SCIENTISTS IN THE FIELD

Where Science Meets Adventure

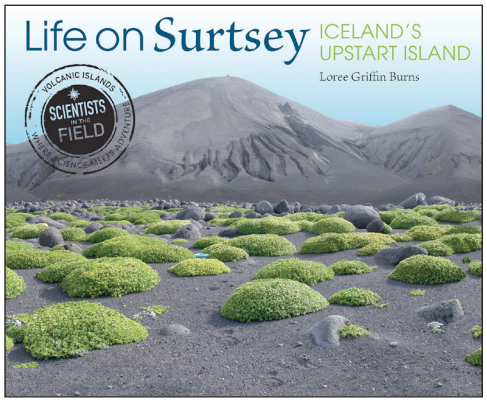
DISCUSSION AND ACTIVITY GUIDE

Life on Surtsey: Iceland's Upstart Island

BY LOREE GRIFFIN BURNS

About the Series

Life on Surtsey 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.



Life on Surtsey
by Loree Griffin Burns
978-0-544-68723-3

About the Book

On November 14, 1963, an underwater volcano exploded. Considering that this was the first time in about 6,000 years that this volcano erupted, this fact alone is unusual. Add to this information the fact that this volcanic activity gave birth to a brand new island, and we have a scientific jackpot. The scientific community typically does not expect to see brand new islands created, even in a place like Iceland, no stranger to the fiery rumblings of volcanoes. Immediately Surtsey, as it was named, became off limits to everyone except scientists. When scientists were finally able to walk on the island without their shoes burning off, they had and continue to have a unique chance to discover how life begins on a pile of cooling lava and volcanic material—before it sinks beneath the sea.

About the Author

Dr. Loree Griffin Burns holds a PhD in biochemistry and has found a way to combine her many interests, exchanging her life as a professional scientist for one as a writer of children's science books. Her first book, *Tracking Trash*, was a Boston Globe–Horn Book Honor book for nonfiction. Since then she has written other outstanding books including *The Hive Detectives: A Chronicle of a Honey Bee Catastrophe* and *Beetle Busters: A Rogue Insect and the People Who Track It*. Her lively blog provides information of her life, fascinating research trips and a list of suggested books and websites.

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Pre-Reading Activities

Gather a bunch of recycled materials and place them in the room without label or explanation. Give this exact direction: "Make something in the next X minutes." [Where "X" is the most amount of time you can afford]. The next day (or when time is up) have students write and reflect on the process, or the lack of process, on their ability to make something. Guide the conversation toward identifying any of the common steps that were taken or should have been taken to create something new. How does something new get made out of the materials on hand?

Review vocabulary related to volcanoes (magma, lava, molten lava, flow, etc.). Pass out samples of igneous rocks (granite, quartz, feldspar, mica, obsidian), sedimentary rocks (shale, sandstone), and metamorphic rocks (marble, quartzite, slate). Review the way these rocks are formed. Pass out some rocks and try to place them in the correct category.

If you can obtain pumice stones, have students predict whether or not rocks float or sink. Fill a container with water. Drop in several of the local rocks and any quartz or sandstone and watch them sink. Then drop in the pumice stone. Why does the pumice stone float? Ask students if steel will sink or float and then have them investigate what ships are made of.

Brainstorm and make a list with students of as many landmarks they can think of. Sort this list into groups and discuss how any given landmark came into existence and how it has changed or will change.

Have students pick out a spot on your campus or in your neighborhood that is approximately a 20 meter square. Have them predict what they expect to find and record those predictions. Do this in groups, if appropriate. Have them go out and document all of the plants and animals in that boundary, including insects and other bugs. Use a camera to record each plant and animal. If time allows, do this over several days to record what stays consistent and what changes. Compare actual results to the predictions.

Research Norse mythology and look for stories about a fire giant named Surtur.

Discussion Questions

Look at pictures of Shepherd's Glacier in Glacier National Park over time. Why does it look so different in 1913 compared to today? Go through the book and look at the photography and graphics that show the changes on Surtsey. List the ways you see it changing. How do these changes compare with the changes to Shepherd's Glacier or to other landforms? What is unique about Surtsey and its location compared to other evolving landforms?

How many different ways do natural events and weather affect natural landmarks and physical geography? Why are the volcanoes in some areas more dangerous than in other areas?

This book predicts that Surtsey will only exist for a few hundred years. The graphic on page 7 shows that in just 45 years, the island is half its original size. What does this prediction mean in terms of how much government support it should be given and for how long? How can science predict how long an island will last? Compare this prediction with the predictions for something like the snows of Kilimanjaro. Is this a fair comparison? How should predictions be used in forming public policy? What is the danger in ignoring informed predictions? Compare this prediction to weather predictions.

When this island was formed, from the very beginning, no tourists were allowed on it—only scientists. Is this fair? Since science funding is typically difficult to obtain, did the scientists miss an opportunity to secure funding from the general public who may have paid to see a brand new island? Or was banning the public essential for preserving a once in a lifetime scientific opportunity?

Erling conducted an island census once a year during the summer. During the years between 1972 and 1984, Erling made only three visits. Erling himself wonders about what they miss by only coming in July. What is the value and the limitations of this research? Iceland presents logistical problems for research, but what should scientists be doing to document the evolution of this island, assuming that money is no problem?

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Applying and Extending Our Knowledge

On the table of contents page, Burns states that she spelled Icelandic names using the Icelandic alphabet in the text, but reverted to the Anglicized spelling in the Source Notes and Bibliography. The first page speaks of the different naming conventions, noting that Dr. Olafsson did not receive his first name until after his parents got to know him a bit.

- Inspect the Source Notes and compare the differences between Icelandic and English names. Write a justification or a criticism of the use of the Icelandic alphabet in the text, but not in the back matter. Explain if the attempt to "include a small taste" of Icelandic language succeeds or fails.
- With the help of your librarian, research scientific address and language idiosyncrasies in various countries around the world. Compare and contrast things like common names versus scientific names—the two-name, binomial system via Linnaeus mentioned on page 14. Consider when we use common names versus when we use genus and species nomenclature.
- In addition to language, Iceland has geographical features, climate features, ecosystem features, cultural features, and more that are very different from much of the United States. Have groups of students explore some of these differences with a presentation that highlights the biggest differences and any similarities. Perhaps have some groups find the place in the United States that has the most in common with Iceland, especially if the groups have very different ideas about which place in the United States that may be.

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.SL.7.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
CCSS.ELA-Literacy.W.6.1(a-d) Write arguments to support claims with clear reasons and relevant evidence.
CCSS.ELA-Literacy.W.6.2 Write informative texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
CCSS.ELA-Literacy.RI.6.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.
CCSS.ELA-Literacy.RI.6.6 Determine an author's point of view in a text and explain how it is conveyed in the text.

Iceland has more volcanoes than anywhere on Earth. It has volcanoes that produce bubbling lava and ones that spew a pyroclastic flow, such as the hot lava that rained upon Erling and crew when they first visited the newly formed Surtsey. The smoking volcano was easily visible from Erling's home. While there are many books and online resources for understanding the way volcanoes work, a great source for activities is *Earthquakes, Volcanoes, and Tsunamis: Projects and Principles for Beginning Geologists* by Matthys Levy and Mario Salvadori. Many of the activities below are also found in this book.

- Build a mound of sand to resemble a mountain. Place a film canister inside the mound so that the opening of the container is level with the top of the "mountain," forming a "crater." In the pill container place about a half-teaspoon of baking soda, some liquid soap, and (make sure to add this last) red wine vinegar. Students should be able to see "slowly bubbling lava" flow down the side of the mountain.
- To demonstrate more of a "pyroclastic flow" repeat the above procedure, but this time quickly cap the film canister and have ready some sand to quickly pour over the lid (it only takes seconds for the lid to blow off). Please make sure that you demonstrate safety concerns by wearing safety glasses and a lab coat (this experiment can be messy). We recommend practicing this experiment without students several times to ascertain how much baking soda and red wine vinegar to use for the most effective demonstration.
- A smoking volcano can be demonstrated by making a hole at the bottom of the mountain and inserting an air tube up to the top. The smoke can come from dry ice or burning kindling over moist paper. Please observe careful safety procedures for using dry ice or for building a fire.
- The way gasses contribute to volcanoes can be

easily demonstrated by shaking a carbonated beverage that is tightly capped and then by slowly unscrewing the cap. Most of us will not need the reminder that this can be very messy!

- The volcano that created Surtsey, however, is not quite like those in these activities. This volcano was underwater, which the text tells us kept it on the quiet side. Have students try to figure out a way to get one of the volcano demonstrations above to explode underwater and push something to the surface (please review plans before exploding a volcano to make sure students stay safe). Shaking a carbonated drink can and opening underwater may be a good way to give students an idea of what is happening. Perhaps your students will come up with a better plan! It is worth reading to read *Eruption! Volcanoes and the Science of Saving Lives* by Elizabeth Rusch, which is another Scientists in the Field book.

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.
CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

The different types of volcanoes mentioned above form and erupt for a variety of different reasons. Iceland has most of the world's volcanoes.

- Have students research the different types of volcanoes and build or draw them.
- Have students show and present pictures or videos of the various types of volcanoes, including any videos showing eruptions.
- Distribute map templates of the world and have students locate active volcanoes. Students should annotate the map to indicate the type of volcano, dates of its most recent eruption, and predictions of when it will erupt next. Have students calculate the percentage of each type of volcano compared to the total number and the percentage of each type found in Iceland.
- Have students determine whether or not there are types of volcanoes in other parts of the world that are not found in Iceland. If any are found, what makes them unique? Have students prepare a video or visual depiction showing the differences and similarities, including rationales for all material included in the presentation.

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Students may not have an appreciation for the "lifeless" nature of Surtsey. We do not have experience with blistering rocks, scoured by volcanic heat, rising from cold salt water and receiving a coating of molten lava. To get an idea of what this means:

- Fill a few small pots with potting soil. Do not plant any seeds. Give these pots water and sunlight (as if you did plant seeds) and check regularly. Does anything grow?
- Find a place where you can clear everything growing. Ideally this will be a spot that school personnel will not weed or water or do anything at all. Check this spot regularly. Do not add or remove anything—the goal is to see what happens without human intervention. Keep a log for what this area looks like over time. Take dated and labeled pictures for this log. This is a good activity, if possible, to do with classes over several years.
- If your area is near a wildlife preserve or other areas that are not maintained by people, visit and record over time the changes. Make sure to record the GPS coordinates for the specific area you are monitoring. Create the protocol for how to position the camera or how to sketch the area so that

everyone recording in this location records from the exact same vantage point. Have a discussion for why scientists want data to be consistent and easily replicated. Create a field book listing all plant and animal life seen and recorded.

- Displaying our findings is an essential part of science. Using information from student field journals or information about your area, have students create a science poster showing what organisms are found or have drifted into your area. A rubric may be found here: sciencenetlinks.com/student-teacher-sheets/scientific-poster-checklist/.

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On page 7, we read that Surtsey has shrunk about 50 feet and lost territory to the sea in 45 years.

- Write a cosmological explanation of Surtsey as a play, poem, musical, folktale, or story or find a different creative explanation. You may wish to look at Rudyard Kipling's *Just So Stories* or other folklore for a model of how to approach this activity. Create something that may be shared with younger students. Whatever is created should include a rationale based on the events of Surtsey.
- If possible, use your music teacher, art teacher, or other resources to create sets, costumes, music, choreography, etc., to perform your story of Surtsey's birth, life, and return below the surface.

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CCSS.ELA-LITERACY.RI.6.9 Compare and contrast one author's presentation of events with that of another (e.g., a memoir written by and a biography on the same person).

Erling spoke Icelandic first. He taught himself to speak Danish because he wanted to learn about the animals in the books he liked. He has spent decades on Surtsey and "does recognize that it's time to train his replacement, someone who will continue to survey the insects on Surtsey in the decades to come." (page 44).

- What do students care so much about that they will study for weeks in order to learn about regardless of whether or not the subject is a school requirement? Spend some time reflecting or blogging or writing about this question and sharing your reflections with students or teacher.
- Reflect about those things that are important enough to students that they will continue doing them for twenty years or more (up to the 45 years that Erling has been tracking insects).

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Surtsey, from the very beginning, is a place that is only available to scientists. The intent was to measure changes that take place that are not linked in any way to the actions of people. This includes care about not

accidentally bringing in any sort of plant or animal life and continues with strict rules about expelling bodily materials. The text says they want to minimize the impact people have on this new island.

- Share with students the arguments over "controlled variables." If we wish to prove that plants grow faster with fertilizer, will it be true that plants grow slower without fertilizer? Will there be other factors that could make a plant without fertilizer grow faster? What variables will we be able to control? Discuss the differences and the meaning of both internal and external validity when designing an experiment. Erling wonders whether his visits in July cause him to miss counting various animals, especially Cochylis dubitana moth. Explore with students the variables on Surtsey that are probably overlooked by only visiting in July.
- Some of the factors that make a more accurate census less likely are human logistics and safety. What would happen if Erling and crew attempted to visit in the middle of winter? Have students research the pros and cons of visiting Surtsey more frequently, including in the winter. Considering the fact that life on the Arctic Circle makes winter visits unlikely at best, have students prepare a plan, including financial details, for a winter visit of at least one week. Make sure they consider the fact that the more resources brought in (especially for things like heating), the more difficult it is to control variables. If Surtsey were heated where the people were staying, could that cause changes directly related to human habitation? Consider the changes that are related to the lighthouse built (picture on page 50).
- Erling and crew see trash washed up on the island (page 43). The picture exists without much explaining of how the trash got there. Students may assume that the trash is from Iceland, perhaps where Erling lives. Perhaps it is, but have students design a method for investigating and proving where the trash does come from. *Tracking Trash*, another Scientists in the Field book, is a great resource and also by Burns.
- Have students design an experiment with three distinct variables to test.

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On page 11, we see gulls. Page 13, shows us some grass. On 16 and 17, we see a few more birds. On page 53, Matthias is in a grassy field. By this time, Erling has a full crew of scientists studying geology, birds, plants, insects, and other organisms. On page 44, we see a picture of the proof of a new species to the island—eider ducks. On page 65, we see a picture of an unnamed seal—Surtsey's next resident?

- Pick several of the plants and animals and find the sources that explain the habitat requirements for these organisms. What did the gulls require from Surtsey before they could begin nesting there? What did the grass require to grow? Prepare a timeline that goes along with a presentation of how life came to Surtsey.
- Why did Burns include the picture on page 65? Have each student come up with a theory. Then have students work in group to generate a theory. Meet as a class and fine-tune the three most likely scenarios.
- Return to the graphic on page 7 and the quote: "Scientists predict the island will survive for hundreds of years, but not for thousands." This picture and quote could be the basis of an epic poem, a futuristic news documentary, or a science fiction thriller. Have students answer the question of what life will look like on Surtsey for the next five hundred years or so. Citations from the text should form the basis for each student's creative interpretation (complete with a justification for various choices made in the creation).

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CCSS.ELA-LITERACY.RI.6.1 Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
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Other Websites to Explore

Wikipedia may serve as a beginning spot for researching Norse Mythology, which provides interesting information about Surtur and Surtsey: en.wikipedia.org/wiki/Surtr

EarthSky has a short article about Surtsey and also shows a few additional new islands: earthsky.org/earth/surtsey-and-the-birth-of-new-islands

This YouTube video has excellent shots of the island and introduces more of the scientific community studying Surtsey: youtu.be/a0ZnlfDkErM

Iceland on the Web is a commercial site that has interesting links to several Icelandic volcanoes. www.icelandontheweb.com/articles-on-iceland/nature/volcanoes/surtsey

The Khan Academy has a video explaining the relationship volcanic activity has to the formation of the Hawaiian Islands, which is an interesting contrast to Surtsey: khanacademy.org/science/cosmology-and-astronomy/earth-history-topic/plate-techtonics/v/hawaiian-islands-formation

Further Reading

Burns, Loree Griffin. *Tracking Trash: Flotsam, Jetsam, and the Science of Ocean Motion.* Boston: Houghton Harcourt Mifflin, 2010.

Levy, Matthys. *Earthquakes, Volcanoes, and Tsunamis: Projects and Principles for Beginning Geologists:* Chicago Review Press, 2009.

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