SCIENTISTS IN THE FIELD

Where Science Meets Adventure

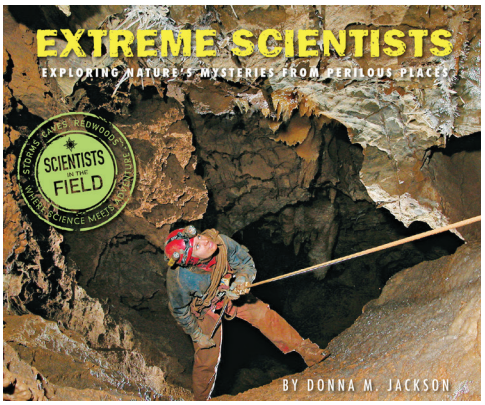
DISCUSSION AND ACTIVITY GUIDE

Extreme Scientists: Exploring Nature's Mysteries from Perilous Places

By Donna M. Jackson

About the Series

Extreme Scientists is part of the award-winning Scientists in the Field series, which began in 1999. This distinguished and innovative series examines the work of real-life scientists doing actual research. Young readers discover what it is like to be a working scientist, investigate an intriguing research project in action, and gain a wealth of knowledge about fascinating scientific topics. Outstanding writing and stellar photography are features of every book in the series. Reading levels vary, but the books will interest a wide range of readers.



Extreme Scientists: Exploring Nature's Mysteries from Perilous Places
by Donna M. Jackson

About the Book

Most people wouldn't equate being a scientist with danger, but some researchers face extremely dangerous conditions every day in pursuit of knowledge. Donna M. Jackson profiles the work of three such scientists studying hurricanes, cave microbes, and redwood forest canopies.

About the Author

Growing up in Massachusetts, Donna Jackson wanted to be a singer-songwriter, but she also enjoyed exploring the "who, what, where, when and why of things." It was that curiosity and her love of mystery and science books that led her to journalism and then to writing nonfiction for young people. Donna is the author of many award-winning books including *Bone Detectives*, *Bug Scientists*, *ER Vets*, and *The Elephant Scientist.* Her books have received the Orbis Pictus Award, an ASPCA Henry Bergh Honor and a Robert F. Sibert Honor. She lives in Colorado with her husband, Charlie; their family; and two dogs, Sydney and Lily.

Pre-Reading Activity

Make a list of all the times students have done something outside of their comfort zone. What, if anything, do these activities have in common? Were there any activities that were worth the adrenaline rush? Ones that were not worth the risk?

Make a list of jobs that students would refuse to do regardless of the rewards. Are any of these jobs ones that involve physical risks?

How many students are afraid of heights, confined spaces, severe weather, or being completely in the dark?

EDUCATOR'S GUIDE

Extreme Scientists: Exploring Nature's Mysteries from Perilous Places

By Donna M. Jackson

Discussion Questions

What is the balance between staying safe and getting necessary information?

Have you or anyone with you ever panicked in severe weather? What about in a dark or unfamiliar place? Way up high on a mountain or in a tree? What calmed you or the person with you down? What steps would you take to remain calm in the face of danger?

Think about flying into a hurricane or diving underwater in a dark cave for the first time or climbing hundreds of feet above the ground in a tree with untested bark and branches. On a scale of one to ten, with ten being not at all comfortable and one being extremely comfortable, rank your likelihood of following in the footsteps of the three scientists in the book. Explain your reasoning for each of your ratings.

Think about a prospective career that you can see yourself doing. What are the risks of that job in comparison to the risks of these three scientists?

If no one were willing to do these three jobs, what would be lost?

Many people regularly complain that we underestimate their abilities. What one person sees as a risk, someone else sees as being relatively safe. What is something you do that other people may not understand? If this question does not seem to apply to you, explain why flying into a hurricane, squeezing through dark caves, or spending several days in the redwood canopy is safe.

Think about something you enjoy doing. Now think about sacrifices you would be willing to make in order to keep doing this activity. How much are we willing to sacrifice in order to do a job we enjoy? When does the price of the sacrifice force us to move to other activities? Now change the terminology from "something you enjoy doing" to "something that must be done." Is there still a point in which the sacrifices are just too much?

Is one of these three scientists more at risk than the other two?

Applying and Extending Our Knowledge

Paul Flaherty, our first extreme scientist, is a meteorologist. He tracks hurricanes. Hurricanes, however, are only one type of dangerous storm.

- Make a chart of all hazardous weather storms. Create the criteria for rating danger from the various storms and then rank the storms from the least dangerous to the most dangerous. For each type of storm show the range of hazard.
- Create a poster showing what the average person should do to minimize the danger.
- What experience does your class have with hazardous weather? Record, if possible, the class's history with various types of severe weather, keeping in mind that some students may not be willing or able to speak of storms that have caused destruction or even death in their own family.
- On page 16 the author says, *"But it's not the high winds that cause the problems; it's the wind shear, either vertical or horizontal."* Create an online presentation explaining how this affects the plane. Make sure to explain the difference between vertical and horizontal wind shear, as well as explaining why high winds do not by themselves cause problems for planes. If possible, make a model plane and show the effect, perhaps using fans.
- Create a poster or build models showing the difference between a turboprop plane and several other types of planes (such as an airline passenger plane). Make sure we know why a turboprop plane is better equipped to handle hurricane weather than other planes.
- The WP-3D planes (or "P-3" planes) feature three types of radar. Create a diagram showing what each type of radar does and why these planes need all three.
- The eye of a hurricane is vastly different from the outer edges. If you were selecting music to define a hurricane, which music would you choose? Play your music and then explain it in terms of Flaherty's flight into and out of the eye of a hurricane. Read Jeff Masters' account of his flight on pages 22 and 23 and find new music to match his story. What differences are there in Flaherty's flights into a hurricane and the story Masters tells?
- Choreograph a dance for young students in

Extreme Scientists: Exploring Nature's Mysteries from Perilous Places

By Donna M. Jackson

which you play music and young students act out the flight of a plane into and out of a hurricane.

- On page 24 we read: *"Despite such dangers, the rewards of hurricane hunting far outweigh the risks, says Paul."* The easy part of this question is to explain why this is true. Prepare a cost/benefit analysis proving this statement. Take into consideration the cost of the planes, the personnel, plane repair and maintenance, and the cost of dropping dropwindsondes (see page 20), as well as other cost considerations. The harder part may be in explaining whether or not this would be true for you specifically. Argue why you should or shouldn't be on one of these hurricane planes.
- In the question section, we read that the hurricane season runs from June 1 through November 30. Explain why we do not worry about hurricanes during other months. Prepare an online presentation or a poster presentation explaining how the hurricane season works.

Hazel Barton studies "extremophiles"! Extremophiles are super-resilient single-celled microbes that are Earth's oldest living organisms. They are found everywhere, including some of the most inhospitable places on the planet.

- Draw and write a comic book in small groups featuring these extremophiles. Make sure to have both good and evil superheroes. Make sure your comic book includes definitions of the microbes that are used as the characters. Marvel has some useful comic book writing templates at marvel.com/games/play/34/create_your_own_comic . Keep in mind this quote from page 30: *"'We thought we would find two or three species that are very, very good at making a living when there's no energy around,' says Hazel. 'But we found five hundred species—species that we wouldn't expect to see."*
- If your school has the devices and software, make an animated movie explaining the types of microbes Barton studies. Keep this quote from page 31 in mind: *"'If you had a million people who did one kind of job, the city wouldn't work. But you have people who take the trash, you have people who teach, you have people who bring food in, sell it, and everybody has his role to make the city function'"*
- Page 29 states that the range of extremophile potential spans the explanation of life on Mars to environmental cleanup. Divide the class in half. Have one group work on life on Mars and the other work on environmental cleanup. Come up with a theory individually—not in a group—that explains the role of extremophiles in creating life on Mars or cleaning up the planet. Then break into small groups of three or four to come up with a group theory. Then create a theory for the Mars group and for the environmental cleanup group. Make sure these theories suggest a method for testing the theory. Then have the groups trade theories. Each group will be responsible for critiquing the other group's theory. What two things are good about the theory? What are at least two problems? What two things need to be added? What language needs to be tweaked? Finally, come up with a class theory for both life on Mars and environmental cleanup.
- Design an ad campaign to accentuate the benefits of extremophiles to our world. If possible, make a sixty-second promotional video that can be shared electronically and shown at your school. This promotional video should explain the advantages of investing money into the continued study of extremophiles.

Common Core Connections

CCSS.ELA-Literacy.RST.6-8.1
Cite specific textual evidence to support analysis of science and technical texts.
CCSS.ELA-Literacy.RST.6-8.7
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
CCSS.ELA-Literacy.W.7.1
Write arguments to support claims with clear reasons and relevant evidence.
CCSS.ELA-Literacy.W.7.2
Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
CCSS.ELA-Literacy.W.7.2.b
Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.
CCSS.ELA-Literacy.W.7.4
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are

defined in standards 1-3 above.)
CCSS.ELA-Literacy.RH.6-8.7
Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.
CCSS.ELA-Literacy.SL.7.1
Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.
CSS.ELA-Literacy.SL.7.5
Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

Hazel's interest in science came to her from her grandfather. Then when she was fourteen, she took an outdoor adventure class that introduced her to caving. These two factors directed Hazel to microbiology and caves.

- Whether or not you see yourself as a future scientist, write a paragraph or more about the person or program that has the best chance of convincing you to become a scientist. What is it about them or about what they do or say that makes science seem like a possibility for you?
- If you do not see yourself as a future scientist, explain the personal obstacles or problems that make a science career seem unlikely.
- If you see yourself in a science-related career, what are the factors that make science come alive for you?
- What do schools and science curriculum do well to encourage future scientists? How can they improve?

Common Core Connections

CCSS.ELA-Literacy.WHST.6-8.2
Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
CCSS.ELA-Literacy.WHST.6-8.4
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-Literacy.W.7.1
Write arguments to support claims with clear reasons and relevant evidence.
CCSS.ELA-Literacy.W.7.1.b
Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.
CCSS.ELA-Literacy.W.7.9
Draw evidence from literary or informational texts to support analysis, reflection, and research.
CCSS.ELA-Literacy.W.7.4
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1-3 above.)

In the caption on page 34 we read, *"Cave diving is as dangerous as it is exciting. A number of divers have died after losing their way in the passageways and running out of oxygen."* On page 37 we read, *"Millions of uncharted caves await exploration beneath the earth's surface."*

- Assign one wall of your classroom as signifying the love of taking risks. Have the opposite wall signify the desire to avoid all risk. Have the class position themselves between those two walls based on their own willingness to put themselves in Hazel's shoes. Look especially at the pictures on pages 34, 35, 36, 41, and 43. Pair students to discuss their reasons. Have the people closest and farthest from the wall explain why. Are there personal experiences that influence our comfort with risk?
- Debate the benefits and risks of cave exploration. Include in the debate financial information, safety, new discoveries, and other factors that either encourage or discourage exploration. The key question: When does the risk outweigh the potential benefits? If possible, use the information from the class's response to the lining-up activity above to help frame the debate in a personal way. Also use the information from the question section in which Hazel explains her safety steps (page 44).

Common Core Connections

CCSS.ELA-Literacy.W.7.7
Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.
CCSS.ELA-Literacy.W.7.9
Draw evidence from literary or informational texts to support analysis, reflection, and research.
CCSS.ELA-Literacy.SL.7.1
Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

EDUCATOR'S GUIDE

Extreme Scientists: Exploring Nature's Mysteries from Perilous Places

By Donna M. Jackson

When we examine all of the pictures and information about caves, we see caves that are very warm, we see ice caves, caves that are dry, and caves that are underwater. We also know that there are perhaps millions of caves still to explore.

- Research the various types of caves on our planet and prepare a poster or an online presentation that classifies the caves and shows pictures of the various types.
- Considering that there are millions of caves still to discover, draw and describe a make-believe cave, but make sure the cave creation is based on the laws of physics and derives from your existing understanding of already explored caves.
- Using cardboard boxes and other found materials (that are safe), build a cave maze to crawl through.
- What questions does the class have about caves, extremophiles, and the daily work of a cave scientist? Create a class booklet of the questions students have written. When appropriate, have these questions guide the day's discussion.
- Create a Post-it board for cave questions that students may post. Leave Post-it notes around for students to answer. Review protocol for the ethics of both posting and answering. If your school allows, do this in an online social media forum.
- Since this book was published, more caves have been discovered. Prepare a slideshow with as many new cave pictures as time allows. Using the cave classification information from above, place these new caves into the appropriate classification. Have students explain the significance of the new cave discoveries. Are there any new caves that have the potential of explaining life on Mars or of containing extremophiles that will clean the environment? How would Hazel view this new information?

Common Core Connections

CCSS.ELA-Literacy.W.7.7
Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.
CCSS.ELA-Literacy.RST.6-8.1
Cite specific textual evidence to support analysis of science and technical texts.
CCSS.ELA-Literacy.RST.6-8.7
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
CCSS.ELA-Literacy.SL.7.1.c
Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.
CCSS.ELA-Literacy.W.7.4
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1-3 above.)
CCSS.ELA-Literacy.W.7.6
Use technology, including the Internet, to produce and publish writing and link to and cite sources as well as to interact and collaborate with others, including linking to and citing sources.
CCSS.ELA-Literacy.RH.6-8.6
Identify aspects of a text that reveal an author's point of view or purpose (e.g., loaded language, inclusion or avoidance of particular facts).
CCSS.ELA-Literacy.WHST.6-8.2
Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Steve Sillett's career as a skywalker may have begun when he climbed trees as a boy in Pennsylvania. While most of this book concerns his work with redwoods in California or Oregon, Steve has climbed trees in Costa Rica and Australia as well—probably many more places than the book mentions. He says, *"'Every forest canopy is an unexplored world.'"* (p. 47–48). He notes that many other organisms, both plant and animal, live in trees, including many that are not named.

- What trees are in your neighborhood? Using a camera, create a field guide of all of the different trees in your neighborhood. Make sure to label, date, and map the location of all these trees. Include your full name on all of these pictures.
- Devote regular times each day for students to collect pictures of all the different organisms that are found on trees. It may be necessary to select a number of trees and assign teams to take pictures of the algae, moss, vines, insects, birds, etc. that are found on various types of trees. Include the frequency in which these organisms are found.

Make sure to have your name and dates and labels on all pictures. Also make sure that the location of the tree is very clear.
- Sillett speaks of "mapping" trees. This includes measuring the trunk circumference, height, and other information. In your field guide, include this same information for the trees in your neighborhood.

Common Core Connections

CCSS.ELA-Literacy.RST.6-8.3
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
CCSS.ELA-Literacy.WHST.6-8.6
Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.
CCSS.ELA-Literacy.WHST.6-8.7
Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Steve loves climbing trees. We see evidence in the book of information he collected in the canopy, which is much different from the information he observes at ground level.

- Read the question section on pages 65–67, especially the questions dealing with keeping yourself safe and keeping the tree from being damaged. If your school allows it and if you have trees that can be climbed, climb into a tree as high as safety allows. Safely take pictures of the tree and compare these pictures with pictures taken at ground level. Are there any differences?
- If you are unable to climb trees, but you have a good camera with a good zoom or telephoto lens, try getting the same information with the camera.
- On page 60 we see that the higher up in the redwood tree one travels, the smaller, scalier, and skinnier the leaves. Collect a few leaves from the highest part of a tree that you can safely reach and compare them with the leaves on the tree at lower levels. Are leaves up high any different from the leaves down low? If not, speculate on how much higher the tree would have to grow to show a measurable difference in leaf size. Or, is the species of the tree the most important factor? Is there any way to compare the dwindling size of redwood leaves with the leaves on other trees such as maples, oaks, birch trees, etc.? Support your position. Find a classmate that disagrees with you and argue—politely!
- How many different organisms live in the forest canopy? Explore the links listed and see how many different organisms, in addition to the ones listed in the text, depend on the forest canopy.

Common Core Connections

CCSS.ELA-Literacy.RST.6-8.3
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
CCSS.ELA-Literacy.WHST.6-8.9
Draw evidence from informational texts to support analysis, reflection, and research.
CCSS.ELA-Literacy.SL.7.1
Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

Some of the redwoods Steve climbs into are thousands of years old!

- Make a personal timeline with historical events from the time one redwood was just sprouting up to today. How far back are you able to trace your own family tree?
- Write a memoir from the point of view of the redwood. Make sure to include the different groups of people, plants, and animals that stood in its shade.
- Many technologies, tools, fads, fashions, theories, animals, etc. have disappeared within the redwood's lifespan. Some have come into being and faded away recently in comparison to the two-thousand-year lifespan of some of these old trees. Make a list of as many "extinct" items that came after the redwood sprouted and disappeared before the redwood died. What new items will go away before the redwood dies?
- What happens to a redwood after it dies? Make a presentation, either online or as a poster, showing the forest both before and after a redwood dies. Make sure to include information on how redwood

seeds germinate and grow. Make sure to include information on what happens to the animals and plants that made the tree their home and habitat.

Maple leaves or oak leaves are very distinctive. Redwood needles are often not even thought of as "leaves" by young students. When we look at the leaves on page 60, we see distinct differences based on where we find the leaves on the tree.

- If you have access to a variety of evergreen trees, collect the leaves and put them in one area. Put the name of the trees in another area and see how well students are able to match them. If you do not have access to evergreens, find pictures of the various evergreen leaves and use them.
- While the text does not explicitly say so, we can safely infer that Steve knows how to recognize the leaves of many trees. Collect or take pictures of all the different trees on your campus or in your neighborhood. Before checking reference books or other reference sources, compare the leaves and create your own classification system for distinguishing leaves. This activity is also useful for comparing tree bark. Create a museum exhibit showing the leaves of your school grounds or your neighborhood.
- Redwood leaves are not exactly the same at different heights, but they still are very similar. What about the trees in your neighborhood? Are all the leaves on the tree the same?

Common Core Connections

CCSS.ELA-Literacy.RH.6-8.7
Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.
CCSS.ELA-Literacy.W.7.2.d
Use precise language and domain-specific vocabulary to inform about or explain the topic.
CCSS.ELA-Literacy.W.7.3
Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.
CCSS.ELA-Literacy.WHST.6-8.7
Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Print Resources

Carson, Mary Kay. *The Bat Scientist.* Houghton Mifflin, 2010.

Montgomery, Sy. *Quest for the Tree Kangaroo: An Expedition to the Cloud Forest of New Guinea.* Houghton Mifflin, 2006.

Other Websites to Explore

ScienceDaily – Caves
www.sciencedaily.com/terms/cave
ScienceDaily is an online source for the latest research news, with this page specifically related to caves and cave science.

ScienceNetLinks
sciencenetlinks.com
A site from the American Association for the Advancement of Science that provides links to lessons, tools, collections, and the latest science news specific to topic.

Institute for Redwood Ecology
www2.humboldt.edu/redwoods
Information on redwoods and their ecology from Professor Stephen Sillett and Humbolt State University, including a photo tour titled Science Atop the World's Largest Trees.

Guide created by Ed Spicer, curriculum consultant, and Lynn Rutan, retired middle school librarian, now reviewer and blogger at *Bookends: The Booklist Youth Blog*.