The other teachers all wanted to know how I did [the cladogram activity]; they had never done it. I knew they would be well received, because it makes kids do better on the Standards of Learning—that is the bible; it's part of No Child

Left Behind. I shared my final project with the teacher who teaches AP biology. The clad activity I got in this seminar gives students the animals and the characteristics; you put them in order. I changed the activity so the students have to come up with their own animals and characteristics. They hypothesize what relationships they think would be there, and then go to websites to determine a clad and then compare theirs to the scientific ones.

Becoming more creative in her teaching

Ms. Estes has been inspired by the course to be more creative in her teaching, which she feels is reflected directly in her classroom.

We are not doing the same old thing, so it's more interesting for 15 year-olds. This course enhances your students' learning experience. We can learn the material in a more interesting manner. One of the things it has given me is not just personal knowledge but also places to get other activities. You learn how and where to look for other activities. Especially valuable are sites for high school students... And I did not know that AMNH has so many sites within their organization where my students can see pictures of animals in their collection; we discuss similarities and differences.

A knowledgeable, experienced high school science teacher provides authentic science explorations for her honors students using content, activities, and strategies from this SoS course

Paula Herbes teaches AP Biology, honors-level Genetics, and Environmental Science in a suburban high school in central New Jersey. Ms. Herbes' students are economically and ethnically diverse: the majority are first or second generation immigrants from China, India and Russia. Many of their parents have jobs related to science. She has been teaching for 29 years and has an MS in biological sciences, specializing in evolution and genetics.

Ms. Herbes has taken nine Seminars on Science, including the *Evolution* course. She took the *Evolution* course for the opportunity to communicate with educators around the US and to gain additional educational materials and ideas.

SoS course activities lead students to experience for themselves the complexity of a rigorous scientific exploration

Even though Ms. Herbes has extensive teaching experience and content knowledge—and her students are quite advanced in terms of science—*Evolution* added to her resources and strategies for deepening scientific thinking.

[In the past] students have had a difficult time expanding to ask further questions in an investigation, and were only using the data to draw conclusions. The "Flashy Fish" activity really drove home the idea of 'field research'—the importance of accurate data collection and analyzing the data given, which may then add more questions, then developing additional experiments, and so on. They couldn't just conclude from something that was tested once—they needed to go on and do new trials. Under different environments they got different

results; what might be an acceptable answer in one area may not be in another—it doesn't always happen the same way.

In Honors Genetics, change in genes is what it is all about! I teach selective pressures and the techniques to compare them—the phenetics versus cladistics [exercise] was excellent for this. The recommended book, The Beak of the Finch, is excellent Environmental Science, and the factors that drive evolution (geology, climate change) all apply here. I consistently incorporate biodiversity (at the molecular level, species level, and community level) in each unit that I teach: this course provided information at all levels—appropriate, scientific, applicable, and cutting edge technology.

The material, additional reading materials and the activities that we worked through in Evolution were very applicable to the level that I teach, and can be adapted both for lower levels and upper levels—they are very flexible. The sequence of topics was excellent, and the [assigned] reading materials were all appropriate.

Excellent professional development provides this highly experienced teacher a rigorous and challenging professional development experience

Ms. Herbes has participated in many professional development offerings, including everything from courses offered within the high school where she teaches, to attending courses at her local university, to participating in extensive, international research projects. She still feels that the AMNH Seminars on Science, and the Evolution course in particular, rates very favorably compared to those other opportunities.

Not only was the online experience convenient, it is so beneficial to be able to communicate with other members of the class, along with the scientists and instructors. The interactions were all positive and really drove us to do more of our own investigations that spring-boarded off the required material. It was distinctive in that Dr. Eldredge was so involved, supportive, and truly interested in the material and the participants! Steve Ryan and Lorraine Bertan were also very instrumental not only in their timely responses and feedback on the required assignments, but also in adding leading questions that drove me to read more and more... and more! I purchased the required texts and the recommended one, and went to all the links provided for the readings—you may say that sounds 'very nerdy'! But it really helped to expand my lessons in all three courses that I teach.

This SoS course fits in with and supports this teacher's overall philosophy of education

Ms. Herbes is clearly a self-motivated, enthusiastic learner who values life-long learning and takes advantages of many different opportunities to do so. The Evolution course not only enriched her repertoire of activities and strategies, but it also gave her more tools to “teach by doing.”

It has been part of my educational philosophy to 'teach by doing'—and to demonstrate to my students that it is important to be a life-long learner... to keep up with current research is so important to allow students to grasp two major

concepts: 1) that no one knows everything and it is okay to admit 'I'm not sure,' or 'we should research that question and find out what is known'; and 2) all answers are not known. That's what drives science: 'the elimination of possibilities' until the most reasonable explanation can be supported!

The time, money and resources that you accumulate [by investing in professional development] are all invaluable. Remember: no one can take away your education! Science is about exploration, debate, research, plausible explanations and excitement, and these are all part of the SOS experience.

A rural fifth grade teacher gains confidence and enhances her curriculum, including her prescribed reading and literacy program

Kathy Brown is an experienced middle school teacher who covers all subjects, including general science, with her 5th grade students. She teaches in an isolated, rural town in southeast Alaska. Her students include Tlingit natives, as well as increasing numbers of immigrants from Mexico and the Philippines.

Overcoming isolation and getting “really excellent education” through the AMNH

Ms. Brown has taken a range of on-line and university-based professional development courses. She has taken two Seminars on Science courses—first *Earth Inside and Out* and then *Evolution*.

She feels that the AMNH Seminars on Science are by far the best professional development opportunities she has. She enrolled in the *Evolution* course:

...because the Earth course was so fantastic! I knew the quality would be excellent and I wanted the content. I knew that the AMNH has good content and is well organized. I knew I would get quality stuff from them.

There isn't all that much professional development available to me. The university has some courses... and I can do distance education; in fact right now I am doing an online course [through another provider], but it is not quality oriented... The really excellent education is through AMNH! I had to work really hard. It was condensed into six weeks – there was so much reading and new information. I was tired from studying all the new ideas and concepts, but I loved the challenge... I came away saying 'aha!' I am always encouraging other teachers to sign up for them.

Deepening understanding of evolution by “doing what a scientist would do”

The opportunity to “do what a scientist would do” created a more authentic learning experience for Ms. Brown and greatly enhanced her understanding of evolution.

One of the things that stands out is that we actually analyzed lineage—the evolutionary strand. We did what the scientists do—go into the actual NIH website and paste in the DNA strand, and then, say 'I want to compare where different animals are and how they are related on a tree.' You copy the actual DNA strand and then you click a button and then it draws the common ancestors.

This helped me to see that is how they figure this stuff out! I had the general idea—but once I took the course, I understand better how things are connected and I have the language to explain this to my students... I am more factually correct; I have a better sense of things and more confidence [in my own knowledge].

Accessing high quality books and web links to improve science instruction

Ms. Brown's school, like many schools across the country, has responded to No Child Left Behind legislation by implementing a standardized reading program. Her school's program, which she describes as "kind of canned," does provide ample time for the students to explore non-fiction topics. She saw an opportunity to introduce the topic of evolution through this new reading program.

I ended up purchasing a bunch of picture books on evolution [referred from the SoS resources]. I had them in the reading area. When working with small groups, I can pick up the books and explain evolution to them. I found it interesting that some of the other kids were curious about what their peers were learning... My students will have more accurate information and a more accurate picture of the world. I will also use some of the links in the SoS course, for example, UC Berkeley has a fabulous website directed at kids. Those are incorporated into the lesson plans I did.

We are supposed to be teaching the standards but now we are still behind the 8-ball. We went ahead with language implementation; science has fallen way behind. So having this experience will beef that up and allow me to give better science instruction.

Help in teaching evolution in an inhospitable environment

Several of the high school science teachers in Ms. Brown's district are creationists. She feels that the online discussions about evolution help her prepare her students to question misconceptions about evolution that they may encounter.

I find the fact that some science teachers believe in creationism totally shocking. I feel that it is more on my shoulders to make sure my students are getting the real story before they get to those high school classes, so they can have more educated conversations... This issue was discussed in online chats in the seminar, which were heated sometimes! That was one of the most controversial discussions, and it was a great conversation.

An experienced, discerning teacher gains resources and inspiration to motivate her advanced high school students

Coleen Weiss-Magasic teaches high school courses in Biology, Anatomy, Bioethical Issues and Microbiology. In alternating years she also teaches AP Biology. Her school is located in the rural town of West Milford, New Jersey. She describes the community as "90% Caucasian, mostly blue- and white-collar workers." She has been teaching for 18 years, and has a Masters degree in biology.

Ms. Weiss-Magasic has taken seven SoS courses, including Evolution. *“I was skeptical of online courses, but I have learned a lot [in the SoS courses]...”* She enrolled in the Evolution course because *“... I think it’s a fascinating topic. It amazes me that we are having the same argument [about evolution] as we were 200 years ago, and I wanted to learn about current thinking... I have been teaching too long to do it just for the sake of money; I am only inspired when the course interests me.”*

Participating in a rigorous, professional online community

Ms. Weiss-Magasic was particularly impressed with the level of dialogue and the complexity of the topics and discussions on the forums:

I got a lot out of the professional interaction with my peers—all interactions have been very pleasant even if people weren’t in agreement. It was an educated level of conversation but not in an arrogant way. We talked about a different way to classify organisms, both from science and teaching perspectives. We were thinking about the paradigm shift we might have to deal with: what might this mean in the classroom and all of the ramifications in terms of reclassification of endangered species. We moved through and thought further about it—it really pushed your thinking.

Deepening her own knowledge base about evolution

This teacher was also impressed by the content knowledge that she gained in the Evolution course, and she wants to share that with her students:

I didn’t realize that deciding a species was such a big issue. Some piece of it is DNA but some is looking at more data—being able to look at the whole picture and put that together... I think this course provided me with a stronger and more varied knowledge base about evolution, as well as informing me as a teacher.

Enhancing her teaching: motivating her students, enriching her curriculum, and bringing scientists to life

Ms. Weiss-Magasic carefully chooses professional development that feeds her personal interests in science—such as her interest in evolution—and therefore helps her to motivate her students:

When I was young I was so curious, and I don’t see that as much in kids today. We haven’t even scratched the surface [of understanding evolution]. I want them to love it.

This course provided more information than others she has taken in both content and activities to enhance the content:

Evolution is a basic, overriding theme in biology. This is a good resource to have available to teachers. I have taken other online courses but I like the combination of pure science content along with the activities [for students]. It’s a good balance.

Ms. Weiss-Magasic has also been inspired to share the “human-ness of science” with her students. She wants them to know that scientists who have made great discoveries and contributions are regular people – like the students themselves:

I loved the Meet the Relative activity... I also did the Darwin one. I am trying to portray him as an individual, for example the work he did when he got home made him queasy. I want students to understand that Darwin wasn't born thinking he was going to have a great discovery.