A SPECTACULAR FIND: TEACHER GUIDE

Subject: Earth Science
Grade Level: Middle School
Last Updated: November 3, 2008

Case Summary

A mysterious find in a province of Southwestern China may shake up everything we know about ancient human life! A group of Chinese paleontologists has discovered an ancient human skull in proximity to a dinosaur fossil, prompting some in the public to ask if dinosaurs and humans coexisted. To prepare for their upcoming CNN interview, the scientists need to get their data in order and decide whether or not the two specimens are from the same time period.

Credits

This case was written by Bethany L. Turner (PhD candidate, Anthropology, Emory University, Atlanta, GA) and Katherine K. Shamsid-Deen (teacher, Columbia Middle School, Decatur, GA), fellows of the Emory University PRISM program (http://www.prism.emory.edu). Authors may be contacted at blturne@learnlink.emory.edu

Learning Objectives

At the end of the case, students will be able to:

1. Examine and interpret primary data, examining the validity of their own and others' interpretations and formulating a scientific argument.
2. Describe the principles of uniformitarianism and relate them to stratigraphic layering and geological age.
3. Distinguish relative from absolute dating.
4. Describe the process of radioactive decay and how it permits radiocarbon dating and potassium-argon dating of fossil material.
5. Describe the process of radioactive decay and radioisotope dating.
6. Construct stratigraphic models showing how fossils of different ages can be near each other but in different stratigraphic layers.
7. Differentiate between different rock types found in stratigraphic profiles and how they typically form.

Georgia Performance Standards

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. (NSES Content Standard A)

S6E5. Students will investigate the scientific view of how the Earth's surface is formed. (NSES Content Standard D)

c. Describe processes that change rocks and the surface of the Earth

f. Describe how fossils show evidence of the changing surface and climate of the Earth

g. Describe soil as consisting of weathered rocks and decomposed organic material.

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Assessment

At the end of the case, students will pass in their box charts, which will be graded based on completeness and clarity. Even though we go over these periodically in class, knowing that they will be passing the box charts in encourages students to listen and efficiently take notes.

For their final assessment, the students created informative posters in which to summarize and present "the doctors'" findings. We used butcher-block paper cut from large rolls. On these posters students argued against the idea that humans and dinosaurs coexisted. They supported their arguments with interpretations of a "radioisotope laboratory report" handout (included with Scene 2) and a completed stratigraphic map handout (also included with Scene 2), as well as written summaries of when dinosaurs vs. humans first evolved and in the case of the former, when they went extinct. They describe the different rock types in the strata at the site and discuss how it is that two layers from vastly different time periods could both be represented at the surface.

In addition, the students participated in an outdoor "dig," which was constructed by the facilitators with the invaluable help of the school's groundskeeper. A patch roughly 3ft. by 9ft. was cleared of sod, and a grid was constructed using white string tied to extra-large nails that were nailed into the dirt, creating eight squares of equal size. Marbles, toy cars and other small baubles were buried under different rock types, which were purchased in bags at a local lawn & garden and scattered around the "site." The grid was then covered over with the sod clumps, and the next day, students were given spoons, small trowels and instructed to properly excavate two or three grids in small groups, using the techniques they learned about in their case research.

Overall grading for the case is based on their combined grades for their box charts and products. Grading will be based on a 5-point scale (5=excellent, 4=very good, 3=good, 2=fair, 1=poor) that will be converted into a percentage and from there into total points depending on the weight of the assignment, for each of three criteria:

- Accuracy and depth of product components; attention to grammar and mechanics
- Individual contribution/participation within the team
- Individual research ability and effort – online, print, investigative questioning

The second and third criteria (participation, individual effort) will be judged not only by facilitator observations, but by student evaluations to be completed at the end of the case (See **Self-Evaluation Worksheet** in Student Materials).

Implementation Strategy

This case is designed to take place over six 90-minute class sessions, wrapping up during the first 15-20 minutes of the seventh class. It has two scripted scenes, the second of which includes two handouts. This case can be facilitated by two facilitators or even a single teacher, because rather than placing a facilitator with every group, the students spend time brainstorming with their group and then as a whole class.

Students read, discussed and took notes in their groups in 10 minute blocks (totaling about 25 minutes per scene), then reconvening as a whole class to volunteer their observations, questions, hypotheses and learning issues (learning issues are things that students say they need to know or look up to define unknown terms, answer their questions, and/or test their hypotheses) at the end of every 10-minute block. During this group brainstorming, the teacher/facilitators floated from group to group, checking progress and helping students with any stumbling blocks they may have had. During the whole-class volunteering time, the teacher/one of the facilitators took notes on an overhead or with a Smart Board. In this way, students learned to work as a team while still benefiting from sharing their information as a whole class or even competing with other groups for volunteering, while the teacher made sure that all students were at the same point in the case at each step.

Implementation Schedule

Day 1 (90 minutes total)
- Read Scene 1; complete box charts; share and discuss as a class (30 minutes/lunch/40 minutes)
- Divide Scene 1 Learning Issues; Begin in-class research (10 minutes), finish for homework
- Homework: Research Scene 1 Learning Issues

Day 2 (90 minutes total)
- Share Learning Issues research from weekend homework; catch-up
- Read Scene 2; Complete box charts

Day 3 (90 minutes total)
- Share and discuss Scene 2 box charts
- Divide Scene 2 learning issues; Research learning issues (30 minutes/lunch/60 minutes)
- Homework: Finish researching learning issues

Day 4 (90 minutes total)

Guest speaker - Dr. John Kingston, Emory University: Dr. Kingston is a paleoanthropologist who discussed his research in east Africa and hominin evolution in general, then answered students' questions. (Note: the current scientific literature refers to ancestral human species as both hominids and hominins, though hominin is becoming the more common usage.)

Day 5 (90 minutes total)

Activity – The mock archaeological dig; students properly uncover, describe, measure and take the mass of each "artifact" that they find, as well as a representative sample of each rock type in their grid (90 minutes).

Day 6 (90 minutes total)
- In groups, work on poster, dividing up tasks depending on student interests & strengths.
- Homework: Finish individual poster component(s)

Day 7 (20 minutes total)
- Finish poster, pass in
- Case evaluation; wrap-up

Case Notes

What Went Well

1. The topic: Students really enjoyed the dinosaur and palontology aspects of the storyline, and the fact that it took place in China made it interesting as well (K.S-D. traveled to China in Summer 2005 with a Fund For Teachers grant (www.fundforteachers.org) and has infused much of the curriculum with what she experienced and learned about in China).
2. The webpage: The resources listed on our webpage were very helpful in guiding student research and provided interesting and user-friendly information (**Resources** for a complete web resource listing). This helped students engage in free-form research while still providing the necessary structure to help them do so in a timely fashion.
3. The dig: Students had a great time on their mock dig, and they learned about rudimentary archaeological techniques, that contrary to popular movies, archaeology typically involves a lot of careful digging, tedious note-taking, meticulous measurements and detailed drawings. There were nevertheless a lot of smiles and excitement.
4. The guest speaker: Dr. Kingston's talk was a complete success. He understood his audience well and brought with him an LCD projector and laptop so that he could give a slideshow with satellite images of Africa, photos of his field sites, and artistic depictions of ancient hominins. He included up-to-date information, including the latest finds in Africa and Indonesia, and brought high-quality casts of famous hominin skulls. When he concluded his talk and asked if there were any questions, almost half of the hands shot up and Dr. Kingston spent the next 30 minutes answering enthusiastic and *extremely* insightful questions from the students. Before he left, he even posed for pictures with students, each of them holding different hominin casts. Anyone implementing this case would benefit from researching local universities and contacting individuals with a research background in geology, paleontology, anthropology or evolutionary biology to see if they would be willing to fill this role.
5. Content Breadth: We saw a real opportunity with this case to interface with life science concepts, specifically human evolution and organismic evolution over large periods of time. In addition to earth science objectives, the students therefore learned topics in an interdisciplinary framework, and will hopefully see the links between earth and life science.

What Could Have Gone Better

1. Time management: Because of the depth and breadth of this case, it tends to take up more class time than our other cases. However, since the case went so successfully, and the students seemed to learn such a great deal, that we consider it worth the class time. With so much testing and random field trips, assemblies and other interruptions to normal class schedules, however, this could be a potential issue to watch out for.

Issues of Evolution in the Classroom

Since this case was implemented in both sixth and eighth grade classes, we had the opportunity to see the different modes of engagement with the material, specifically

learning issues such as "when did humans evolve?" and "when did dinosaurs evolve?" While the 6th graders raised no concerns whatsoever with evolution versus creationism or theories of intelligent design, the 8th graders raised those concerns almost immediately. We took this as an opportunity to address the issue as a whole class for about five minutes, in which we explained to the students that their concerns that this contradicted what they learned in church or at home was perfectly valid and understandable. We emphasized that science as a paradigm has nothing to say about religious beliefs, because the scientific method does not include any aspects of faith or belief. However, just as they would not expect to be taught evolution at church, they should not expect to bring religious belief to their science class. As a take-home message, we reminded them that they need not change their beliefs or feel that they're being told that those beliefs are wrong, and that they are free to make up their own minds about evolution *once they have learned about it in an objective and open way*. Following this discussion, even the most vocal of the students had no problem proceeding through the case, and researched topics in hominin and dinosaur evolution with no reluctance or protest.

Facilitator Guide:

Facilitator Scenes with Key Concepts Underlined:

Scene 1

Dr. Li Wong sat back in the dirt, his eyes wide with disbelief, and yelled, "Dr. Chen, come over here and see this, you're not going to believe what I've found!"

Dr. Jin-Mai Chen got up from her field desk and walked across the site towards where Dr. Wong had been carefully brushing away dirt for the last two hours. She and Dr. Wong were paleontologists from the University of Bejing, and had been excavating this site in the Chongqing Province for more than a month. They were both hoping to find some dinosaurs, since there had been some interesting finds in the area before. She had to walk carefully as she crossed the site, because they had built a grid system out of string throughout the site in order to map the areas that they were excavating. Finally, she got over to where Dr. Wong sat. She crouched down and looked at where Dr. Wong had been brushing away the dirt.

Her eyes widened in surprise and she gasped, saying "Dr. Wong, is that what I think it is?"

Dr. Wong nodded and said, "It's a Sauropod, probably a *Mamenxi*, and very well preserved. But there's more. Do you see what's right over there?" He pointed to an object that was in an excavation square roughly twenty feet away. Dr. Chen walked over to the object and stopped in her tracks.

She looked back at Dr. Wong and said, "This is a *Homo sapiens*! It would have to be from the Late Pleistocene or Early Recent period, judging by the stone tools that are lying next to it. These are two major finds! I'm going to go email the university and tell everyone!"

Scene 2

A reporter called out, "Dr. Chen, is it true that you and Dr. Wong have discovered a human body near a dinosaur fossil in Chongqing Province?"

Another reporter yelled, "Does this mean that humans and dinosaurs coexisted?"

Yet another reporter asked, "Does this refute all of the earlier theories about when dinosaurs and humans lived on the earth?"

Dr. Wong and Dr. Chen looked at each other and sighed. Ever since the University of Bejing had announced their finds, the two paleontologists had become like celebrities. Reporters were everywhere, asking them all sorts of questions, while the newspapers and magazines were full of stories about the dinosaur and human found so close together.

Dr. Chen spoke up so that everyone could hear her, and said, "Dr. Wong and I will be presenting our findings on a CNN network special in a few days. There, we will answer all of your questions and more. Until then, we will be analyzing the data that we gathered, including radiocarbon dates, potassium argon dates, stratigraphic maps and our maps of the site so we can be prepared for our CNN appearance. Thank you."

Dr. Wong leaned over and whispered in her ear, "We've got a lot of work to do. We should get back to the paleontology lab right away!"

Faciliator Box Charts With Key Concepts/Issues Included:

Scene 1 Facilitator Box Chart

Facts	Questions
1. Drs. Chen and Wong are paleontologists	1. How do paleontologists excavate a site?
2. They are excavating in Chongqing Province	2. Where is the Chongqing Province?
3. Dr. Wong is surprised	3. Why is Dr. Wong surprised?
4. There is a grid on the site	4. What is a grid, and why is it there?
5. Dr. Wong had been carefully brushing dirt away for the past two hours	5. Why was Dr. Wong taking so long to brush the dirt away?
6. They had been excavating for dinosaurs for about a month	
7. There had been some interesting finds in the region before	6. What had the other interesting finds been?
8. Dr. Chen called Dr. Wong's find a Sauropod	7. What is a Sauropod? What is a Mamenxi?
9. The Sauropod is probably a Mamenxi	8. What is a Homo sapiens?
10. Dr. Wong also found a Homo sapiens	9. When was the Late Pleistocene?
11. Dr. Chen thinks that the Homo sapiens is from the Late Pleistocene or Early Recent Period	10. When was the Early Recent Period? 11. What are stone tools? What kind are they?
12. There are stone tools next to the Homo sapiens	12. Why are these finds so important?

Hypotheses	Learning Issues
1. A Homo sapiens is a human being	1. Paleontology methods
2. A sauropod is a dinosaur	2. Chongqing Province
3. If 1 and 2 are correct, then this means that dinosaurs and humans were around at the same time	3. What is a Sauropod, a Mamenxi
	4. What is a Homo sapiens
	5. Stone tools
	6. Late Pleistocene, Early Recent Period

Scene 2 Facilitator Box Chart

Facts	Questions
1. A reporter is asking Dr. Chen and Dr. Wong question	1. Why are there so many reporters?
2. The reporter is asking if dinosaurs and humans coexisted	2. What does coexisted mean?
3. Another reporter is asking if this find refutes earlier theories about when dinosaurs and humans lived	3. What does refutes mean?
	4. When did dinosaurs and humans live?
4. The University of Beijing had announced their finds	5. What is CNN?
5. Dr. Wong and Dr. Chen are like celebrities	6. What is radiocarbon? Potassium-argon?
6. Dr. Chen says that she and Dr. Wong will be presenting their findings on CNN	7. What are stratigraphic maps?
	8. Why do they have a lot of work to do?
7. They will include radiocarbon, potassium-argon data, stratigraphic maps and site maps in their presentation	9. What goes on in a palontology lab?
	10. Where is the University of Beijing?
8. They have a lot of work to do and need to get back to the paleontology lab right away	

Hypotheses	Learning Issues
1. Dinosaurs and humans coexisted	1. What is CNN

2. Dinosaurs and humans did not coexist	2. Definitions of Coexisted, Refutes
3. Beijing is in China	3. When humans first evolved
4. Radiocarbon is a dating technique	4. When dinosaurs lived
5. Stratigraphic has something to do with layers	5. What are Stratigraphic maps
	6. What is Radiocarbon, Potassium-argon
	7. Location of the University of Beijing
	8. What happens in a Paleontology Lab

Resources

We found that assembling the most useful of the following online sources as links on a website that the students can access in the computer lab or at home is a very efficient way to structure group or independent research. Also, the students should be encouraged to utilize their textbooks or other resources. These are some helpful resources; a selection of these was included on the "A Spectacular Find" page of the PRISM website under 6th grade Cases (www.prism.emory.edu/columbia).

Xinhua News Agency (March 18, 2004) Paleolithic stone tools unearthed in Chongqing. Retrieved October 31, 2008 from http://www.china.org.cn/english/culture/90651.htm

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