

FINDINGS FROM AN INDEPENDENT EVALUATION OF THE AMNH's ONLINE SEMINARS ON SCIENCE COURSE: *CLIMATE CHANGE*

Inverness Research studied the AMNH Seminars on Science (SoS) program in depth for eight years, from its inception in 1998 to 2006. Since then Inverness has continued to evaluate newly developed courses. In 2012, Inverness Research evaluated the AMNH's newest online course, **Climate Change**. Below we present teacher survey ratings for *Climate Change*, along with profiles of five teachers who took the course.

SURVEY RATINGS FOR *CLIMATE CHANGE*

Course takers report on our follow-up survey that **Climate Change** 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 64 learners from 18 states who completed our follow-up survey about the quality and value of the course. A large majority of survey takers (86%) are K-12 teachers, but preservice teachers and college instructors have also provided feedback about how the course has benefited them personally and as educators. Nearly half of the survey takers (44%) took the course in part because of prior positive experience with AMNH's SoS courses.

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

- *"additional background knowledge of science" (84%)*
- *"a bank of resources for my own learning" (78%)*
- *"motivation to continue learning about the course topics on my own" (70%)*
- *"a deeper insight into the work of scientists" (69%)*

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

- *"I used what I learned to create a unit for my students" (72%)*
- *"I made some course resources available to my students" (47%)*
- *"I have been able to teach new topics this year" [i.e., within the first three months of the school year] (28%)*

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."

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” (64%)*
- *“It helped me to learn a new content area that I may teach in the future” (55%)*
- *“It made me feel more confident teaching science (53%)*
- *“I am better able to assist students in meeting our state or district standards” (39%)*

How do teachers say that this course helps their students?

- *“Students better connect science in school with the real world” (59%)*
- *“The work of scientists is more understandable to students” (58%)*
- *“Students are more curious about the course topic(s)” (51%)*
- *“Students’ access to and knowledge of latest research on the course topics has increased” (45%)*

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” (56%)*

Do teachers recommend the course?³

- *“I have recommended the course to colleagues“ (54%)*
- *“I have shared the materials and resources with colleagues” (53%)*

³ Percentages represent teachers who checked “yes.”

TEACHER PROFILES FOR *CLIMATE CHANGE*

Two teachers working towards certification in Earth Science bring new knowledge, resources and strategies to their high school science courses

A community college teacher brings home the reality of climate change

A strong science teacher refreshes her knowledge and brings cutting edge content to her rural high school dual enrollment Meteorology course

A Marine Biology teacher helps her students explore climate change through the lens of the marine world

Two teachers working towards certification in Earth Science bring new knowledge, resources and strategies to their high school science courses

We spoke with two high school science teachers in rural New York state who took the Climate Change course in the spring of 2012 as part of obtaining their Earth Science certification. One teacher has a background in science, the other a background in music. They both teach earth science courses; one teaches environmental science as well, and the other teaches biology. Between the two of them they have taken 9 AMNH courses to fulfill their Earth Science certification requirements. One of them reported:

It allowed me to get my certification a lot quicker than I ever thought I would have been able to.

From diagrams to computer models—new resources for teaching

The computer model offered in the Climate Change course was one of both teachers' favorite course elements:

You download this computer model... it gives you certain data to plug in and you can put it in different parameters, and [you run the simulation and] come up with different maps that would illustrate areas where climate has increased or decreased.

One of the teachers found a similar, though simplified simulation to use in his class. He used it to illustrate a concept he was exposed to in the SoS course—that there are so many different climate factors interacting at all times that it is difficult to predict what is actually going to happen:

I actually was able to find a pretty cool simulation of the greenhouse effect where the kids can manipulate the amount of greenhouse gases and stuff to see how it affects temperature. They can add other factors like clouds and snow cover, which was similar to what we did in class but just way, way simpler. So I think

that is really an effective tool for them to be able to sort of see directly how the impacts work.

The other teacher has used several diagrams from the Climate Change course in her classes to replace her 'old, very cartoonish diagrams.' One diagram she uses frequently is a diagram of the carbon cycle that includes a clear picture of the role of the ocean:

I also have used the carbon cycle diagram that they gave us. I never really talked before in my classes about all of the carbon that is located in the ocean and I just kind of left that out because it was always difficult for them to see, but with this diagram, it really shows how it moves back and forth.

She has also, for the first time, incorporated several scientific articles into her teaching to address the new literacy requirements for science. These are articles she herself read for the Climate Change course:

I never incorporated the literacy aspects of it before. I never had the articles... I found that several of the articles from the class itself were written in such a way that it wasn't so far above my students' head that they would be able to get the main ideas... The kids enjoyed the articles because they don't always see scholarly articles; a lot of times they will read something from our local newspaper, but that doesn't necessarily make it a scholarly article and so they feel like that I am trusting them with these scholarly articles.

Inquiry labs - new strategies for teaching

Both teachers were also encouraged by the Climate Change course providers to develop inquiry-based units to use in their classes. As a result they've added "inquiry labs." One lab has the students construct an environment and manipulate variables like temperature, light and moisture, and the other has students research alternative energy sources and design a plan to reduce their town's dependence on fossil fuels. One teacher commented that her changed approach better prepares her students to think for themselves and has helped them realize that the issue of climate change does pertain to them:

Well, before I didn't really do any inquiry with the climate aspect. 'Here it is, here is what is in the news and this is what you need to know, let's move on.' Now we spend a good amount of time on it and I let the kids come to me with their questions, and it is more about what they know and how to work with what they know and develop what they know into how they can have an intelligent conversation with somebody else about this hot-button issue that we are dealing with every single day.

A community college teacher brings home the reality of climate change

Elaine Fagner teaches Physical Geology, Historical Geology, Earth Science and Environmental Science to freshmen and sophomores at a community college in Waco, Texas. Many of her students receive financial aid and are older students who are working and/or have families. Elaine's background is in geology and earth science. Prior to teaching, she worked in watershed management and regulatory agencies for 10 years, including a River and Water Authority where climate change, and in particular global warming, was a focus of the work. She decided to take the Climate Change course to further her understanding while getting credit for moving up her pay scale.

An extraordinary learning experience

I wanted the full scope of understanding how climate change works so I had accurate information and better quality information that I could provide students... It was a perfect match to what I did, so my supervisors agreed to give it a shot and see what the classes were like... I have to tell you what—that course rock-and-rolled in terms of content! The actual instructor and the course scientist that came in and out of the course were exceptionally good at dialogue in their discussions⁴, which is where I gathered most of my information.

Based on her “extraordinary experience” of taking the Climate Change course, she has taken 7 other AMNH courses since the fall of 2011 and has encouraged others in her department to sign up for the courses as well. Of all the courses, she found the Climate Change course is the one she uses most.

The climate change story is a direct story that goes in tune with what happened in the geological past through various global warmings and coolings. I have used some of the content from Climate Change in my [other] courses [Physical Geology, Historical Geology and Earth Science] as well.

Revising an existing course based on new knowledge and resources

I have totally done an overhaul of what was offered in Environmental Science based on my experience in the course.

There are two main differences in Elaine's Environmental Science course now. First, because taking the course helped her to deeply understand how and why

⁴ The teacher is referring to the on-line asynchronous discussions that occur during the AMNH SOS courses.

regulations such as the Clean Air and Water Act are in place, she now makes a clear case to her students for why it is important that they understand the purpose of these environmental regulations.

It made me more aware of how and why regulations are in place to protect the environment and why I needed to start paying attention to certain entities. I can name one that we learned a lot about, which was the Intergovernmental Panel on Climate Change, which I had written off as hokey. It has completely changed my whole view to actually read the documents, to look at some of the videos that are out there that they come out with every 2 years. I have incorporated information about that into courses to share that with students.

Secondly, her course now incorporates many concrete examples, videos and models from the Climate Change course to help her students understand the issues and concepts of climate change. For example, she shows them a video about the Paleocene-Eocene thermal maximum (PETM):

There is a PETM video that the museum put together that is like 10 or 12 minutes long, but it is an exceptional look at how organisms shrank during this time of global warming—dramatically, they got real tiny.

She also has the students use the modeling software she used in the Climate Change course to manipulate multiple variables, such as parts per million of carbon dioxide, and see the predicted impact of these changes on the earth's climate and environment.

Bringing home the reality of climate change

Elaine says that by the end of the unit, the students have a deep understanding of climate change and the reality of its impending impact on their lives. For many, this is a depressing realization, but Elaine hopes that the impact of this knowledge will encourage them to make different choices, if not for themselves, for the generations ahead.

It is depressing; they come out and they are depressed by the time they have gone through, like there is no hope. I say 'actually maybe not in our lifetime, and maybe not in ten generations, but every opportunity we take to reduce [consumption] shortens the length of rebound time for the earth' and so you are realizing that it is for humankind. It is not just for our current kind, it is long term for hominids.

A strong science teacher refreshes her knowledge and brings cutting edge content to her rural high school dual enrollment Meteorology course

Andrea Lord teaches 9th grade Earth Science and a dual credit Meteorology course for seniors in a rural county high school in Virginia. The high school has a mix of students from different racial backgrounds and socioeconomic status. Many of the local industries have shut down and a large percentage of families are on public assistance. The local medical industry is thriving, however, and there are also students from doctors' families at the school.

Increasing knowledge and competence

Andrea has been teaching science for 28 years and has a strong science background, with a BS in Geology, a MS in Science and Environmental Education and another MS in Computer Technology education. Even so, when she was given the chance to teach a new dual enrollment meteorology course, for which her students get college credit, she enrolled in the Climate Change course because she hadn't studied meteorology or climate change for "quite awhile" and wanted to feel "competent talking about climate change." Andrea described how just taking this one course increased her knowledge and understanding of the concepts and issues:

I think that for somebody that is currently teaching, and teaching those concepts, that needs a refresher, it is really good... It enabled me to really know more current information and talk with authority about things that are more current, rather than relying on information that I kind of just have been using... since the late 90's.

Stimulating rich conversations

The district administration paid for her course. One of her colleagues, who was unable to take the course, read the course text along with Andrea, stimulating many rich discussions between the two teachers. The course has also stimulated rich conversations between Andrea and her Meteorology students. Her experience with the Climate Change course enables her to draw connections and guide student thinking in a way she was not able to do before:

We have a unit on air pollution...we will just be sitting there chatting...about what makes the clouds and condensation nuclei and all of a sudden, it just slides there. They ask me a question. The course made me feel more confident to be able to throw those things out there.

Encouraging students to do research and draw their own conclusions

When Andrea signed up for the course, her intention was to augment her “very old textbook” with current information gained from the Climate Change course by giving updated lectures to her students. Her experience with the Climate Change course caused her to take a different approach. As part of the course, she was required to evaluate the current climate change data and draw her own conclusions:

I realized what I was getting from evaluating the data myself, rather than having someone just tell me and lecture to me ‘this is what the situation is now’... It made me re-evaluate a lot of thoughts that I had on the topic itself and really look at the research I was seeing... it made me really stop and think about if I was evaluating things in an unbiased manner. [For example] I looked at the whole idea about the melting of the ice caps and...the changes in the ocean temperature and acidity... I think it [climate change] is more serious than I had given it credit for.

She wanted to give her students this powerful experience and decided to have them do similar work. She gave them the assignment to research climate change, summarize what they had discovered, update their text’s information, and then take a stand on what they thought about climate change:

I asked them to take a stand on what they felt about climate change—is it happening, is it positive, is it negative, is it man caused—just a range of what they really thought and to support that with evidence from their research.

Andrea said that most of her students begin class thinking that global warming is not really an issue, and by the end after doing their own research most believe it is happening and humans play a role.

A Marine Biology teacher helps her students explore climate change through the lens of the marine world

We spoke with a teacher who teaches 9th grade Biology and 10-12th grade Marine Biology at a high school in Massachusetts. She has a degree in Marine Biology and still conducts fieldwork for a local aquarium. She has been teaching for four years and took the Climate Change course in Fall 2011, thinking she could gain some material to weave into her courses while earning needed credit towards her teaching certificate.

I am really interested in climate change, and I would like to bring it a lot more into my classes.

Making the topic of climate change more accessible by enriching class lectures

The teacher's school is large and diverse, with many students speaking English as a second language. The language barrier often makes science a struggle for these students. In order to make the topic of climate change more accessible to them, she designed a week and a half unit that used corals to illustrate the impact of global warming and ocean acidification. This unit includes lectures and an inquiry lab. She drew from the books used in the Climate Change course and her course notes to compose her lectures.

In the book there were some sections that had corals in them and so I pulled those sections out, to give [my students] more facts about it.

Giving students the opportunity to design their own experiments

In the corals unit, after introductory lectures and discussions, the teacher pairs up the students and provides them with a variety of household products. Each pair has to set up and run an experiment for demonstrating how long their chosen product takes to dissolve coral samples. Students make hypotheses based on what they learn about ocean acidification and coral reefs from the earlier lectures. This unit was the first lab for which she gave her students a lab assignment without also giving them the procedure to follow. The Climate Change course inspired the teacher to design it this way so that her students could learn how to 'work things out on their own.'

They liked it, but I feel like the struggle wasn't [about] getting the results, it was more thinking 'how we can do this?' They are used to, 'this is what I have to do, step by step', whereas here, I just gave them material and said you got it, now go with it. I think that is something that they need to learn how to do, and that it can become frustrating when you don't get the results that you want. I don't think they understand that. As a scientist, we try things, and then we do them again if it doesn't work out.

The teacher is still working to develop the course and hopes to continue to have her students learn how to do their own research while learning about how climate change affects different aspects of the marine world.