

**Evaluation of AMNH Science Bulletin “Evolution in Action”
The Trilingual (English, French, Spanish) Version**
<http://sciencebulletins.amnh.org/>),

Central Africa's roiling, rapid Lower Congo River is one of the most biologically diverse rivers in the world. More than 320 fish species call it home, and about 90 of these live nowhere else. Ichthyologists from the American Museum of Natural History are working with geographers and hydrologists to explain how this extraordinary species richness came to be. Using the latest genetic methods and hydrological equipment, the team is exploring how regions of whitewater have acted as a barrier to fish movement over tens of thousands of years, thus allowing species to diverge. The results could overturn long-held assumptions about how fish evolve and demonstrate how high-resolution mapping can aid the study of freshwater communities worldwide.



Dr. Stiasny collecting fishes in the Gabon. ©AMNH

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Background:

Science Bulletins are HD media that are on display at the American Museum of Natural History, distributed to informal science institutions across the country (the *Science Bulletins* is currently distributed ~40 institutions, with a potential audience of ~10 million) and distributed on a free Web site for general public audiences (<http://sciencebulletins.amnh.org/>), where they are supplemented by related resources and links, as well as by standards-based educational materials to support their use in middle and high school classrooms. The *Science Bulletins* website offers the same programming formatted for the web with additional online resources and learning activities for 6th through 12th grade students and their teachers. The website had a measured audience of over 250,000 unique visitors last year, and has been enjoying a growth rate of ~70% a year over the prior two years.

This evaluation focuses on the impact one specific science bulletin developed and made available in English, French, and Spanish. The American Museum of Natural History developed the Science Bulletin, "Evolution in Action" as a media-based scientific resource designed to disseminate scientific research through a compelling research story currently taking place in Central Africa Lower Congo River. The general educational goal of Science Bulletins is to present science research to the public by introducing the research in context. Stories feature scientists in different parts of the world, working in teams, asking questions, and showing the tools, fascination, and challenges of the scientific research endeavor. Viewers, such as educators, students, and museum or web visitors may use them for personal, academic, or professional understanding of current science research in many countries.

"Evolution in Action" also had an additional broader impact goal: reaching audiences who spoke French or Spanish by producing captioned versions in all three languages. French was important for reaching francophone audiences around the world and in particular, the communities in the Central African region of the Lower Congo River where the research is taking place and for the benefit of their educational and scientific knowledge of their own river. Spanish was chosen because it is the second largest language spoken in the

metropolitan areas in the United States and third around the globe. In addition, these versions were developed in DVD format because from prior experience locally and internationally we had learned that having only web-based versions did not offer appropriate educational access in communities or schools where technology was not so readily available. For the evaluation, DVDs of the trilingual version were used and other resources from the web version, such as glossary and synopsis were printed and used.

The Evaluation Goals:

There were three overarching goals and questions that framed the evaluation:

- 1) Connection and Interest in the science content: Do viewers connect with or become interested in the scientific aspects of the research story?
- 2) Connections between the scientific story and other topics of personal interest: Do viewers who are not necessarily focused on science reveal additional interest in science and in what scientists do?
- 3) Implications of the multilingual versions for disseminating science to the public and to science educators: Do viewers who are either interested or professionally (science teachers) working within multilingual contexts find value in this resource? And do they have any suggestions for the production, use, or distribution of trilingual versions?

Methods and Protocols

Evaluator (Macdonald) designed the protocols using mixed methods that included surveys, questionnaires, assignments, multiple viewings, and focus groups. Participants were educators enrolled in two different museum-based courses for educators over the 2010 academic semester. Altman and Groome participated in data collection and coding of responses.

The samples

We identified thirty-three (33) educators who would have reasons for using or recommending such a resource and who could provide informed ideas for how it may be used by may best serve the public and students or teachers in a variety of contexts. Both groups were graduate students in two different museum-based courses taught at the museum by the evaluator. The largest group consisted of 25 international education students enrolled in an elective museum-based course (spring 2010) designed to teach the research

and applications of Informal Education in general education contexts. They worked in schools, museums, media, universities, and bilingual programs in a variety of contexts in and outside the United States. The linguistic make up of this group was vast and their interest in participating in the review and assessment of "Evolution in Action" seemed very interesting to them personally and professionally. There were eight science teachers (8) US born and monolingual English speakers. Six (six) bilingual (French and English) curriculum writers born in the US and Canada and raised in different parts of the world. There were four (4) Asian born, who spoke more than one of their native Asian languages and were fluent readers of English while not confident of their spoken English yet. They had been educated either in mainland China or Singapore and were in the US obtaining advanced degrees to develop multilingual programs upon return to their countries. Two (2) were native francophone speakers, a Canadian and a Moroccan getting degrees in international comparative education; and five native Spanish speakers who were bilingual (Spanish-English) working in a variety of bilingual, immersion, or dual language programs in New York City. This group evaluated the resource as a whole group using the methods attached in Appendix A (Methods and protocols) on a Saturday class session (March 28, 1210) at AMNH.

The second group consisted of eight (8) English-only Science teachers participating in a required course on the use of Museum Resources for Teaching Science in Secondary Schools in NY City (Winter 2009). They were all beginning teachers in their second year of teaching and their assignment was to field-test the use of the DVD's Spanish version with their own students. They would focus on the students' discussions and conversations to assess their interest in the content, the scientists, the language usage, the technology, or reveal any prior knowledge about their own backgrounds or experiences. Both groups were introduced to the evaluation by reviewing the printed glossary of terms posted on the web version and the following synopsis introduction also from the from the Web-based Science Bulletin site.

Central Africa's roiling, rapid Lower Congo River is one of the most biologically diverse rivers in the world. More than 320 fish species call it home, and about 90 of these live nowhere else. Ichthyologists from the American Museum of Natural History are working with geographers and hydrologists to explain how this extraordinary species richness came to be.

Using the latest genetic methods and hydrological equipment, the team is exploring how regions of whitewater have acted as a barrier to fish movement over tens of thousands of years, thus allowing species to diverge. The results could overturn long-held assumptions about how fish evolve and demonstrate how high-resolution mapping can aid the study of freshwater communities worldwide.

Summary of Findings and Recommendations

There were very different impressions, findings, applications, and recommendations made by each of the two groups. This diversity also allowed analyzing the implications for each of the three questions more broadly. In short, the resource is an excellent view into how science happens and interested all groups. One group in particular had questions they would like to ask the scientists and this is a very good indicator of interest in the topic, the scientists, their tools, questions, and locations. In our report we refer to the larger group as the international group and the second group as the Science teachers.

I. Interest in the science content: Do viewers connect with or become interested in the scientific aspects of the research story?

Both groups provided high percentages (94%) of responses that indicated their specific reactions and interests in the content. Specifically they refer to the process of speciation, the ongoing process of evolution, evolutionary trees, and how scientists do their work. This generalized interest in content makes the DVD a very useful resource for public interest and for teaching biological evolution. The following statements from the international group which included 70% non-science teachers reflect interest in the content. In the teachers responses, the content and concepts are made more explicit.

"It is extremely interesting and demonstrates how evolution is something that occurs all the time in the natural world"

"How the water hydraulics can actually affect speciation"

"The two species being collected and looking the same but having a different genes"

"The footage of each stage"

"The DNA part"

"To learn that the river topology explains the evolution of fish species"

"Fascinating observing the work of the scientists."

"Why the fish changes in the ways that they do"

"Relationship between the tree of speciation and depths of rivers"

"Exactly why the fish are so different on either side of the river"

"How the water hydraulics can actually affect speciation"

"The two species being collected and looking the same but having different "how the water hydraulics can actually affect speciation"

"The two species being collected and looking the same but having different genes."

Science teachers responding on their use of the DVD with their students reflected on two aspects: its use for supporting their own understanding of the content and on the students' reactions and discussions when they were able to see the captions in their own language. The quality of student conversations, are also indicators of their interest, comprehension, and references to prior knowledge or to experiences with other Science Bulletins stories presented by teachers.

"I liked that the kids saw both male and female scientists and that the scientist was talking in French to the people from Africa"

"Showing how evolution works in my classroom is impossible, We only have resources to do paper labs. These scientists are showing them exactly how it works and what tools you need to do this work. Not paper."

" We used the glossary before I showed them the film and asked if they knew the terms. I was surprised when they said there were several terms very similar to Spanish. Like, adaptation, species, evolution, hydrology, and geographic. I congratulated them and told them to teach me when they found those types of words. I am not sure they know the meaning. I would like to have the glossary in Spanish too."

" I was able to better understand how to use the trees and relations that I had seen in class when we did observations in Hall of Ocean Life."

"Seeing the research process was amazing (students don't tend to get this in the classroom w/cookbook labs)"

" My students in seven grade study earth science. They like to talk about rivers because everyone knows of a river somewhere. I also showed them the DVD of the Bronx River and they made connections with this DVD. Several said they swim in rivers when they go to Dominican Republic or Costa Rica to see grandparents at Christmas. It is warm there at Christmas."

" I would like to learn how to do labs where we study the morphology and genetics of different types of fishes to teach them about species".

"I teach some of these ideas in the Hall of Ocean Life but it is only one trip a year. Now I can find more DVDs on evolution of fishes to use before coming to the museum."

"Several girls in my class said they want to know more about woman scientists. They asked if I have a film of a Hispanic scientist. I told them I knew one of them - Dr. Aquino who is one of my teachers. They want to meet Dr. Aquino. I showed them her picture on the website of the Museum online course".

In addition, in teachers' comments about the students' conversations, teachers also revealed newly discovered aspects of their students' prior experiences with rivers or weather in other parts of the world. Reflect on their own content knowledge; and of the compounded limitations in reaching ELL students. In addition to language differences they suffer from the lack of instructional materials for teaching science typical of many urban high need schools.

II. Connections between the scientific story and other topics of personal interest: Do viewers who are not necessarily focused on science reveal additional interest in science and in what scientists do?

The international group with few science teachers expressed interest in the river or geographical areas as seen in the video. Interest and connections with the content and with the work of scientists is revealed in the questions they would like to ask the scientists. These include curiosity about Science as a profession, the tools they use, and the decisions they make about what to study, where, and why. The science teachers had very different responses.

"I am interested in what this could mean for other areas and what applications it could have" (#8)

"Seeing the river at work"

"How scientists explain their work"

"Seeing the rapids..."

"The river scenes"

"How did they make the velocity of water appear in the computer"

"Around how many species of fishes are living in this place?"

"How did they name the different kinds of fish species?"

"I would ask them some about the methodology"

"How did you find out about this in the first place? How did you learn that might happen?"

"How did they transform their findings to the exhibitions in AMNH?"

"How does some of the equipment work?"

"How does the river topography change? Is it all water flow/hydrological or is there a subterranean influence as well?"

"How did you get into this field?"

"How do they decide what to study and how to study it?"

"Do you know what indigenous knowledge has to do with your study?"

"I would ask them if it would be possible to send some type of camera into the canyon to do more research."

Science teachers (from both groups) responded with more focus on what they could do with this type of resource or how they may share it with others. They specifically addresses the required content to teach the Living Environment Regents level lessons in the curriculum goals for 9th grade in NY State. They also make recommendations about maintaining all three languages on the web and in public spaces, and possibly develop the glossaries in the three languages as well.

"From this video can stem conversations about many different topics."

"I would like to pass this DVD onto the Living Environment teacher I work with since he teaches his students about evolution and biodiversity."

"Yes, I think kids would really enjoy seeing a short film like this as a complement to education about genetics and makes it much more comprehensible and applicable to the students in this context."

"Definitely. It breaks down the issue of speciation into an accessible topic and the visuals provide an easy entry point."

"Share it with colleagues because it is not cool enough to show friends."

"Yes, this is a fascinating phenomenon and also interesting since I have some ties to the region."

"I showed them this DVD after they had seen the one in English about the Bronx River. They said that the Bronx River was easy to understand because they know the area, the people look like them, and there was not a lot of gear and computers that did things they don't understand. Maybe we need some examples of bilingual DVDs that are local and still show stories of science using the equipment we will never see in our classrooms."

"I lent my copy of the DVD to a student that wanted to show it to his dad because he had been a fisherman in Dominican Republic before they moved here. I hope they made this stories in countries more familiar to the students in the city"

"Other teachers in my school can use this DVD in Spanish and also in French. They have students from Haiti and others from Africa whose native language is French or Creole.

"Kids could be asked if they think they understand the basic ideas, then be shown this DVD and asked to relate to what they know → their answers could tell if they really get it.

"I will look into the web version too. I think it's a great resource for teaching and for my own personal understanding of the subject"

In general science teachers' responses showed more urgency. They depend on visuals for teaching specific concepts that are hard to teach without resources. They revealed a desire for more exemplars of this type of visual, Short, scientifically engaging, multilingual, and possibly more close to home - that they can use with students and recommend to colleagues.

III. Implications of the multilingual version for disseminating science to the public and to science educators: Do viewers who are either personally curious or professionally (science teachers) working within multilingual contexts find value in this resource? And do they have any suggestions for the production, use, or distribution of trilingual versions?

The educators in the international group offered the most relevant suggestions and recommendations for application now and in the future. They addressed three topics: the importance of having multilingual and international resources to create a n more informed understanding of what scientists study around the globe; the value of having the web resources (synopsis and glossary) also available in the same foreign languages as the DVDs; and suggestions about production. The science educators reiterated

the importance of visuals that would serve to scaffold understanding of difficult concepts and made suggestions based on their usage with students.

"I don't speak/read Spanish but when subtitles were white on light colors, it was very difficult to read" (#9)

"Broaden our knowledge of about what is happening in different parts of the world"

"Info about speciation in other parts of the world or at other points in history"

"Readings and other online resources also with graphical organizers"

"Glossary in Spanish and English (plus French) in a grid."

"More info or links to the geography, history, population or conditions of the area"

"Subtitles in other languages"

"Korean (please!) I was always wondering why there aren't enough Korean language versions of these resources where this is a high Korean population in NY."

Computer diagram about the whirlpool to use as a supplement for deeper learning. Just talking about it was kind of difficult to understand for students."

"a unit on the terminology"

"it talks about an area of the world which many people around here are not familiar with"

Responses from Science teachers were almost similar to the second questions in their urgency and need of this type of resource for their own content learning as well as for their students. More visualization of science research in context and with scientists rather than just processes, to scaffold the process of research and the concepts they teach.

"I have to use all the DVDs in biology, physics and earth science. I teach 8th grade three science subjects (bio, Earth, and physical science) and I am certified for chemistry only. I make more connections with biodiversity and physics but I know I need to learn more. I am very grateful for these resources:"

"I will use the web in particular if some of the glossary and synopsis is also in Spanish or French. I am always in need for scaffolding content knowledge. Visuals, objects, word banks, everything. But a real short visual story is just great. I also use the other DVDs for "do now" and we begin each class with a Science Bulletin. Others in ecology, I used Acid

Oceans and we made tanks of fresh and salty water to do some simple experiments in class. They said, this science is it really like cooking."

"We had a discussion about using subtitles in Spanish at the same time they hear the English. Some students wanted to hear it in Spanish, Others said; it would be like the stupid movies where you can tell that people's mouths are not moving right for what they are saying. It was a fun discussion and they shared a lot of insight about the living in two languages, Yes, "like your ears are for English and your eyes for Spanish".

Final commentary

Based on the responses and reactions to the DVD, its content, format, and application - we found that the trilingual access offered in "Evolution in Action" provided many opportunities for people who are not necessarily science educators to engage, show interest, and recommend improvements. In addition, for those who are science educators teaching students who speak other languages, it was a treasured resource that supported educators' learning about students and teaching them science. They learned about their students' prior experiences with linguistic understandings, geographical knowledge, and awareness of the bilingual learning processes, and unknown interest in the science and the work of scientists.

The challenge of making these resources is the dissemination to more needed areas. If AMNH continues to produce multilingual DVDs perhaps a set can be put together along with the glossaries and synopsis in the various languages. This approach may serve two purposes: facilitate and scaffold the scientific concepts for those learning the content in a new language and for English speakers who are becoming more interested in multilingual expertise to know and study science in other parts of the world.

In addition, it appears that these the multilingual resources would be valued by adults and students who are not necessarily focused on science. Perhaps those who are studying world languages because of personal, academic, or professional endeavors as revealed by the international educators interested in developing multilingual skills in their countries.

The final recommendation based on the evaluators' experiences with these two groups of educators is to continue the development of Science Bulletins in general and in multilingual versions in particular. Science teachers have identified the English versions of science bulletins as the best resource to

reveal the work of scientists to their students, and the *Educators Guides* are most useful resource to prepare students to learn in the museum. Now, with the knowledge gained through this evaluation, we believe that the multilingual versions will be used more for three different purposes: to expand the notion of how to scaffold science for ELL students through visual resources; to highlight geopolitical dimensions of science research and teaching; and to discuss English Language Arts skills connected to the “multilingual glossaries” mentioned by many of the participants.

Appendix A

Methods and tasks for International Group:

1. Pre-viewing review of Science Bulletin synopsis introduction and glossary as posted on the web. Additional terminology related to multilingualism were also added to the glossary to determine familiarity with either science or with international and multilingual education perspectives. Prior to viewing, participants identified familiar and unfamiliar terms and it helped code their responses according to content, geographic concerns or interests, visual input, or linguistic interests.
2. All participants viewed the DVD twice. First viewing completely in English with no second language captions and followed by post-viewing questionnaire. Second viewing with Spanish or French captions and followed by survey.
3. Evaluator held a fifteen-minute focus group to examine the different impressions by members of the group and their ideas for use of the “captioned” DVD in various contexts.

Methods and Tasks for Science Teachers’ Group:

Assignment to a subgroup (8) of the total 27 course participants. The eight educators teach ELL or bilingual Spanish-English students. They were asked to select time of their own choosing to show the DVD twice: first time with Spanish subtitles and the second time with English subtitles. This strategy provides the teachers (English speakers only) with a longer period to hold discussions and conversation in whatever level of English they students could communicate. Teachers took note of the content of the conversations and comments made by students. They classified the conversations of comments into three categories: about the content, about themselves, about the language.. Finally they had an interview/ conversation with the evaluator/instructor to surface the salient topics of conversation in relation to what teachers had learned about their students, their ability to understand the concepts when there was a visual resources, and to reiterate the strategies recommended for teaching and scaffolding science for ELL students.

Analysis of findings

Evaluator reviewed all data collected through the above methods ad protocols and created categories relevant to the three research questions. Recommendations are based on the goals of science bulletins and on skills for scaffolding science in ELL contexts another time with English narrative and subtitles. These two showing would give teachers opportunity to have more discussions with students about the content and the languages. In addition they would take note of the topics of.

Evaluation Protocols: “Evolution in Action” Trilingual DVD

Part I: Please read the following synopsis of the DVD and the related glossary to answer the related questions posed prior to viewing the DVD.

Synopsis Introduction: Central Africa's roiling, rapid Lower Congo River is one of the most biologically diverse rivers in the world. More than 320 fish species call it home, and about 90 of these live nowhere else. Ichthyologists from the American Museum of Natural History are working with geographers and hydrologists to explain how this extraordinary species richness came to be. Using the latest genetic methods and hydrological equipment, the team is exploring how regions of whitewater have acted as a barrier to fish movement over tens of thousands of years, thus allowing species to diverge. The results could overturn long-held assumptions about how fish evolve and demonstrate how high-resolution mapping can aid the study of freshwater communities worldwide.

EVOLUTION IN ACTION - GLOSSARY

Please review these English terms and indicate if they are familiar (F) or new (N) to you.

acoustic Doppler current profiler	F	N
adaptation	F	N
biodiversity	F	N
DNA (deoxyribonucleic acid)	F	N
echo sounder	F	N
endemic	F	N
evolution	F	N
genetics	F	N
geographic isolation (allopatry)	F	N
global positioning system (GPS).	F	N
habitat	F	N
hydrology	F	N
morphology	F	N
nucleotide	F	N
population	F	N
speciation	F	N
species	F	N
monolingual program	F	N
bilingual program	F	N
dual language program	F	N
English language immersion program	F	N
ELL Student	F	N
TESOL teacher	F	N
ESL instruction	F	N

PART 2

Please answer the following five questions based on the introduction and glossary.

1. What do you think this DVD is about? And why do you think so?

2. What language(s) do you speak, read, and write? And how did you learn them?

3. When you watch foreign films do you prefer them with subtitles or dubbed? Why?

4. Do you use more than one language in your daily life? With family and friends? Please explain.

5. Do you use or would like to be able to use more than one language in your work as an educator? And or do you work with students who are learning English as a second language or who are learning content in more than one language, such as dual language or bilingual language development programs. Do you plan to teach or develop programs with multilingual components? Please explain with some detail the context for your answer.

6. Please check one self-descriptor in each of the following categories:
 - a. Male or Female
 - b. Educator for more than five years ;or Less that five years
 - c. English is my first language; or English is not my 1st language.
 - d. Im in Masters Program at TC; or I am in doctoral program
 - e. Im under 30 years of age; 30-40; or 40-50

Part 3: Post English-only viewing questionnaire

1. What was more interesting to you about this Science Bulletin and why?
2. Why are these scientists so interested in this topic?
3. If you were to meet these scientists what would you like to ask them?
4. Would you choose to show the DVD to friends or other colleagues in education?
Why?
5. If you reviewed “Journey to the Stars” in a language different than English, what is your opinion about the different multilingual formats used in the two resources?
6. The Internet version of “Evolution in Action” includes essays, resources for teaching, definitions to the glossary terms, and other related links. Would you explore those after having seen this DVD? Why?

Part 4 – Post viewing of DVD with foreign language captions in “Spanish”

- f. My favorite part of the DVD was _____
- g. The most familiar part was _____
- h. The most interesting part was _____
- i. The most difficult to understand was _____
- j. Something totally new I learned was _____
- k. I would show this DVD to friends because _____
- l. I wouldn't show it to friends because _____
- m. The most beautiful part for me was _____
- n. I thought the captions in “Spanish” were _____
- o. I would like to watch it again because _____
- p. I would use It for teaching about _____
- q. I would complement it use by adding _____

These are my general comments and recommendations about how “the foreign language captioned” DVD may be useful to teachers of different science subjects, careers, technology, geography, media studies or other subjects.