FINDINGS FROM AN INDEPENDENT EVALUATION OF THE AMNH's ONLINE SEMINARS ON SCIENCE COURSE: *SHARKS AND RAYS*

Inverness Research studied the AMNH Seminars on Science program for eight years, from its inception in 1998 to 2006. Below we present teacher survey ratings for *Sharks and Rays*, along with profiles of three teachers who took the course.

SURVEY RATINGS FOR *SHARKS AND RAYS*

We have less data on the quality and value of ***Sharks and Rays*** than on other AMNH courses, because it was one of the last courses created. Fifteen course takers from nine states who responded to our annual follow-up survey had taken *Sharks and Rays*.

These course takers report that the course has benefited them personally and professionally, and that their students also profit. Based on course taker reviews to date, it is one of the highest ranked courses for the extent to which it piques student curiosity about the course topics. We present below a small sample of our findings for the course. The majority of survey takers (80%) are K-12 teachers, but several informal science educators and preservice teachers also provided feedback about how the courses have benefited them personally and as educators.

What do teachers gain for their own learning from Sharks and Rays?[1]

- *"additional background knowledge of science" (87%)*
- *"a bank of resources for my own learning" (80%)*
- *"a deeper insight into the work of scientists" (67%)*
- *"motivation to continue learning about the course topics on my own" (67%)*

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

- *"I used what I learned to create a unit for my students" (69%)*
- *"I made some course resources available to my students" (69%)*

How does the course help strengthen teaching?

- *"It helped me to learn a new content area that I may teach in the future" (92%)*
- *"It provided a bank of resources that I can share with my students" (77%)*

[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."

- *"It provided me with hands-on inquiry learning experiences that can serve as a good model for the kind of work I can have students do" (64%)*

- *"I am better able to assist students in meeting our state or district standards" (50%)*

How do teachers say that this course helps their students?

- *"Students now better appreciate the natural world" (83%)*

- *"Students' curiosity about the course topics is piqued" (75%)*

- *"Students better connect science in school with the real world" (67%)*

- *"It helps students better understand the work of scientists" (67%)*

- *"Students have better access to and knowledge of latest research" (50%)*

How does the course compare with other professional learning opportunities?

- *"The course was more valuable than other professional development available to me locally" (83%)*

- *"The course is more valuable than other distance learning courses I have taken" (75%)*

Do teachers recommend the course?[3]

- *"I have recommended the course to colleagues" (69 %)*

TEACHER PROFILES FOR *SHARKS AND RAYS*

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

The Sharks and Rays course helps a high school biology teacher in Florida enrich his courses with new content and more engaging activities

From *Jaws* to dichotomous keys: A New York high school teacher experiences in-depth learning and gains a new classroom tool

A Los Angeles high school teacher gains new insight into diversity and the fossil record in the *Sharks and Rays* course

[3] Percentages represent teachers who checked "yes."

The Sharks and Rays course helps a high school biology teacher in Florida enrich his courses with new content and more engaging activities

Mr. Fritz teaches Anatomy and Physiology and Integrated Sciences to 10th through 12th grades in a small city on the east coast of Florida. Before he began teaching seven years ago, Mr. Fritz was the director of an aquatic toxicology lab. He decided to enroll in the SoS online course, *Sharks and Rays*, in Summer 2004 because he needed a few more hours to graduate with his masters from the University of Florida. He had been taking online graduate courses and had "pretty much run out of science courses" and found the SoS courses to be an opportunity to take a "real science class."

Discovering little known facts about sharks to share with students. During the course, Mr. Fritz not only developed a better understanding of some of the genetic and evolutionary relationships between the sharks, rays and skates but he discovered some little known facts about sharks as well.

> *I was doing some research for a paper [for the online course] and I found [in the journal Nature] that some researchers identified cells in the snouts of sharks that can detect temperature changes, to one thousandth of a degree Celsius. They have known about the electrical sense, but they didn't know about the temperature sense… They don't really know why sharks are able to do this.*

> *I also discovered that Hammerhead sharks snack on stingrays. I didn't know that. I always figured they were big fish eaters. They go sneaking along, head down to eat, over the sand, like a pogo stick. Then they just inhale stingrays right out of the dirt.*

Mr. Fritz shares these anecdotal stories with his students and finds that these kinds of stories enliven his teaching and engage the students.

Gaining a new teaching tool: A classroom debate about osteichthyes and chondrichthyes. As his final project for the SoS course, Mr. Fritz designed a curriculum unit for his Integrated Sciences course. In this unit the students work in teams to debate whether sharks, for example, have more economic, environmental or research value than tuna. Each team gets points for style, creativity, organization, and content.

> *The objective is that students understand some of the form and the function of the different kinds of fish, and the related environmental concepts, commercial fishing strategies, and resource management issue. They have to tie all of those ideas together and provide proof that the species they have chosen is more valuable to humans.*

Mr. Fritz finds that the students enjoy the debate format much more than writing a research report and he feels they are covering the same topics just as thoroughly.

> *Generally, they like any time they have a chance to argue. They are usually learning something they didn't understand before, and it is new and it is unique and they can get loud in the classroom and that is what they are supposed to do. They work together and they can be real animated.*

Learning online instead of wasting time. Mr. Fritz has taken a number of other online courses and has often found that the instructors assigned busy work. In contrast, the assignments for the SoS course helped him to learn.

> *I just thought that the assignments that they gave were more meaningful. I felt like when I was working on something, I was accomplishing something and learning, instead of just being busy.*

He also appreciated that the course covered a lot of information about the different organisms, not just about their biological functions, but also about their economic value. Mr. Fritz summarized the SoS course by saying:

> *You'd have to have your eyes closed not to have something to take back to the classroom.*

From *Jaws* to dichotomous keys—a New York high school teacher experiences in-depth learning and gains a new classroom tool

We spoke with a teacher who teaches 9th grade Biology and 12th grade Forensics on the east end of Long Island, New York. She teaches in a multicultural and economically diverse district that encompasses both rural and more developed communities. The teacher was a forensics scientist in the area of toxicology for thirteen years and made the switch to teaching seven years ago. She enrolled in the SoS online course, *Sharks and Rays*, in Summer 2004, because she felt she could apply the information about classification in her classroom.

Knowledgeable scientists provide personal feedback and an in-depth learning experience. Even three years after taking the course, this teacher is still talking about how knowledgeable the professors were and, as a result, how much she learned.

> *I learned a lot that I had no idea about. I think I walked into the course not even knowing really much about sharks, except from 'Jaws'. Seriously, I remember learning a lot about sharks and shark characteristics and classification.*

The teacher described two additional characteristics that made this course stand out from other courses: Personal feedback and in-depth learning through conversations with the professors and other students.

> *The scientists involved in it were so knowledgeable and the feedback was so personal, as opposed to some online courses that I've taken, where the responses are kind of generic responses. [In the SoS course] when I gave a response, each of the scientists who were involved responded to exactly what I said and I liked that about it, because it wasn't like you were left spinning your wheels or going through the motions.*

> *It is more in-depth than a lot of other courses which kind of stay at the surface. They give you an assignment to do and then they ask specific questions about it. You answer the questions, but then they respond to your answers and they ask you*

another question, "Well what did you think about this?" So you are forced to go a little deeper. It is this line of questioning and the responses of the other students—even though it is online, it is like having a conversation.

A new teaching tool: A dichotomous key for identifying shark species. In the New York State biology curriculum students learn how to use a dichotomous key. As part of her final project for the SoS course, this teacher developed a dichotomous key for identifying 20 different species of sharks.

Before, I did it with pine trees. There is more variety with sharks. I couldn't find 20 different pine leaves. Instead I used drawings of 20 different sharks. [When the students use the key they look at a drawing] and if the shark has a particular characteristic, then they go to line 'A', for example, and if it doesn't match they go to another line. At the end of the laboratory by following these steps, they should be able to name all 20 sharks, using the scientific name, genus and species.

The teacher finds that the students enjoy the challenge of identifying the 20 shark species, and says they compare it to solving a crossword puzzle.

A Los Angeles high school teacher gains new insight into diversity and the fossil record in the *Sharks and Rays* course

Ms. Morris is a high school teacher in Los Angeles. She teaches Biology and AP Biology at a Title I school with 65% Latino and 35% African-American students. She has been teaching for seven years. She enrolled in the SoS online course, *Sharks and Rays*, in Summer 2004 because she wanted to take a class about sharks and get professional development credits in the process. She was a biology major and had thoroughly studied invertebrates but had never studied sharks.

Gaining confidence teaching shark anatomy. This year, Ms. Morris' students wanted to do a comparative anatomy study between shark specimens and another species, such as cats, for the science fair. Because of her experience in the SoS course she felt comfortable helping them with this topic.

I was able to help them with the anatomy and some of the evolutionary history of sharks. I don't think I would have been able to do without the course.

As part of this process she shared a demonstration from the SoS course with her students.

[During the course] the professor was at different sites and he would do demonstrations. The best one was when he put the liver [in water]. I never knew the shark liver floated, that is their buoyancy system. I thought that was really interesting. He put a cow liver and a shark liver in water and the shark liver floated.

Ms. Morris had her students work in groups to test this phenomenon and the students were as excited as she was to learn about the buoyancy system of the shark.

Learning about shark fossils and evolution: Enriching dialogue with her students. When Ms. Morris was talking with her class about fossils and evolution, she wove in many examples from the SoS online course.

> *When we talk about evolution and fossils, why are we finding so many shark teeth, but we don't find complete specimens? [This leads to the discussion] in the fossilization process, what can fossilize and what doesn't? Sharks don't really get fossilized, which is something I hadn't thought about. I had always seen sharks teeth, but through the course we had a whole week where we talked about shark fossils. When you do find a complete specimen, it is such a big deal, because cartilage doesn't fossilize very well.*

During the course, Ms. Morris learned that animals don't necessarily have to look alike in order to be related—as in the case of sharks and rays. This is another example she brings to her students to help them understand the complexities of evolution and to broaden their conversation.

> *The students love the tidbits. Kids are always interested in sharks and they want to know more information about sharks and they ask a lot of questions. We kind of go off on tangents sometimes and that is fine, that is part of learning.*