Title/Author: *The Secret Life of a Snowflake* by Kenneth Libbrecht

Suggested Time: three days (Recommendation: about 20 minutes per session)

Common Core grade-level ELA/Literacy Standards: RI.2.1, RI.2.3, RI.2.4, RI.2.5, RI.2.6, RI.2.7, RI.2.8, RI.2.9; W.2.2, W.2.8; SL.2.1, SL.2.2, SL.2.4; L.2.1, L.2.4, L.2.5

Lesson Objective:

Students will actively listen to the informational picture book *The Secret Life of a Snowflake* in order to learn more about the physical characteristics of snowflakes. This book study can easily be paired with other books and articles about snowflakes. This book is particularly well-suited to use after reading *Snowflake Bentley* by Jacqueline Briggs Martin to explore the characteristics of scientists.

Teacher Instructions:

**Before the Lesson**

1. Read the Key Understandings and the Synopsis below. ***Please do not read this to the students****.* This is a discussion to help you prepare to teach the book and be clear about what you want your children to take away from the work.

Big Idea/Key Understandings/Guiding Questions

What does it mean to be a scientist? One key takeaway is that a scientist contributes knowledge that benefits the understanding of others. A scientist is someone who is curious, purposeful, persistent, and passionate as he/she explores the unknown.

Synopsis

As a scientist, Dr. Kenneth Libbrecht tries to understand how things work in the natural world. He looks at snowflakes under a microscope and takes photographs of what he sees. He learns and explains how snowflakes grow and why each one has a unique shape.

1. Go to the last page of the lesson and review “What Makes This Read-Aloud Complex.” This was created for you as part of the lesson and will give you guidance about what the lesson writers saw as the sources of complexity or key access points for this book. You will of course evaluate text complexity with your own students in mind, and make adjustments to the lesson pacing and even the suggested activities and questions.
2. Read the entire book, adding your own insights to the understandings identified. Also note the stopping points for the text-inspired questions and activities. *Note: you may want to copy the questions, vocabulary words, and activities over onto sticky notes so they can be stuck to the right pages for each day’s questions and vocabulary work.*
3. Consider pairing this series of lessons on *The Secret Life of a Snowflake* with a text set to increase student knowledge and familiarity with the topic. A custom text set can be found[here](https://achievethecore.org/page/2597/the-secret-life-of-a-snowflake-with-companion-text-set)[.](https://drive.google.com/drive/folders/0B66A6Ds77LpiU3dIZVFxMFFkLUk) *Note: This is particularly supportive of ELL students.*

*Note to teachers of English Language Learners (ELLs): Read Aloud Project Lessons are designed for children who cannot read yet for themselves. They are highly interactive and have many scaffolds built into the brief daily lessons to support reading comprehension. Because of this, they are filled with scaffolds that are appropriate for English Language Learners who, by definition, are developing language and learning to read (English). This read aloud text includes complex features which offer many opportunities for learning, but at the same time includes supports and structures to make the text accessible to even the youngest students.*

*This lesson includes features that align to best practices for supporting English Language Learners. Some of the supports you may see built into this, and /or other Read Aloud Project lessons, assist non-native speakers in the following ways:*

* *These lessons include embedded vocabulary scaffolds that help students acquire new vocabulary in the context of reading. They feature multi-modal ways of learning new words, including prompts for where to use visual representations, the inclusion of student-friendly definitions, built-in opportunities to use newly acquired vocabulary through discussion or activities, and featured academic vocabulary for deeper study.*
* *These lessons also include embedded scaffolds to help students make meaning of the text itself. It calls out opportunities for paired or small group discussion, includes recommendations for ways in which visuals, videos, and/or graphic organizers could aid in understanding, provides a mix of questions (both factual and inferential) to guide students gradually toward deeper understanding, and offers recommendations for supplementary texts to build background knowledge supporting the content in the anchor text.*
* *These lessons feature embedded supports to aid students in developing their overall language and communication skills by featuring scaffolds such as sentence frames for discussion and written work (more guidance available* [here](https://achievethecore.org/page/3159/ell-supports-for-writing-and-discussion)*) as well as writing opportunities (and the inclusion of graphic organizers to scaffold the writing process). These supports help students develop and use newly acquired vocabulary and text-based content knowledge.*

The Lesson – Questions, Activities, Vocabulary, and Tasks

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| --- | --- |
| **Questions, Activities, Vocabulary, and Tasks** | **Expected Outcome or Response (for each)** |
| **FIRST READING:**Read aloud the entire *The Secret Life of a Snowflake* book with minimal interruptions. Stop to provide word meanings or clarify only when you know the majority of your students will be confused. | The goal here is for students to enjoy the book, both writing and photographs, and to experience it as a whole.  |
| **SECOND READING:** Focus instruction on the size and color of snowflakes. This reading will focus on pages 9-15. The remaining text will be addressed separately in subsequent read-alouds. As you read, emphasize the headings. They will help focus the students. Stop at the following quotes to ask clarifying questions and discuss as much of the vocabulary as you can while maintaining some flow. See the vocabulary chart (below) for reference. p. 9 *“Each snowflake has its own* ***unique*** *design. No two are alike.”* * ***Unique*** means that something is unlike anything else. How are snowflakes ***unique****?*

p. 10 - “*This page shows the sizes of some snowflakes when* ***compared*** *to a penny.”** Look at the snowflakes on this page. Are they all the same size? What are they***compared***, or measured, against?

p. 12 - *“Snowflakes are* ***crystals*** *of pure ice, which is clear and* ***colorless****. Seen through my microscope, each snowflake looks like a tiny piece of carved glass.”** ***Colorless*** means without any color. So, if snowflakes are ***colorless***, what color are snowflakes?

p. 13 - “*When I photograph snowflakes, I like to shine colored lights through the ice from behind. The lights make the clear ice look* ***colorful****.”** If ***colorless*** means without any color, what do you think ***colorful*** means?
* Look at the snowflake on this page. Why does Kenneth Libbrecht like to shine colored lights through the ice from behind?

p. 14 - “*When light hits a pile of snow, it bounces off all the tiny surfaces and edges of the ice crystals.”** ***Reflect*** means to move in one direction, hit a surface, and then quickly move in a different direction. So, when light ***reflects*** off snow, what happens?
* The heading on page 14 is “*White as Snow.”*  Even though snow looks white, it isn’t really white. What color is it?

p. 15 – Refer students to the heading “*Light Makes White.”*  “*Any pile of small, clear objects looks white. Salt, sugar, crushed glass, and snowflakes all look white because they* ***reflect*** *light instead of* ***absorbing*** *it.”** ***Absorbing*** means *“taking in.”* Does snow *“take in”* light?
* Why do piles of snow, salt and sugar look white?
 | * No two are the same. Each one is different.
* The page shows snowflakes of various sizes, all ***compared*** to the size of a penny. The picture shows snowflakes on top of or next to a penny.
* Snowflakes are clear, like glass. They have no color by themselves.
* ***Colorful*** means there is lots of color - it’s *full* of color.
* Students should infer that Kenneth Libbrecht thinks the colored lights make the ***colorless*** snowflakes look prettier and more interesting than the clear, ***colorless*** flakes.
* Light hits each of the tiny surfaces of all the snowflakes and then bounces off.
* Snow is clear and colorless.
* No, snowflakes ***reflect*** light.
* Piles of snow, salt, and sugar look white because all the tiny surfaces ***reflect*** light, instead of ***absorbing*** it.
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| **THIRD READING:** Focus the instruction on changes of matter (water) and the hexagonal shape of snowflakes. This reading will focus on pages 16-33. The remaining text will be addressed separately in the fourth reading. As you read, emphasize the headings. They will help focus the students. Stop at the following quotes and ask clarifying questions and discuss as much of the vocabulary as you can while maintaining some flow. See the vocabulary chart (below) for reference. p. 18 - *“When you heat a pot of water on your stove, some of the water* ***evaporates*** *to become water* ***vapor*** *in the air.”** What causes water to **evaporate**?
* When water **evaporates** what does it become?

p. 18 - *“As the warm, moist air rises and cools, some of the water vapor* ***condenses****. It forms tiny drops of water called droplets. The water droplets are so small and light that they simply float in the air.”**“You cannot see water vapor in the air, but you can see the cloud of water droplets above a boiling pot.”** You can see **condensation** when a glass of water sitting in the sun gets water drops on the outside of the glass. Why can’t you see water droplets in the air?

p. 19 - *“The clouds you see floating in the sky are made of countless numbers of tiny water droplets.”** What are clouds made of?

p. 23 - *“It takes about 100,000 tiny cloud droplets to make a single snowflake that is heavy enough to fall to Earth.”** About how many droplets are needed to make a falling snowflake?

p. 24 - *“The Number Six: Many snowflakes look like six-pointed stars.”** How many **branches** do most snowflakes have? How do you know?

p. 26 - *“Even the tiniest cloud droplet contains trillions of water molecules. A water molecule is the smallest unit of water that can exist.”** What is a **water molecule**? How many water molecules are in a cloud droplet?
* Help students understand how large a trillion is by beginning with a 1 and adding 0s to a trillion.

p. 26 - *“When water freezes into ice, the water molecules all line up in a pattern to make an ice crystal. The molecules always hook together to form small hexagons, which have six sides.**“Snowflakes are shaped like hexagons because of the way the water molecules line up within the ice crystal.”** How many sides does a hexagon have? (Consider having students count the sides of a hexagon.)

p. 32-33 - *“The Right Way to Make a Paper Snowflake.”** Read pages 32-33 and have students make snowflakes. This will create a kinesthetic connection for the students to the concept of a hexagon-shaped snowflake.
 | * Heat causes water to **evaporate**.
* As water **evaporates**, it becomes water **vapor.**
* You can’t see water droplets in the air because the water droplets are so tiny and light. They float in the air.
* Clouds are made of tiny water droplets--water vapor that has condensed.
* About 100,000 droplets are needed to make a falling snowflake.
* Most snowflakes have 6 branches. We know this because the text says that most snowflakes look like six-pointed stars, which means it has 6 points or branches. We can also see the six branches in the photographs Libbrecht has taken.
* A water molecule is the smallest bit of water there is. There are trillions of water molecules in a single cloud droplet.
* A hexagon has 6 sides.
 |
| **FOURTH READING:** Focus the instruction on the actions and characteristics of Kenneth Libbrecht as a scientist. This reading will focus on rereading selected pages of text from pages 8-46. Go to the pages with the following quotes, reread the text, and ask clarifying questions. Discuss as much of the vocabulary as you can while maintaining some flow. See the vocabulary chart (below) for reference. Teachers are encouraged to collect characteristics on an anchor chart to be used during the culminating task. (See anchor chart sample.)p. 8 - *“I have an unusual* ***hobby****. I look at snowflakes under a microscope and take photographs of what I see.”** Briefly explain **hobby** as an activity to which someone chooses to spend time for pleasure, not for work.

p. 8 - *“First I let the snow fall onto a blue collecting board. Then I look closely for interesting crystals. When I spot one I like, I use a small paintbrush to carefully pick it up and place it onto a glass slide. Then I put the slide under my microscope and photograph the snowflake.”** Close your eyes. Think about snow falling. Picture it in your brain. As I re-read each line of text, act out the motions that Kenneth Libbrecht would do for each snowflake that he finds interesting.

p. 8 - *“I have taken thousands of pictures this way, of all kinds of snowflakes.”** Kenneth Libbrecht does this as a hobby; this is something that he chooses to do. Think about the amount of time it would take to take photographs of thousands of snowflakes. What does this tell you about Kenneth Libbrecht?

p. 12 - *“Snowflakes are crystals of pure ice, which is clear and colorless. Seen through my* ***microscope****, each snowflake looks like a tiny piece of carved glass.**“You need a* ***microscope*** *to see all the details in a snowflake. Looking with just your eyes, the bright edges of the crystals blur together. That is why the snowflakes on your sleeve look white.”** Kenneth Libbrecht has learned a lot about snowflakes. What is he teaching us on this page?

p. 13 - *“When I photograph snowflakes, I like to shine colored lights through the ice from behind. The lights make the clear ice look colorful.”** What does this tell us about Kenneth Libbrecht?

p. 16 - *“As a scientist, I try to understand how things work in the natural world. I especially like to study snowflakes.”** What are some of the things that Kenneth Libbrecht has taught us about snowflakes?

p. 36 - *“I have figured out about how many different ways a snowflake can grow. The number is very large...On the other hand, young, simple snowflakes cannot take as many different forms. I grow very simple snow crystals like these in my laboratory…”** Think about what you know about Kenneth Libbrecht. We know that he is “curious,” “purposeful,” “persistent,” and “passionate.” Why would he grow snow crystals in his laboratory?

p. 46 - *“The next time it snows, go outside with a magnifying glass and take a close look at the falling snowflakes. You may be amazed by what you find!”** Kenneth Libbrecht’s hobby is studying snowflakes. In this book, he has taught us a lot about snowflakes and snow crystals. Why would he ask us to go outside and use a magnifying glass to take a close look at snowflakes?
 | * Students silently pantomime each step of the observation process.
* Listen to the students’ descriptive words and elevate their language to the words: “curious,” “purposeful,” “persistent,” and “passionate.” Begin an anchor chart with these words as headings and add supporting evidence. See sample under the Culminating Task.
* snowflakes are crystals of pure ice
* snowflakes are clear and colorless
* snowflakes looks like carved glass
* the details of a snowflake can be seen through a microscope
* snowflakes look white because the edges blur together
* Listen to the students’ descriptive words and elevate their language to words such as “curious,” “purposeful,” “persistent,” and “passionate.” Add supporting evidence to the headings of the anchor chart.
* Prompt students to answer with anything they have learned from the text during any of the reads (ex: how snowflakes are made, their shape, why they look different from each other).
* He is curious about snowflakes. He wants to find answers to the questions he has about snowflakes, so he keeps trying to do new things with snowflakes.
* Kenneth Libbrecht is curious, purposeful, persistent, and passionate about snowflakes. He wants us to learn about snowflakes, too.
 |

Final Day with the Book - Culminating Task:

This book provides a contemporary example of a scientist who studies snowflakes. If you have not already done so, consider first teaching the book, *Snowflake Bentley*, by Jacqueline Briggs Martin. Both books provide insights into the key understanding of what characteristics make a scientist. While *Snowflake Bentley* provides more information about what motivates a scientist, this text adds detail to what Wilson Bentley and Kenneth Libbrecht learned about snowflakes and snow crystals.

If you have not read *Snowflake Bentley*, write a response to these questions.

* What characteristics of snowflakes inspired Kenneth Libbrecht to spend his life studying snow?
* What are the characteristics of Kenneth Libbrecht that made him a successful scientist?

ANCHOR CHART:

|  |  |  |  |
| --- | --- | --- | --- |
| Purposeful | Persistent | Curious | Passionate |
| -he focuses closely on snowflakes -he uses a microscope to study snowflakes (p. 8) | -takes “thousands of pictures” -puts colored lights behind to make the snowflakes colorful (p. 8) | -he’s explored and looked for many different ways that snowflakes can grow in his laboratory (p. 36) | -he is excited enough about snow to study it-he also encourages us to study snow (p. 46) |

SAMPLE RESPONSE:

 Kenneth Libbrecht is fascinated by snow and spends his life studying snow. At first, part of what interested Kenneth Libbrecht about snow was that “each snowflakes has its own unique design” (p. 9). Once he started studying snow, he began learning many things about snow and snowflakes. He shares this information in his book, *The Secret Life of a Snowflake.* In this book, we learn that snowflakes are colorless, even though they look white. He also tells us that snowflakes are hexagonal (six-sided) crystals. We also learn how snowflakes are made from about 100,000 tiny water droplets. Kenneth Libbrecht shows us that there are lots of interesting things to know about snow.

 In this book, we also learn about the characteristics of Kenneth Libbrecht that make him such a successful scientist. We know that Kenneth Libbrecht is purposeful, because he has focused just on snowflakes. He knows what he wants to study and he dedicates himself to that purpose. On page 8, Kenneth Libbrecht talks about taking “thousand of pictures.” We know he is persistent, because he didn’t give up after just a few pictures. He is curious like a good scientist too! He talks about how he’s found so many different ways that snowflakes can grow (pg. 36). Finally, we know he is passionate because of how much he loves snow. We also know he is passionate because, at the end of the story, he encourages us to study snow, too (p. 46).

If you have read both *The Secret Life of a Snowflake* and *Snowflake Bentley*, write a response to these questions.

* What are the characteristics of a scientist? How are the characters in our two books the same? How are they different?
	+ Provide a Venn Diagram graphic organizer for this task to students.
	+ From the Venn Diagram, construct a compare-contrast paragraph about Bentley and Libbrecht. Teacher may choose to use this as a modeled, shared, guided, or independent writing.



SAMPLE RESPONSE:

We read two books about scientists who studied snow. In *The Secret Life of a Snowflake,* we learned about Kenneth Libbrecht, who is alive today and studying snow. In *Snowflake Bentley,* we learned about William Bentley, who lived a long time ago, but he also studied snow. Even though Kenneth Libbrecht and William Bentley lived a long time apart, they both are similar. Both men showed the characteristics of scientists in their work. They were both curious. They explored lots of snowflakes and looked for better instruments (like microscope cameras) to learn about snow. Both men were also persistent. To take good pictures of snowflakes, they had to take thousands of pictures of snowflakes. This helped them learn about snow. They were also both purposeful and passionate as they focused all of their lives and energy on snow.

Vocabulary:

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| --- | --- |
| **These words merit less time and attention** (They are concrete and easy to explain, or describe events/processes/ideas/concepts/experiences that are familiar to your students) | **These words merit more time and attention**(They are abstract, have multiple meanings, and/or are a part of a large family of words with related meanings. These words are likely to describe events, ideas, processes or experiences that most of your student will be unfamiliar with) |
| p. 8 - **hobby** - an interest or activity to which a person devotes time for pleasurep. 12 - **crystals** - a small piece of ice that has many sidesp. 26 - **water molecule** - the smallest amount of water that can existp. 26, 27 - **hexagon** - a six-sided shape | p. 9 - **unique** - something that is unlike anything elsep. 10 - **compared -** measured or judged against something elsep. 12 - **colorless -** without any colorp. 12 - **microscope** - a scientific tool that magnifies things we look at; it makes something very small look larger; micro = small, tiny; scope = viewp. 13 - **colorful -** has lots of color; *full* of colorp. 14 - **absorb -** take something inp. 15 - **reflect -** move in one direction, hit a surface, and then quickly move in a different directionp. 18 - **evaporate** - when liquid changes to vaporp. 18 - **condenses** - when vapor changes to liquidp. 18 – **vapor** - gasp. 24, 38 - **branches** - an offshoot of a main part; one of the 3 or 6 offshoots from the center of a snowflakep. 38 - **identical** - exactly the same |

Extension learning activities for this book and other useful resources

1. Make a snowflake using the instructions from *The Secret Life of a Snowflake*, p. 32-33. Use this activity as an opportunity to discuss text features and following written directions. *Note: This is particularly supportive of English Language Learners.*
2. Check out Kenneth Libbrecht’s web site: [www.SnowCrystals.com](http://www.snowcrystals.com) for additional extension ideas.
3. Explore states of matter further with online resources-- <http://easyscienceforkids.com/all-about-states-of-matter/>
4. Make a mini-water cycle-- <http://thewaterproject.org/resources/lesson-plans/create-a-mini-water-cycle.php>

**What Makes this Text Complex? *Secret Life of a Snowflake***

1. **Quantitative Measure**

Go to <http://www.lexile.com/> and enter the title of your text in the Quick Book Search in the upper right of home page. Most texts will have a Lexile measure in this database.

 

1. **Qualitative Features**

Consider the four dimensions of text complexity below. For each dimension\*, note specific examples from the text that make it more or less complex.

**Meaning/Purpose** - Scientist Kenneth Libbrecht shares his hobby of studying and photographing snowflakes. He explains the development and characteristics of snowflakes. In doing so, he demonstrates the characteristics of a scientist: curiosity, purpose, persistence, and passion.

**Language** - This is an informational text with a large number of academic vocabulary words (e.g., moisture, microscope, photography). It has a conversational tone, but there are also many unfamiliar Tier 3 vocabulary words. While the sentence structure and tone are accessible, the vocabulary is very challenging.

**Structure** - There are many informational text features, including headings, labels, captions, illustrations, and photographs. The photographs/illustrations are closely integrated with the text and serve to clarify key ideas. Teachers will need to give special attention to focusing students’ eyes and minds on the part of the page being read, as well as the illustrations.

**Knowledge Demands** - This text includes scientific ideas and vocabulary, including the water cycle and states of matter.

\*For more information on the qualitative dimensions of text complexity, visit <http://www.achievethecore.org/content/upload/Companion_to_Qualitative_Scale_Features_Explained.pdf>

1. **Reader and Task Considerations**

*What will challenge my students most in this text? What supports can I provide?*

* The scientific concepts and vocabulary may be challenging. Support the concepts and vocabulary by using repeated readings, questions
* To clarify word meanings, an anchor chart, and careful attention to how the illustrations and text connect.

*How will this text help my students build knowledge about the world?*

* + This text will help students understand the science of snow.
	+ This text will also allow students to develop the concept of what it means to be a scientist in having curiosity, purpose, persistence, and a strong passion for a particular area of study.
1. **Grade level**

What grade does this book best belong in? 2nd grade

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