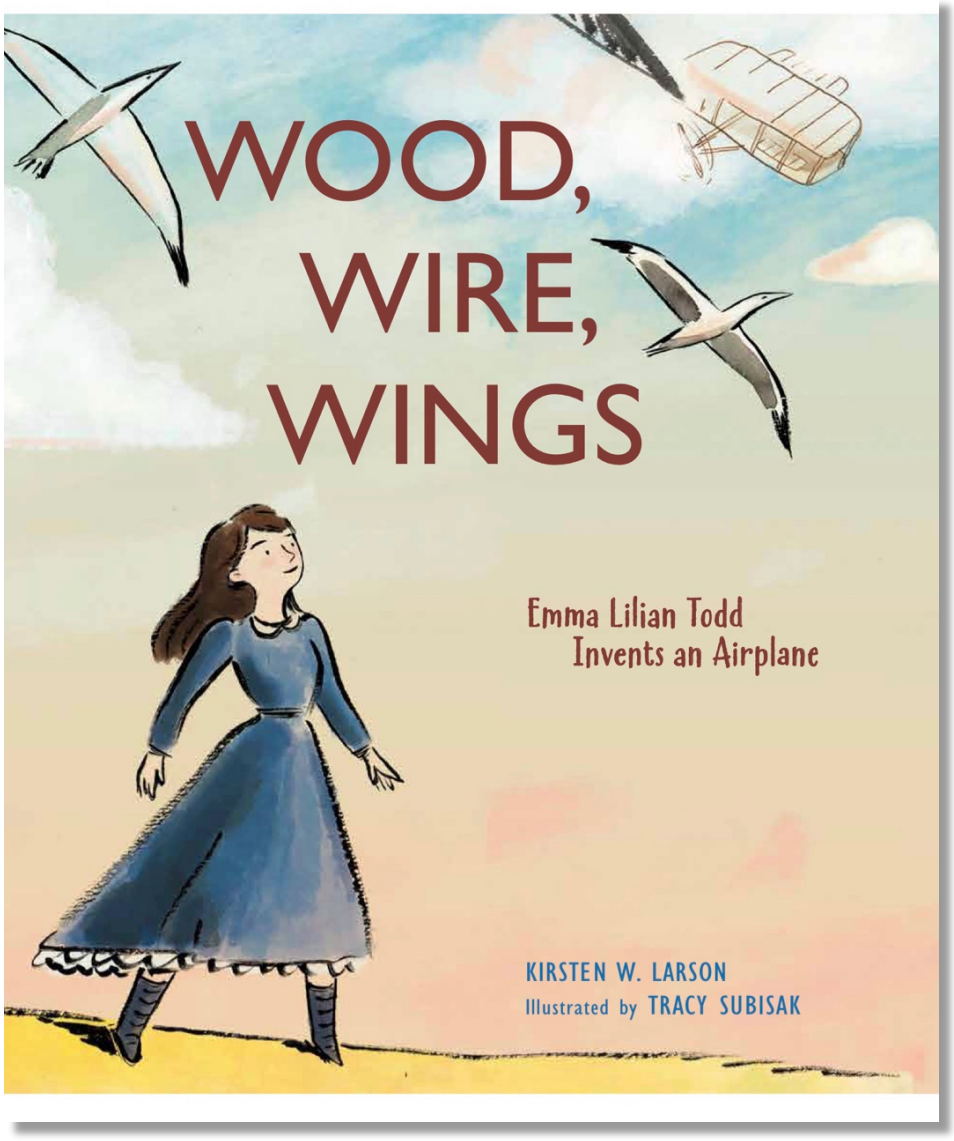
Wood, Wire, Wings

Emma Lilian Todd Invents an Airplane

A teacher's guide created by Marcie Colleen
based upon the picture book biography
written by Kirsten W. Larson and illustrated by Tracy Subisak



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Kirsten W. Larson
Author, ***Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane***

Kirsten W. Larson used to work with rocket scientists at NASA. Now she writes books for curious kids. She's the author of *WOOD, WIRE, WINGS: Emma Lilian Todd Invents an Airplane,* illustrated by Tracy Subisak (Calkins Creek, February 2020), *Cecilia Payne: Making of a Star (Scientist)*, illustrated by Katherine Roy (Chronicle, Fall 2021), along with 25 other nonfiction books for kids. Kirsten lives near Los Angeles with her husband, lhasa-poo, and two curious kids. Her house is filled with LEGO, laughter, and lots of books!

Find her at kirsten-w-larson.com or on Twitter/Instagram @KirstenWLarson.

Tracy Subisak
Illustrator, ***Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane***

Before becoming a children's book illustrator and author, Tracy Subisak was an industrial designer, working on innovative approaches to existing products and helping lead inventions of new products. Because of her background in design, she was excited to work on the upcoming nonfiction picture book titled *Wood, Wire, Wings* by Kirsten Larson, a bio of Emma Lilian Todd, the first woman to successfully design and engineer a working airplane. She is also the illustrator of several picture books including *Grizzly Boy*, *Cy Makes a Friend*, and *Shawn Loves Sharks*. Her debut author/illlustrated picture book *Jenny Mei is Sad* (Little Brown) will come out in spring 2020.

Tracy was born and raised in Ohio, has lived in Taiwan, South Korea, NY, and San Francisco, and now makes her home in the Pacific Northwest. She is always eager to go adventuring and is a true believer that experience begets the best stories.

Marcie Colleen
Curriculum Writer

This guide was created by Marcie Colleen, a former teacher with a BA in English Education from Oswego State and an MA in Educational Theater from NYU. In addition to creating curriculum guides for children's books, Marcie can often be found writing picture books of her own at home in San Diego, California. Visit her at www.thisismarciecolleen.com.

How to Use This Guide

This classroom guide for *Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane* is designed for students in first through fifth grade. It is assumed that teachers will adapt each activity to fit the needs and abilities of their own students.

It offers activities to help teachers integrate *Wood, Wire, Wings* into English language arts (ELA), mathematics, science, and social studies curricula.

All activities were created in conjunction with relevant content standards in ELA, math, science, social studies, art, and drama.

Aligned for Grades 1-5 in both Common Core ELA and Math, and Next Generation Science Standards

1st grade: CCSS: ELA.RL.1.1,2,3,5,7; RI.1.1,2,3,4,6,7,8,9; W.1.2,3; SL.1.1,2; L.1.1,2,4; MATH: 1.OA.3, 1.MD.4

NGSS: K-2-ETS1-1,2,3

2nd grade: CCSS: ELA.RL.2.1,3,5,6,7; RI.2.1,2,3,4,6,8,9; W.2.1,2,3; SL.2.1,2,5; L.2.1,2,3,4; MATH: 2.OA.1

NGSS: K-2-ETS1-1,2,3

3rd grade: CCSS: ELA.RL.3.1,3,4,7; RI.3.1,2,3,4,6,7; W.3.1,2,3,4,7,8; SL.3.1,2,3,4,5; L.3.1,2,3,4; MATH: 3.OA.1,3; MD.2

NGSS: 3-5-ETS1-1,2,3

4th grade: CCSS: ELA.RL.4.1,2,3,4,6; RI.4.1,2,3,4; W.4.1,2,3,4,7; SL.4.1,2,5; L.4.1,2,3,4; MATH: 4.OA.1,5

NGSS: 3-5-ETS1-1,2,3

5th grade: CCSS: ELA.RL.5.1,2,3,4,6; RI.5.1,2,3,4; W.5.1,2,3,4,7; SL.5.1,2,5; L.5.1,2,3,4; MATH: 5.OA.1,5

NGSS: 3-5-ETS1-1,2,3

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English Language Arts

Reading Comprehension

Before reading *Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane*

Tell students to look closely at the Front Cover ~

- Describe what you see.
- Who do you think the woman is?
- When do you think this story takes place? Today or a long time ago? What clues on the cover tell you this?
- Can you guess what the story might be about? What are some clues that tell you the setting?

Now read or listen to the book.

Help students summarize in their own words what the book was about.

- "Lilian grew up in a time when it seemed like everyone was tinkering." What do you think the word "tinkering" means? How does Lilian tinker?
- Name two famous inventions that were created during Lilian's childhood.
- Where did Lilian find some of her materials for her inventions?
- Inventing was not considered work for women in Lilian's time, so what job did she take instead? What did the job entail? Why do you think this job appealed to Lilian?
- What was it about the first full-sized airplanes that Lilian did not like? How did Lilian want her airplane to do different?
- Describe a few of Lilian's first attempts at creating an airplane in your own words, using evidence from the text.
- How did Lilian overcome her financial and space issues when her project became too large?
- Why did Lilian choose to showcase her plane at the 1909 Interborough Fair in New York? What was the outcome?
- Lilian decided she needed to use an airplane motor, instead of a car engine. Why did this set her back almost a year? How did Lilian spend her time waiting for the proper engine?
- Why did Lilian choose to wait for the wind to die down before her plane took off? Do you agree or disagree with her decision? Explain your answer.
- Why did Lilian choose to not pilot her own plane?

- Although she did not create the first airplane, how did Lilian Todd advance the field of aviation?

Let's talk about the people who created *Wood, Wire, Wings.*

- Who is the author?
- Who is the illustrator?
- What kind of work did each person do to make the book?

Reading Nonfiction

While reading *Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane* aloud to the class, have students take notes in two columns:

- *Things We Learned*
- *Questions We Have*

Pause before each page turn to add notes to the columns. These columns can either be worked on individually or put on the smartboard and worked on as a class.

Things We Learned (Facts)	Questions We Have	Answers We Found

- Once the story is read, discuss the *Questions We Have* column.
  - Were any of these questions answered as the story went along?
  - If so, ask students to find the answer within the text.
  - Record the answer next to the question in a third column labeled *Answers We Found.*

- For all remaining questions in the *Questions We Have column*, that have yet to be answered, students will need to take the steps to find answers, either through Internet or book research.
  - Discuss how to find answers to questions through research.
  - Assign students to specific questions to help them focus.
  - Record all answers in the *Answers We Found* column.

- After the answers have been shared with the class, engage in a discussion on research practices.
  - What was the most difficult part about finding answers?
  - Was it easier to find answers on the Internet or in a book?

    - Which source is more reliable, the Internet or a printed book? Why?
    - How can you determine whether to trust a source?
    - What tips would you give someone who is about to do research?

- Read the Author's Note and The Age of Airships at the back of the book.
    - Create an additional chart to document what information in the back matter was included in the story and what information was not included.
    - Why do you think Kirsten Larson chose to include certain information in the main text and leave other information to the backmatter?
    - Choose three facts from the backmatter and explain why you think each was not included in the story.

Extension: Design and illustrate posters representing each Fact, Question, and researched Answer based on *Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane* and display them within the classroom.

Writing Activities

Piloting Lilian's Plane ~ creative story

Imagine that you have been chosen to pilot Lilian Todd's airplane as she observed and took notes. Write about your experience.

- Who are you? Where do you live?
- How were you chosen to be the pilot? What experience do you already have with flight?
- What was it like when you saw the airplane for the first time?
- Once aboard, how did you feel? Were you nervous?
- How did Lilian react? What did she say to you before and after the flight?
- What was the best part? Would you pilot a plane again? Is there anything you would do differently?

Research photographs from 1910 to aid students in placing themselves in the time period. Photographs can be found through the Smithsonian Air and Space Museum website (https://airandspace.si.edu/) and the Library of Congress (https://www.loc.gov).

Have students share their stories of piloting the airplane with the class.

Dear, Olivia Sage: Writing a Persuasive Essay

As her dream outgrew her apartment and her wallet, Lilian needed to turn to others for help. One such person she turned to was Olivia Sage, one of the richest women in the world. But often people don't just hand money to anyone who asks. Lilian needed to

ask Olivia Sage while providing enough details to inform Olivia what her money would be used for. She needed to *persuade* Olivia Sage to help her.

Ask your students if they know what "persuade" means. If not, can they make any guesses?

Discuss:

- What it means to persuade
- Times you might want to persuade someone (e.g., persuade your parents to let you stay up late, persuade your teacher to not give a test)

Writing to persuade tells the reader what you believe, gives the reader at least three reasons why you believe it, and has a good ending sentence. You want to try and convince the reader to agree with you.

Pretending to be Lilian Todd, have students write a persuasive essay to Olivia Sage stating why they need money and why she should give it to you.

Use the following TREE structure:

T = Topic sentences	The topic sentence tells the reader what you think or believe. Example: *I am writing to you because I have been creating an airplane, but now I need financial help.*
R = Reasons	The reasons why you believe what you believe. Write at least two to four sentences giving three reasons. Use evidence directly from the text.
E = Ending	Wrap it up with a conclusive sentence.
E = Examine	Look closely. Do you have all of your parts?

Share your essays with the class. Which is the most persuasive? Why do you think so?

Speaking and Listening Extension: Create a TV commercial or PowerPoint presentation to encourage people to read *Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane.* Be sure to incorporate the TREE structure!

Quotable Lilian

Kirsten Larson included several of Lilian Todd's quotes throughout *Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane*, many of them about gender issues of her time.

Have students choose one of Lilian's quotes and write a four-paragraph essay about what this quote means to them.

Speaking and Listening Activities

Picture books are written to be read aloud. Here are some other ways to bring *Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane* to life in your classroom and have fun with speaking and listening skills!

Choral Reading

- Turn *Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane* into a script. Read the script out loud together. Emphasize memorization of the students' parts as well as good vocal expression.

Mime

- While the teacher reads the book aloud, students can act out the events in the book. Emphasize body motion and facial expressions, as well as listening skills.

Drama

- Create a Flipgrid or PowerPoint presentation to encourage people to read *Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane.*
- Create an infomercial for your own invention.

Language Activities

New Vocabulary: Brainstorming

What is brainstorming?

- To demonstrate, show the class a paper plate.
    - Then, give the class two minutes (use a timer) to list as many things as possible that the paper plate can be used for.
    - Record their ideas on the board.
    - Once the two minutes is up, review the list on the board.
    - Explain that what they were just engaged in was brainstorming.

Look up 'brainstorming' in the dictionary. (Depending on the level of your students, a student volunteer can do this or the teacher can.)

    - Read the definition.

- Explain that a brainstorm is when you take all of the ideas in your head and let them out, kind of like how a cloud lets out all of the rain during a storm.

Explain the "rules of brainstorming."

- Nothing is a bad idea. Do not criticize any ideas while brainstorming.
- Hitching is welcome. Listen to others' ideas and let their ideas spark new ideas in you. This way, in group brainstorming, ideas build upon each other.
- Be off-the-wall. Outrageous and humorous ideas are welcomed.

Now knowing what we know about brainstorming, let's try some brainstorming activities.

- Categories Game. Have students sit in a circle and take turns brainstorming items in the announced category. For example, "animals." Go around the circle and have each child name an animal. They cannot repeat a response that another child gave. Go around the circle more than once if kids seem to have more ideas in that category. Other potential categories include fruits, vegetables, colors, items of a specific color, creatures that swim, musical instruments, and things with wheels.

- Hypotheticals. Move brainstorming into the abstract by having students brainstorm answers to hypothetical questions. For example, ask them what a dog might be thinking while he sits at home or what might happen if people could fly. Record all of the answers so they can be read back to the kids when the brainstorming is finished. Rather than going around a circle and putting pressure on kids to think of something new, have students raise their hands to share answers. If a child is quiet, call on him/her early in a round before too many obvious answers have been said.

- Silly Answers. Teach students that they should share anything they can think of in a brainstorm, even if it does not seem like the best answer, by having them share the silliest answers they can think of to some questions. For example, brainstorm the silliest way to get from one end of the room to another. Turn it into a physical activity by having them demonstrate their silly methods, too. When students start running out of ideas, ask: "Who can think of something even sillier?" to prompt more responses.

After better understanding brainstorming, discuss:

- The value of brainstorming.

- Why brainstorming is so important to inventors and creators.
- How students could use brainstorming in their everyday life.

Math

Math Without Numbers

Inventors and engineers use math skills every day, even when they don't use numbers. These skills are important to anyone who is thinking critically and solving problems.

Help your students practice with the following activities:

Classifying and grouping games: Mix up many kinds of blocks and ask students to classify them by size, color, or shape. Older children can classify and group themselves based on birthday months, color of clothing, etc.

Estimation: Using dried beans and several containers of different heights and widths, students are to guess which containers will hold the most beans and which containers will hold the least beans. Have students put the containers in order according to their capacity. Once the class has agreed on the order, fill each container with beans, one at a time. Count how many beans are in each container. Were they right about the order?

Patterning: Build a simple pattern using M&Ms, buttons or pieces of paper. Start with an alternating pattern (called an AB pattern): one red candy, one green candy, one red, one green, and so forth. Be sure to repeat the pattern at least once. Next, students should continue the pattern by building a sequence that's exactly like the initial pattern. "How did you know to start with a red?" or "Why did you use a green here?" Some more difficult patterns to practice are: AAB, ABB, AABB, and ABC.

BONUS:
- How do you think classifying and grouping, estimating, and patterning assist inventors like Lilian Todd?
- How would you use these skills in your daily activities?

Calculating Travel

Lilian planned for her plane to be able to go 40 mph (we don't know if she actually achieved this). She also envisioned people flying planes to the country for a picnic in the future. Imagine Lilian Todd would like to fly her plane from the airfield in Long Island to Central Park in New York City, about 20 miles away. How long, with her 40 mph estimation, will it take her to fly there?

Where would you like to go to have a picnic? Choose a location and then calculate its distance from the nearest airfield. How long will it take you to get there?

Science

The Engineering Design Method

The Engineering Design Process is a process that engineers, scientists and inventors use to problem solve.

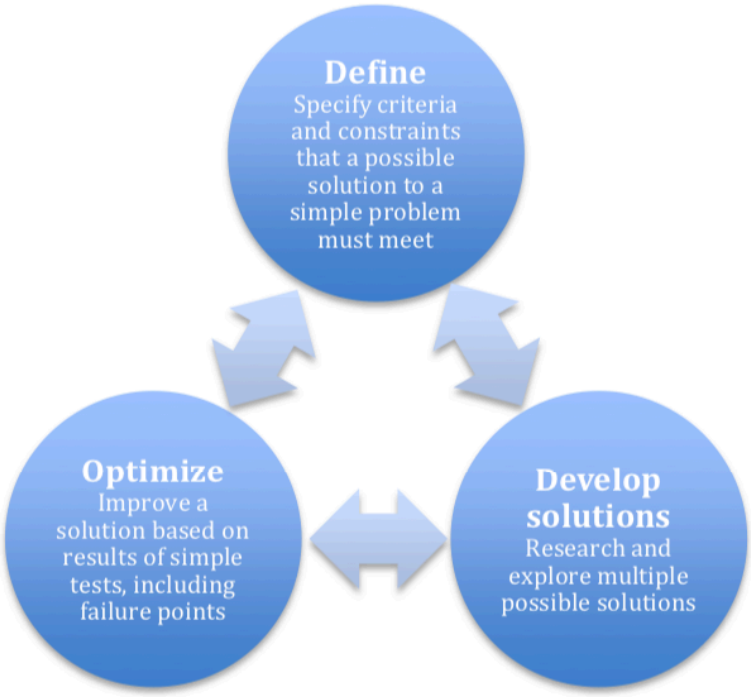

Figure 1 Next Generation Science Standards www.nextgenerationscience.org

After introducing the process to the class, lead them through a discussion.

- Describe how these three steps help with problem solving.
- What do you think would happen if you skipped a step?
- Why do you think there are two way arrows between the circles denoting the different parts of the process?
- Can you find evidence that Lilian Todd used many of these steps in *Wood, Wire, Wings: Emma Lilian Todd Invents an Airplane*? How so? Use textual examples.

Build an Airplane

This challenge allows students to test out the Engineering Design Process for themselves as they problem solve a way to build an airplane that really works! Of course, a little imagination is going to go a long way here, too!

- Explain to students that they will be working to build an airplane that can fly.

- Provide the students with several craft items (paper, paperclips, stapler and staples, rubber bands, etc.)
- Each airplane must:
    - Be able to travel in the air from one point to another.
    - Be a construction, not merely a folded piece of paper.
- Each student must create a Design Notebook for their airplane and carefully document their use of the Engineering Design Process throughout the process of building their airplane.

Once all airplanes have been constructed, test them out one by one as a class. Did they work? Retest? If they didn't work, head back to the drawing board like a real inventor.

Often up awards to increase the competition.

- Longest Flight
- Highest Flight
- Most Materials Airplane
- Least Materials Airplane
- Best Looking Airplane

How Birds Fly

Lilian Todd studied how birds fly in her quest to develop an airplane. She learned how they lift off the ground and fly or glide through air.

Guide students through their own discovery regarding flight and lift.

Take a piece of paper. The best type of paper to use is the thin sheets used in magazines.

Hold the short edge of the paper up to your mouth using both hands.

What do you think will happen if you blow hard across the top of the paper? Will it go down or up?

In most cases a person would think the paper would go down and not lift up when they blow air across the top.

But this is not the case. Blowing faster-moving air above the sheet paper lowered the air pressure above the paper. Now the air pressure below the paper is higher and creates lift. Lift does exactly what it sounds like; it lifts objects off the ground when everything is just right.

How do you think this information can help in wing creation for an airplane?

Necessity is the Mother of Invention

Today, inventions do so many things we take for granted. During Lilian's time there was an increase in inventions, many of which she saw when she worked at the the U.S. Patent Office.

Lead students in creating a list of some of the machines or inventions that make our daily lives easier.

- Who invented these machines? When?
- If you could invent something, what would it be?

Have students design inventions and create a Flipgrid or PowerPoint presentation demonstrating what it can do and convincing others to buy it.

Social Studies

1910—What a Year

A lot can happen in a year and it did in 1910.

Not only was 1910 the year that Lilian Todd became the first woman in the world to design and build a working airplane, but there were many other advances and milestones, as well.

Assign groups of 2-4 students to research a notable event, person, or innovation of 1910, and then present to the rest of the class in an original celebration of 1910.

The following links can be starting points for research:

https://en.wikipedia.org/wiki/1910

https://www.onthisday.com/events/date/1910

https://www.thefamouspeople.com/born-1910.php

Famous Female Inventors

Assign a famous female inventor for students to research in the library and on the Internet. A list of 10 are below, but do not feel limited to those on the list.

- Margaret Knight
- Melitta Bentz
- Caresse Crosby
- Katharine Burr Blodgett

- Stephanie Kwolek
- Ada Lovelace
- Bette Nesmith Graham
- Mary Anderson
- Ruth Wakefield
- Marion Donovan

Possible sources for information:

- Nonfiction books
    - *Girls Think of Everything: Stories of Ingenious Inventions by Women* by Catherine Thimmesh, illustrated by Melissa Sweet (Houghton Mifflin 2000)
- Library research
- The Internet
    - A Mighty Girl "Sisters in Innovation: 20 Women Inventors You Should Know" (www.amightygirl.com/blog?p=12223)

Take notes and gather as much information as possible on the following five topics about your inventor:

- Early Life/Childhood/Family
- Life as an inventor
- Famous work
- Legacy
- Other fun facts

Once the information is gathered, work to create either an illustrated poster or booklet of the findings.

Gender Bias in Science

We hope students today realize that girls can do and be anything boys can. But bias still exists in the science, technology, engineering, and mathematics fields.

While we rarely recognize biases within our own thinking, this activity, adapted from www.smarttutor.com, will raise consciousness and spark discussion.

1. Ask children to draw a picture of an inventor or scientist. They may not ask any questions of you or any of their peers. They must simply draw the first inventor or scientist that comes to their minds, with no talking or sharing.
2. Then, students should create a brief written description of who their person is and their person does.
3. Ask them to share their drawings and descriptions with the class.

4. While students are sharing, chart the number of male and female inventors and scientists that students create on a graph. Do not reveal what you are doing to avoid skewing the results.

Discuss the results. Often children draw mostly male scientists or inventors in lab coats with chemicals or something of the sort. Share the graph with the students. Do the results show an internalized gender bias? Challenge the class to discuss where they feel this bias comes from and why it is harmful to society.

Use Lilian Todd's experience in *Wood, Wire, Wings* as an example.

- How have the STEM fields changed for females since Lilian's time?
- How have they stayed the same?
- How can we take steps to end gender bias in the sciences and engineering?