

THE SKULL IN THE ROCK

HOW A SCIENTIST, A BOY, AND GOOGLE EARTH
OPENED A NEW WINDOW ON HUMAN ORIGINS

By Lee R. Berger and Marc Aronson

NATIONAL GEOGRAPHIC TEACHER'S GUIDE

Contains
Common
Core
Standards



“Sometimes it is hardest to see the things that are right before your eyes.” (From *The Skull in the Rock*)

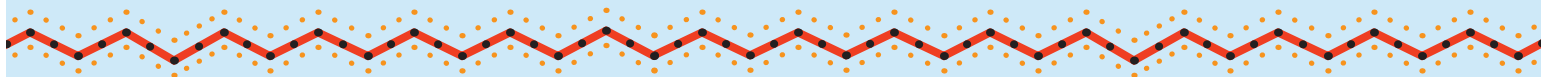
Over the course of the last year, many major scientific publications—including *Scientific American*, *Science*, and *Nature*—underscored the importance of a recent fossil finding by featuring *Australopithecus sediba*—the new species of hominin that Professor Lee Berger and his son discovered in South Africa. The fossils of an eleven-year-old boy and adult female are the two most complete hominins ever unearthed, and there are fragments of at least four more individuals at the site.

The Skull in the Rock, by Lee Berger and Marc Aronson, not only reports on that finding for middle school-aged kids, but also explores its importance to scientists and to the “rest of us,” and sheds light on what it means to be a paleo-

anthropologist, and, more generally, a scientist. In a book that answers questions and at the same time peaks curiosity—the beginning of all inquiry—Marc Aronson takes us behind the scenes, into the field, and beyond.

At a time when books addressing STEM subjects—science, technology, engineering, and math—are in demand in every classroom and when the new Common Core Curriculum is being implemented, *The Skull in the Rock* will answer many classroom needs.

In Fall 2012, the Science Common Core Curriculum will be released. As of now, you’ll find that this book connects to several areas in the Language Arts curricula. Common Core Curriculum standards can be found at the end of the guide.



Discussion Questions and Activities



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1. When 9 year-old Matthew Berger spied a brown rock with a thin yellow bone stuck in it, he called to his father Professor Lee Berger, “*Dad, I’ve found a fossil.*” Most of us would have used the expression, “*I think I found a fossil.*” Discuss with the class the distinction between the two statements. Why was Matthew so sure? What prepared him to state that he found a fossil with such certainty?

The author, Marc Aronson, compares that declaration with two other famous statements, “*What hath God wrought,*” and “*Mr. Watson, come in here.*” Research who said those words and why they are so important. Hold a debate on whether Matthew’s words measure up to the significance of the others.

2. What other memorable quotes do your students know that hold great meaning? Ask students to gather suggestions from their parents and bring in several of their favorites to class. Write them on sentence strip or oak tag and place them along with their attributions around the classroom.

As a young boy, Lee followed in his grandfather’s footsteps and learned to read the land. He trained his eyes to notice what is different, what doesn’t fit in. This is called an anomaly.

See how good your students are at observing anomalies, finding things that are out of place or do not belong. Before the start of the school day, make about ten to fifteen subtle changes in the classroom. Perhaps a desk or chair is missing or turned slightly, or something is there that doesn’t belong or is out of place. Have them observe the room and record the anomalies they find.





Above: Karabo, with the rock still attached to his skull. [From page 36, *The Skull in the Rock*]

Adjacent page: Matthew Berger as a young boy with the fossil he helped his father discover. [From page 6, *The Skull in the Rock*]

3. A nationwide contest was held in South Africa to name the boy skeleton that Lee Berger found. The winning name was Karabo, “the answer.” Discuss with your students the significance of the name. What would they have named the boy? Each student should suggest a name and write a short paragraph explaining why he/she chose that name. Then hold a mock contest to pick the best name for the skeleton.

4. In 2011, the Institute for Human Origins conducted a letter-writing contest asking Lucy, a hominin that lived about 3.2 millions years ago and was discovered in 1974 by anthropologist Donald Johanson, what it means to be human. Your students can repeat this activity by writing letters to Karabo asking him what it means to be human.

Then, based on what your students have learned about Karabo from *The Skull in the Rock*, they each should write his response.

5. Lee Berger used Google Earth as a tool to explore the Cradle of Humankind from the perspective of the “eye in the sky,” looking for features that he had not noticed in 17 years.

Your students can do the same thing and explore the town they live in from the “eye in the sky” to discover features that they cannot see from ground level. Go to Google Earth and in the search box, type in either the town name or an address such as the address of your school. The image will “fly” over to an aerial view of the school. The first thing your students should look for are the GPS coordinates, located at the bottom of the map. For example, the address of the Morris School in Lenox, Massachusetts is: (Latitude) 42° 21' 19.36”N, (Longitude) 73° 17' 50.78” W. Have your students record the coordinates for your school. Then close out Google Earth and immediately click back on to it, typing in the GPS coordinates and see where the image flies. If they were typed in correctly, the image should fly back over your school. Next the students should zoom in closer and observe carefully. Have them record things they can see that they can't see from the ground.

6. The picture on page 41 shows a child's femur embedded in the ground at Malapa. Why did Lee place a South African 2 Rand coin next to the bone, employing a technique that is also used by art and antique collectors who take photos of their collections?

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7. “We used to speak of ‘hominids’—the large group including us, our ancestors, and our primate relatives. Now, Lee Berger and many other scientists prefer to use the term ‘hominins’—meaning only humans and our human-like relatives—treating this cluster as distinct from the chimpanzee, gorilla, bonobo, orangutan, and gibbon group.” Discuss with the class the scientific, social, and religious aspects of this split in terminology.
8. While your students can read large numbers, understanding the true nature of them is difficult. What do two million years, the time ago when Karabo walked on earth, look like? The following exercise will put the enormity of two million years in perspective.

First have your students put together a list of all the events they can think of that have occurred in the world since they were born. They can include personal as well as national and global events. Then take them outside to your school’s field. Place a marker or a flag at the back of the end zone on one side of the field. That marker represents present time. Place another marker at the back of the end zone on the other side of the field. The distance between the two markers represents two million years. Now have each student place his/her thumb and index finger together and hold them up to an eye. They should then slowly separate their fingers until they just see a tiny space between their fingers. The space they see just as their fingers separate is the time span of all the events they listed since they were born.



The physical distance to represent two million years is approximately 100 meters. With that knowledge your students can calculate the size of the space between their fingers.

Adjacent page, top: The mandible Lee found in his hunt is more than 100,000 years old. [From page 11, *The Skull in the Rock*]

Adjacent page, bottom: The clavicle itself, removed from the stone. It is approximately 2.75 inches (7 cm) long. This is the first clue that opened the door to the story of human evolution. [From page 9, *The Skull in the Rock*]



Above: Sediba made the cover of many magazines, including *Scientific American*. [From page 58, *The Skull in the Rock*]

9. On page 57 in *The Skull in the Rock*, Marc Aronson tells us that while many in the scientific community embrace sediba and Lee Berger's approach, there are a number of scholars who express doubt or hesitation about what sediba means—where it fits into human evolution.

Discuss with your class the implications of the passage.
Include in the discussion:

- The nature of scientific discovery
- The difficulty in proving paleo-anthropology discoveries
- The relationships between certain scientific scholars
- Will there ever be a final solution to the mystery?

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10. A useful resource is the website of the Institute of Human Origins. Here you click on an interactive time line and view human lineage though time. Your students can find out more about *Australopithecus sediba*, Karabo, and the many other hominins that have been discovered since 1924 when Raymond Dart discovered the skull of *Australopithecus africanus*, a three-year-old child he named the Taung child, at Buxton, South Africa.

<http://www.becominghuman.org/>

11. *The Skull in the Rock* is not only a book about an extraordinary discovery, but it is also a biography of Lee Berger. The characteristics he showed as a young boy served him well as a scientist and an inquirer. As a class, develop a list of Lee's traits. Then each student should note which traits he/she shares with Professor Berger. Create a chart of these characteristics and enter the names of your students that exhibit each trait. When you are finished, identify the students who might do well in a career in science.

12. As a closing activity, view with your students a lecture about *Australopithecus sediba* by Duke University anthropologist Steven Churchill:

<http://www.youtube.com/watch?v=pJOOo9C0dYE>

13. Your students can continue to follow the discoveries of Lee Berger and his team by visiting the companion website to *The Skull in the Rock*, [scimania.org](http://www.scimania.org). This site encourages young adventurers to explore new horizons and take part in the exciting world of discovery.

<http://www.scimania.org>.



Common Core Standards for grades 6–8



The following are general standards for reading, writing, speaking, and listening. The numbering corresponds to the general standard.

Reading

1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. **(Activities 2, 4, 7)**
2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas. **(Activity 7)**
3. Analyze how and why individuals, events, and ideas develop and interact over the course of a text. **(Activities 2, 7, 9)**
4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. **(Activity 1)**
5. Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole. **(Activity 1)**
6. Assess how point of view or purpose shapes the content and style of a text. **(Activities 7, 9, 11)**
7. Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words. **(Activities 2, 5, 8)**
8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence. **(Activities 7, 9)**





Top: Lee at age seven.
[From page 13, *The Skull in the Rock*]

Bottom: Lee presenting his findings during a National Geographic lecture series in 2011. [From page 56, *The Skull in the Rock*]

Writing

1. Write narratives to develop real or imagined experiences or events using effective techniques, well-chosen details, and well-structured event sequences. **(Activities 3,4)**
2. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **(Activities 1, 3)**
3. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation. **(Activity 5)**
4. Draw evidence from literary or informational texts to support analysis, reflection, and research. **(Activities 3, 4, 10)**

Listening and Speaking

1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. **(Activities 7, 9)**
2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **(Activities 7, 9, 10, 12)**
3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric. **(Activities 7, 9, 10, 12)**
4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. **(Activities 7, 9)**

This guide was created by Clifford Wohl, Educational Consultant.



Praise for *The Skull in the Rock*

“... a fine pairing of an impassioned personality and scientific achievement.”—*School Library Journal*

“A fascinating account of an Indiana Jones–style fossil hunter and how his discoveries have changed the way we see human evolution.”
—*Kirkus Reviews*

“This story is greatly enhanced by illustrative material, which includes photographs of Berger; the research site from which the fossils were extracted; the fossils themselves....and striking facial reconstructions of these ancient ancestors.”
—*Hornbook*



About the Authors



Lee R. Berger is a professor at the Institute for Human Evolution, the University of the Witwatersrand, Johannesburg, South Africa. An award-winning researcher, author, and speaker, Berger is a Fellow of the Royal Society of South Africa, and the winner of National Geographic Society’s first Prize for Research and Exploration. He has appeared in dozens of television documentaries and is a regular commentator on evolution and paleontology. Berger graduated from Georgia Southern University in 1989 and received his Ph.D. from the University of the Witwatersrand in 1994. He is an Eagle Scout and Boy Scout Honor Medal winner, as well as an avid diver and PADI Divemaster. Lee Berger is married to Jacqueline, and they have two children, Megan and Matthew.



Marc Aronson earned his doctorate in American History at NYU and has made his career as an award-winning editor and author. He has also co-authored a set of books with other experts including *Ain’t Nothing But a Man* (Jane Addams prize honor); *If Stones Could Speak* (Orbis Pictus honor), and *The World Made New*. He teaches in the MLIS program at Rutgers University and frequently speaks in schools around the country.

THE SKULL IN THE ROCK

On Sale: October 23, 2012
Ages: 10 and up • 64 pages
8-1/2" x 10-7/8"

Category: Juvenile Nonfiction/
Science & Nature/Discoveries

978-1-4263-1010-2 (HC)
\$18.95 U.S. / \$21.50 CAN

978-1-4263-1053-9 (LB)
\$27.90 U.S. / \$32.00 CAN

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