

Teacher Page

How to Be an Inventor

How to Use This Resource

This teacher resource is a companion to the student Listening Guide for the Tumble Science Podcast episode "How to Be an Inventor." It includes a chapter-by-chapter summary with clickable YouTube links, Tier 2 and Tier 3 vocabulary for each section, and answer keys for all student questions.

Introduction

► [00:00 – Introduction](#)

Hosts Lindsay and Marshall introduce scientist and inventor Josh Miele. Josh is blind, works at a technology company, and has invented tools including the audio description platform for YouTube, a new use for the smartpen, and a braille chord chart system for musicians. He explains that people with disabilities are natural inventors because they constantly have to find new ways to do everyday things.

Tier 2 Vocabulary	Tier 3 Vocabulary
invent: to create something new that didn't exist before disability: a condition that limits a person's movements, senses, or activities necessity: something that is needed; a requirement	patent: an official legal right that prevents others from copying an invention audio description: a spoken narration added to a video to help blind or visually impaired viewers understand what is happening on screen braille: a writing system using raised dots that can be read by touch, used by people who are blind

Answer Key:

1. What is Josh Miele's job? What makes him especially good at it?

Answer: *Josh is a scientist and inventor who creates tools for blind people. He's especially good at it because he is blind himself, giving him firsthand experience with the problems he is solving.*

2. Josh has invented several things. List two of his inventions below.

Answer: Accept any two of: the audio description platform for YouTube; a new use for the smartpen to help blind people get more information about objects; a braille chord chart system for musicians.

3. Josh says that people with disabilities are natural inventors. Why does he think that?

Answer: Because people with disabilities constantly have to figure out new ways to do things others take for granted. They are always problem-solving out of necessity.

Step 1: Identify a Problem

► 03:20 – Step 1: Identify a Problem

Josh introduces the first step of inventing: identifying a problem you want to solve. His example problem is that blind people have no way to access street-level geographical information — there are maps of countries and continents, but nothing that helps you navigate your own neighborhood. Josh describes how he uses his cane and landmarks to build a mental map of his surroundings, which is what led him to recognize the problem.

Tier 2 Vocabulary	Tier 3 Vocabulary
identify: to recognize and name something landmark: a recognizable feature used to help navigate or find one's way accessible: able to be reached, used, or understood by everyone, including people with disabilities	geographical: relating to the physical features of an area, such as streets, buildings, and terrain echolocation: (implied) using reflected sound to locate objects — similar to how Josh hears his cane bounce off buildings

Answer Key:

1. What is the FIRST step in the invention process?

Answer: Identify a problem you want to solve.

2. What problem did Josh want to solve? Describe it in your own words.

Answer: Blind people had no way to access street-level maps that would help them navigate their own neighborhoods and cities.

3. How does Josh use his cane to build a mental map of his neighborhood? What are "landmarks"?

Answer: Josh uses the sound of his cane bouncing off buildings and objects to sense his surroundings. He also identifies specific things (like a newspaper stand) as landmarks — fixed reference points he uses to know where other nearby things are.

Step 2: Understand the Problem

► 06:02 – Step 2: Understand the Problem

Step 2 is making sure you truly understand the problem — not just from your own point of view, but from the perspective of the people you are designing for. Josh shares the story of his failed "braille gloves" invention: the technology was clever, but people simply don't want to wear gloves. He emphasizes that an invention must fit into people's real lives, and the only way to know that is to talk to them first.

Tier 2 Vocabulary	Tier 3 Vocabulary
research: careful study to find information and learn about something	prototype: a first model of something new, built to test an idea before full production
challenge: something difficult that requires effort to overcome	user testing: the process of seeing how real people interact with a product or idea
practical: likely to work in real life; useful and not just theoretical	

Answer Key:

1. Why isn't it enough to just invent a technology? What else matters?

Answer: *The technology has to work within the entire system of people's lives — it has to be something people actually want to use.*

2. Josh invented "braille gloves" — but the invention failed. What went wrong?

Answer: *The idea was good in theory, but people don't want to wear gloves. Josh didn't fully research whether users would actually adopt the solution in their daily lives.*

3. What does Josh say inventors should do before building their idea?

Answer: *Talk to the people they are inventing for. Ask them if the idea would actually be useful, and if not, find out why and what would be useful instead.*

Step 3: Explore Options

► [09:59 – Step 3: Explore Options](#)

Step 3 is exploring many different possible solutions and thinking creatively. Josh's preferred solution was tactile maps — maps printed with raised lines and dots that can be felt with the fingers. He realized that a braille embosser (a special printer that makes raised dots) could be repurposed to print maps instead of letters. He describes all the steps he needed to figure out before printing could even begin.

Tier 2 Vocabulary	Tier 3 Vocabulary
option: a choice; one of several possible solutions creative: using imagination to come up with new ideas pros and cons: the advantages and disadvantages of an idea	tactile: relating to the sense of touch; something you feel with your fingers tactile graphics: images, charts, or maps that use raised lines and textures so they can be understood by touch braille embosser: a special printer that creates raised dots on paper, used to produce braille text or tactile images

Answer Key:

1. What does "tactile" mean? Give an example from the episode.

Answer: "Tactile" means relating to touch or the sense of touch. Example: tactile maps are maps with raised lines that you feel with your fingers.

2. What was Josh's favorite idea for solving the map problem? Describe how tactile maps work.

Answer: Tactile maps are maps with raised lines on paper. Each raised line represents a street, so a person can feel the map with their fingers and build a picture of the neighborhood in their mind.

3. What special technology did Josh decide to use to print the maps? How does it work?

Answer: A braille embosser — instead of printing braille letters, it uses dots like ink to draw pictures (maps) on paper, with raised dots forming lines and shapes that can be felt.

Step 4: Experiment!

► [13:53 – Step 4: Experiment!](#)

Step 4 is experimenting — building a prototype and testing it. Josh created a computer program that converted street data into a format the braille embosser could print. His first attempt (the "smoke test") produced a garbled mess, but he quickly identified a simple programming mistake, fixed a couple of lines of code, and ran it again. Out came a beautiful tactile map of downtown Berkeley — a moment Josh describes as getting chills.

Tier 2 Vocabulary	Tier 3 Vocabulary
experiment: a test carried out to see what happens or to check if an idea works prototype: the first working model of an invention disappointed: feeling let down when something doesn't work as hoped	smoke test: the very first test of a new device or program to see if it works at all — named for early electronics that would literally smoke if wired incorrectly debugging: finding and fixing errors (bugs) in a computer program

Answer Key:

1. What is a prototype? Why is it important to build one?

Answer: *A prototype is the first working example of an invention. It's important because it lets you test your idea in reality and find out what works and what needs to be fixed.*

2. What is a "smoke test"? Where does that name come from?

Answer: *A smoke test is the very first test of a new device — just turning it on to see if it works at all. The name comes from early electronics: if you wired something wrong and turned it on, it would literally start to smoke.*

3. When Josh ran his smoke test, what happened at first? How did he fix it?

Answer: *The map came out as total garbage — it didn't work. Josh looked at his programming, found a simple mistake, changed a couple of lines of code, and ran it again. The second attempt produced a beautiful map of downtown Berkeley.*

Step 5: Get People to Use It

► [16:44 – Step 5: Get People to Use It](#)

The fifth and final step is making sure people can actually access and use the invention. A great idea that nobody can find, afford, or use isn't really a successful invention. Josh worked to get his maps into libraries and schools that had braille embossers, so blind people who didn't own one could still print maps. People's emotional reactions — some cried when they first touched a map of their own neighborhood — showed how powerful and meaningful the invention was.

Tier 2 Vocabulary	Tier 3 Vocabulary
access: the ability to get, use, or reach something distribute: to share or spread something to many people emotional: relating to strong feelings	MacArthur Fellow: a recipient of the MacArthur Foundation "Genius Grant," awarded to people doing exceptionally creative work in their field TMAP: Josh Miele's tactile map platform, which allows anyone to download and print braille maps of their neighborhood

Answer Key:

1. Why isn't a great invention enough on its own? What's the final step?

Answer: *Even a great invention fails if people can't find it, afford it, or use it. The final step is making sure the invention actually reaches the people who need it.*

2. What challenge did Josh face in getting people to use his maps? (Hint: think about cost.)

Answer: *Braille embossers are much more expensive than regular printers, so most people don't own one. Josh needed to make sure that places like libraries and schools — which do have embossers — knew about the maps and could help people access them.*

3. Describe how people reacted when they used Josh's tactile maps for the first time.

Answer: *People were very emotional — some cried. It was powerful for blind people to finally be able to feel a detailed map of streets they already knew well but had never been able to see laid out in front of them.*

Closing Activity

► [19:31 – Closing Activity & Credits](#)

Lindsay and Marshall review all five invention steps and challenge students to invent something of their own. The five steps to review with students:

Step 1: Identify a problem you want to solve.

Step 2: Make sure you understand the problem — talk to the people who have it.

Step 3: Explore different options for solving the problem; think about pros and cons.

Step 4: Experiment — build a prototype and test it.

Step 5: Figure out how to get people to use your invention.

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