



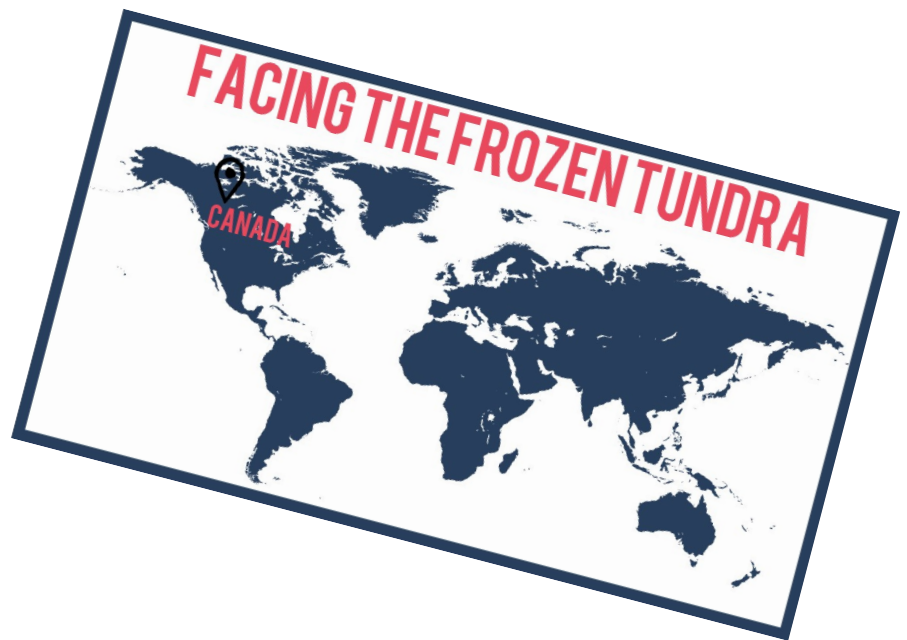
Get Your Chill On Facilitator Resources



Problem Cheat Sheet

Adventure:

4: Facing the Frozen Tundra



Quest:

2: Get Your Chill On

Goal:

Design a transporter that will safely carry Flynn's ice sculpture so that it will not melt or break on the way to an ice sculpture contest.

Setting/Background Story:

Flynn has made an ice sculpture, and she wants to participate in an ice sculpture contest in another town. To get there, she will have to tow her sculpture behind a bus because it is so large. She is worried that the sculpture will fall and break or that it will melt from the heat of the bus engine. She needs to build a transporter that will travel without tipping over and that will protect her sculpture from heat.

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Quest Structure:

Session 1: GEERling(s) receive a supply of household materials and try to use them in creative ways to design a solution to Flynn's problem—building a transporter to carry an ice sculpture and protect it from heat. At the end of the session, GEERling(s) share their solutions.

Session 2: Flynn shares with the GEERling(s) information about heat conduction, conductors, and insulators. She tells the GEERling(s) she needs to use insulators to protect her ice sculpture from heat. The GEERling(s) research these concepts to gather information that will help them plan their new designs.

Session 3: The GEERling(s) use their new knowledge to design a transporter that will travel without tipping over and that will protect the ice sculpture from the heat of the bus engine.

Test for Success:

The transporter must travel 5 feet without tipping over. It must hold an ice cube and keep the ice cube from melting when a hair dryer (on "low" in session 1 and "high" in session 3) blows hot air on it for a given amount of time (30 seconds in session 1 and 45 seconds in session 3).

Detailed Background on the Quest



In *Get Your Chill On*, the GEERling(s) will design a device that will carry an ice cube a short distance and also protect the ice cube from melting.

Flynn has made an ice sculpture, and she wants to enter it into a contest that is being held in another town. The only way to get her large sculpture to the contest is by towing it behind a bus. The GEERling(s) will help Flynn by designing a transporter that can carry the ice cube and that can protect the ice cube from the heat of the bus engine. They will do so without any introductory information on the first day. Their solution should be sturdy enough to travel without tipping over, and it must keep Flynn's ice sculpture from melting.

On the second day, the GEERling(s) will be introduced to the concept of heat conduction. We will discuss how certain materials transfer heat faster than others and compare metal to wood. They will also learn about materials engineering and conduct research about conductors and insulators of heat using our online resources. We will talk about how material engineers develop new materials to be used in new products and solutions. They will be encouraged to conduct their own research online as well.

On the last day, the GEERling(s) will build a new transporter. Their solutions should combine their creative ideas with the knowledge of heat conduction that they gained from their research. The difference in the Test for Success will be that the hair dryer should be used on a higher setting than in the first session. If the ice cube has not melted a noticeable amount and the structure does not tip over when moved, they will be considered successful.

Canada — Sports and Food



Canada is a multicultural country with a diverse population. With its history as a British colony and a French settlement, there are strong influences in Canadian culture from England and France. Canada is also strongly influenced by Aboriginal groups which means the people who lived there before European colonists arrived. As more and more people from around the globe have immigrated to Canada, Canadian culture has grown even more diverse.

All these different cultural influences affect Canadian cuisine, so the food in Canada is just as diverse as the population. When you think of Canadian food, you probably think of maple syrup. That makes sense because Canada is the biggest producer of maple syrup in the world! One interesting Canadian food is poutine. This is a dish of French fries topped with gravy and cheese curds. If you've never heard of cheese curds, those are the chunky parts of cottage cheese. This food is very popular in Canada. Does it sound good to you?

Sports are an important part of Canadian culture. Because of the country's cold climate, winter sports are very popular. Ice hockey is the most popular winter sport, and it was invented in Canada! People also enjoy other winter sports, like skiing, curling, and ringette. Ringette is similar to ice hockey, but instead of a puck, players use a rubber ring. The sticks are straight, not curved like hockey sticks are. Some of the rules are different too. In the warmer parts of the country, lacrosse is very popular in the summer. This sport also originated in Canada. Canadians also enjoy Canadian football, which is similar to American football but with some different rules.

Canada is very competitive in the Winter Olympics. In the 2010 Winter Olympics, Canada won 14 gold medals. That was more than any other country that year—in fact, that's more gold medals than any country has ever won in one year at the Winter Olympics!



Materials List



The following materials can be purchased at any grocery store or dollar store. These materials were chosen for the sake of teaching of the GEERling(s) to imagine new uses for everyday objects and to make the preparation for this activity easier and more affordable for you.

Please gather the following materials prior to starting this adventure with the GEERling(s). As they work on their solutions, the GEERling(s) should only use the items listed below because they represent the materials that the character, Flynn, has to use on hand. In this quest, Flynn is gathering these materials from the house where she and her parents are staying.

Material:

What it Represents:

Popsicle Sticks (15)	⇒ Wood plank found in the garage
Spools (4)	⇒ Wagon wheels found in the garage
Toothpicks (30)	⇒ Small wooden rods found in the garage
Straws (10)	⇒ Large wooden rods found in the garage
Styrofoam Cup (1)	⇒ Bin found in the basement
Empty Tin Can (1)	⇒ Garbage can
Bubble Wrap (Two 4x4 Pieces)	⇒ Found in the basement
Plastic Wrap (Two 4x4 Pieces)	⇒ Found in the kitchen
Tape (1 container)	⇒ Found in the kitchen
Aluminum Foil (Two 4x4 Pieces)	⇒ Found in the kitchen
Cotton Balls (10)	⇒ Pillows from the house

In addition to these materials, please provide scissors for the GEERling(s) to use to alter the materials in any way they choose.

To test the solutions, you will need a hair dryer, 2 ice cubes for each GEERling or team, and access to an electrical outlet.



Make sure the GEERling(s) understand what all of these items are! If they aren't familiar with them, you can show them pictures online.

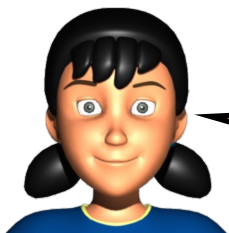
Engineering Concepts



In this quest, the GEERling(s) will be learning about heat conduction which is a method of heat transfer. An important principle to remember is that heat energy always moves from a warmer object to a colder one. This is why our hands feel warm when we hold a hot cup of coffee; the heat energy from the hot mug transfers to our cooler hands.

Heat conduction is one of several ways to transfer heat energy. To understand how heat conduction works, we have to think on a microscopic scale. Heat is generated by the movement of atoms. When an object's atoms are vibrating rapidly, the movement creates heat energy. If a warm object comes into contact with a cooler one, the rapidly vibrating objects of the warm object interact with the slower atoms of the cool object and cause them to move more quickly too. It's similar to a line of dominoes. If you hold a metal rod over a flame, the atoms nearest to the flame will begin to move more quickly. Then they bump into their neighboring atoms, which begin to move more quickly too, and those atoms then bump into their neighboring atoms and on down the line until the heat energy reaches all the way to your hand.

Some materials transfer heat better than others. The best conductors of heat are metals. The molecular structure of metals makes the transfer of heat possible. Metal ions are held together by strong molecular bonds, and there are many "free" electrons in motion in metals. These properties allow the atoms of a metal to easily pass heat energy to their neighboring atoms. Other non-metal materials are poor conductors of heat because they do not transfer heat well. An excellent insulator is air because gases do not transfer heat as well as solids and liquids. Materials that trap small pockets of air, such as fabric and foam, make good insulators. Plastic, rubber, and wood are other examples of good insulators. Many animals naturally grow insulators on their bodies in the form of hair or feathers.



Share these ideas with the GEERling(s) to encourage their natural curiosity, but only if they have already brainstormed!

Timing and Pacing



Growin'GEERS is a program that enables young students to develop creative, research, and engineering skills, we have found that this works best to spend several days on each problem. We recommend doing **three two-hour sessions** to best serve the participants and the chaperones. Below is a general guideline for how you could run a problem, but this plan can be altered to meet the needs of your particular group.

Session 1:

Flynn describes her problem and asks the GEERling(s) to help her with a solution. The GEERling(s) experiment with the materials in the Supply Sack and use creative ideas to design their solutions. When time is up, the GEERling(s) present and test their solutions and discuss them with the group. We suggest planning for a 2-hour block, but you can use as much time as your group needs. In this quest, you will need ice cubes for each of the teams and a hair dryer with a high and low setting to test if each group was successful.

Session 2:

Flynn introduces the concept of heat conductivity. The GEERling(s) use computers to research this concept and think about how they can apply this information to the solution they are building for Flynn. You can use whatever amount of time is suitable for your group. Since you'll be using computers, you may want to get them set up before the GEERling(s) arrive. Like Session 1, 2 hours will usually be enough time for Session 2.



Session 3:

This session may take longer than 2 hours because the GEERling(s) will be challenged to use the information they gained from their research and apply it to the hands-on activity. Plan for this session to take a little more time than the first two. For testing, you will use the higher setting of the hair dryer and a new ice cube to test if the GEERling solution works!

***Again, this plan is just a general guideline, and you can choose to alter it in any way that would best serve your group. The GEERling(s) should use make the most of the time in each session. The entire session should be devoted to discussing, designing, building, researching, and having fun! If a group is working slowly, you can help them along by asking some of the guiding questions. If a group is working too quickly, you can encourage them to slow down and think carefully about their designs with the same questions. But make sure that your help doesn't involve making suggestions or leading them to a certain conclusion; their ideas and solutions should be their own!**



Specifics for Space

You will need access to an electrical outlet in order to test the GEERling(s) transporters with a hair dryer. You will also need to mark a 5-foot area on the floor to test how well the transporters move. You can mark the 5 feet using masking tape on the floor. The test also requires ice cubes—2 per team or GEERling—so you will need access to a freezer or a cooler in order to keep the ice cubes from melting before the test starts. Have paper towels on hand to clean up moisture from melted ice cubes!

Guiding Questions for Each Session



SESSION 1

***If your group is new to Growin'GEERS**, show Introduction Video. This video gives an overview of Flynn and Growin'GEERS.

1. Introduce the problem to the GEERling.

Welcome, GEERling(s)! Today we're going to hear from Flynn again about a new problem she's facing. Then we'll work on a solution that will help her. Let's see what she needs us to do!

2. Show **Video A** to GEERling(s).

3. Check for understanding.

What is it that Flynn is asking us to do?

Why does Flynn need our help?

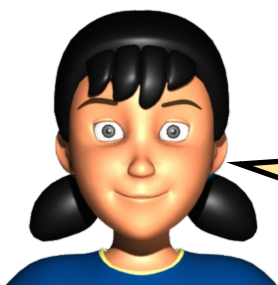
Do you think she could run into any other problems you want to include in your solution?

Did Flynn say anything you didn't understand? Why was it confusing?

4. Inventory the fun pack and set up the workspace.

Go over each item with the GEERling(s) so that they understand all of the materials they have to work with.

(Repeat this step with all of the materials to ensure each pack has the materials that are needed.)



If you plan on using this Quest with a larger group, be thoughtful in assigning groups together to make sure different personalities will work well together.



5. Prepare the area for GEERling(s) to test their solutions. Make a starting and finish line on the floor 5 feet apart for the distance test. Use a hair dryer that has a high and low setting, and make sure you have access to a power outlet. Use a clock with a second hand or a timer to keep track of seconds for the hair dryer test. You will also need fresh ice cubes for this test.

In this first session, the GEERling(s) can use any ideas to create their solutions. Encourage them to be creative!



6. If working with a group, remind GEERling(s) to work cooperatively.
Say: Good teamwork is important! While I watch you working, I want to see every team member contributing to the solution. Make sure you're being helpful to your group and giving your teammates a chance to help too.

If working individually, ask them to walk through their design process with you and how they arrive at a design to build. Don't rush the brainstorming process!

7. Allow 10-15 minutes of discussion among the team. This time is only for planning and brainstorming. Walk around the room and observe the GEERling(s) while they discuss ideas.

8. Allow 50-60 minutes for building. Walk around to observe the teams or individuals as they work. Make sure the teams are working well together and that they are using their time and materials appropriately. The GEERling(s) may want to test out their solutions while they work. You can allow them to pull their solutions to the finish line, and they may briefly use the hair dryer to see how the heat affects their building materials, but save the ice cubes for the real test to minimize messes. If a group is struggling, don't hesitate to share some of the information provided on our additional materials so they don't get frustrated, but make sure they are challenging themselves as well.



The GEERling(s) may get stuck while working on their solutions. If so, use guiding questions to encourage their critical thinking, but be sure not to give them suggestions or lead them to a specific idea. Try these sample questions:

What made you use this material here?

What type of structure are you building?

What materials do you have that could solve the problem you're having?

Have you included everything you need to solve the problem for Flynn?

9. Gather the GEERling(s) together and have them present their solutions. First they need to pull their transporters from the start line to the finish line without it tipping over. Then they will place an ice cube inside the transporter and you will blow hot air from the hair dryer on the "low" setting onto the transporter for 30 seconds. After each team tests their solution, they should present their ideas to the group or facilitator to explain the methods they used to build their solution and why. Use the following questions to promote more critical thinking about the solutions.

What do you think worked well on your solution?

What do you think you could have improved on your solution?

What would you have done differently if you had to solve this problem again?

If you could have any additional materials, what would you want?

How is your solution different from other solutions?

What were some things that your team did well to work together?

How could your team have worked better together?

What other thoughts do you have about the problem and your solution?

10. Show **Video B** to finish the session.



SESSION 2

1. Welcome the GEERling(s) to session 2!

Say: Welcome back, GEERling(s)! I'm glad you're here to continue helping Flynn find a way to transport her ice sculpture. She has something new to say to us. Let's find out what it is.

2. Show **Video C** to the GEERling(s).

3. Have the GEERling(s) to research heat conductivity and insulators on the computer. If they need it, you can make suggestions of what to search for. The GEERling(s) should take notes on their research and work on answering the worksheet questions. Writing this information down will help them to remember it easily when they plan their second solution. Allow 45-50 minutes for research or more if needed. Younger GEERling(s) may need help using the computer, but make sure that they take charge of the actual research even if someone else helps them operate the computer. Ask questions to check their understanding of the material while they are researching. They should not write down notes that they don't understand. Make sure they are able to explain the information in their own words rather than just repeating something they heard or read. We recommend that younger GEERling(s) use videos and images rather than written text if they have trouble reading or if the content is too advanced for them to understand independently.

4. If working with a group, have the GEERling(s) share their new information with their groups. You may want to go through the entire worksheet and ask for everyone's responses, or depending on time, you might just want to highlight some of the questions. Use your discretion, but sharing is very valuable to the learning and engineering processes and should never be skipped over.

If you are working individually, have your GEERling practice their presentation skills for you! Engineers need to know how present their findings, so it is good practice!



5. Show **Video D** to the GEERling(s) and wrap up for the day.

Say: *Great job researching today! You'll use what you learned about heat conduction to help Flynn make a new transporter for her ice sculpture. Please make sure you clean up your materials before you leave. I'll see you next time!*

SESSION 3

1. Welcome the GEERling(s) back to the final session.

Say: *Hi, GEERling(s)! Today you're going to use your new knowledge of heat conduction and insulators to design a transporter for Flynn's ice sculpture. This will be a real challenge, but I think we'll have a good time. Let's hear a message from Flynn before we start.*

2. Show **Video E** to the GEERling(s). Give them time to review what they learned about heat conduction. They may use their notes to review. Allow at least an hour for the GEERling(s) to design and build their new transporters. Encourage them to use what they learned during the previous sessions to design the solution.

3. Have GEERling(s) stop working and present their transporters to the other teams or their facilitator. Test the solutions by having the GEERling(s) pull the transporters over a distance of 5 feet, as in the first session, and by blowing hot air from a hair dryer on the transporters with an ice cube inside. This time, set the hair dryer to "high" and blow the hot air for 45 seconds.

If you want your GEERling(s) to practice their presentation skills, have them present their solution to us! Video tape their presentation and post it on social media with an @growingeers tag for us to see!



If the test was successful, ask them the following questions:

What was the key to your success?

Was your team a pivotal piece of your success? Why or why not?

What was the most challenging part of the quest?

What did you learn about conduction and insulation that helped make your solution successful?

How do you know you were successful? Did you have to test your solution more than once?

If the test was unsuccessful, ask the following questions:

What part of the design process was most challenging?

What materials do you think could have helped you create a better solution?

What could you have done differently to reach success?

Don't get discouraged! What do you think engineers learn from their failures?

Do you think it is important to fail? Why or why not?

4. Show **Video F** and have the GEERling(s) clean up. Try to save any materials that could be used in the future.

Make sure the GEERling(s) understand that failure is truly just a learning experience; not a failure! Encourage them to keep reaching for success!

