



# IGNITE MY FUTURE

## SUBJECTS

Math

## COMPUTATIONAL THINKING PRACTICE

Developing and Using  
Abstractions

## COMPUTATIONAL THINKING STRATEGY

Decompose

## MATERIALS

Poster board/paper/  
chalkboard/whiteboard

Computers with internet access  
and a spreadsheet program  
(Microsoft Excel, Google Sheets  
or a similar program)

Note: this activity can be completed  
without the spreadsheet portion if  
computers are not accessible. Simply  
skip steps 2-4 in the [Create](#) section.

Example packing items for  
a vacation (food, clothes,  
equipment, etc.)

Scales to measure weight  
(if available)

Tape measurers or rulers

Lined paper

Pencils

[Packing List: Dimensions](#)  
student capture sheet

[Average Weights](#) student handout

## LESSON TITLE

# Destination Vacation

*Guiding Question: Why should we continue to explore?*

## Ignite Curiosity

- What would it be like to go on a vacation in the wilderness?
- What factors change what and how we pack for a vacation?
- How can you make sure you have all of the essential supplies you'll need for a trip even if you have limited space to pack?

In this lesson, students will create their own packing lists for a vacation to a national park. In **THINK**, students will work with their classmates to brainstorm items for a packing list and decompose their lists into categories such as food, clothing, entertainment, health, and technical equipment. In doing so, they will learn how the computational thinking strategy of decomposition, or breaking down larger problems into manageable sub-tasks, is effective in many real-life scenarios.

In **SOLVE**, students will draft a preliminary packing list. Students must use the relevant formulas for weight and volume to estimate the dimensions of each item on their list. They will then estimate the total volume and weight of each category and the list as a whole. Students will see that using the computational thinking strategy of decomposition helps to break down complex mathematical equations so that they are easier to compute. In **CREATE**, students work in teams to create their final packing list in a spreadsheet. They will use the formula capabilities of the software to iterate their packing list so that their items fit within the confines of a 60-liter backpack. In **CONNECT**, students will learn about how the computational thinking strategy of decomposition connects to the real-world problems and careers of tomorrow.

Students will be able to:

- **Evaluate** the weight and volume of many everyday items,
- Decompose a large mathematical equation into smaller, manageable parts in order to **create** an iterative packing list, and
- **Analyze** a packing list in a spreadsheet to determine whether it meets the given criteria of fitting within a 60-liter backpack.



Students will work with their classmates to brainstorm items for a packing list and decompose their lists into categories such as food, clothing, entertainment, health, and technical equipment. In doing so, they will learn how the computational thinking strategy of decomposition, or breaking down larger problems into manageable sub-tasks, is effective in many real-life scenarios.

- 1** In a central location, display example items that can be packed for a vacation. Read the following scenario to students:

*Imagine you are planning a week-long adventure to [CHOOSE THE CLOSEST NATIONAL PARK TO YOUR SCHOOL] during spring break. First, you have to research the park in order to best prepare. You might encounter extreme weather conditions, protected plants and animals, and other natural phenomena. You will be hiking and camping during this trip, so you will have to pack light—all of your packing items must fit within a 60-liter backpack. Can you pack everything you need to have a great time and stay comfortable on your vacation in a small pack? Let's see how you do!*

- 2** **Ask students:** What items would you take to a national park? Provide examples such as an electronic device, music, food, and games. Encourage as many answers as possible, even some unrealistic items that will later be easy to identify as unnecessary and likely removed from their list.

- 3** **Provide** time for students to Stand Up, Hand Up, Pair Up:

- **a.** Have each student stand up and raise his or her hand.
- **b.** Instruct students circulate the classroom, looking for a partner.
- **c.** Once students have found a partner, instruct them to sit with their partner and await educator instructions.
- **d.** Instruct students to take out a piece of paper and label it "Research on [NATIONAL PARK NAME]" and write the following categories on that paper, making sure to leave ample space after each:
  - Weather/climate
  - Activities
  - Potential safety concerns
- **e.** Inform students that they are to use the [National Park Service's website](#) to research each of these three items.
- **f.** With their current partner, students will have 3 minutes to research the first category, weather/climate, and write what they learn on their paper.
- **g.** Provide 3 minutes for students to research and discuss.
- **h.** When the 3 minutes is up, have students raise their hands and circulate the classroom again to find a new partner.
- **i.** Allow students 3 minutes to research the activities at the national park and write their notes.
- **j.** Repeat steps h and i for potential safety concerns.
- **k.** When the 3 minutes is up, have students share some of what they learned with the class in a brief discussion. Record their observations on the board.



**4 Repeat** the Stand Up, Hand Up, Pair Up activity in order to have students brainstorm packing items. Ask students to write the following categories on their sheet, leaving space under each:

- Clothing
- Footwear
- Food/cooking
- Health/hygiene
- Emergency/first aid
- Gear/technical equipment
- Entertainment
- Miscellaneous

Provide 2 minutes per category for students to brainstorm. Students should identify a new partner to pair with for each category. When all categories are complete, have students share some of what they learned with the class in a brief discussion. Record their observations on the board.

**5 Ask** students if there are any other items they can add to their lists. Guide students to choose several items that would not be packed in specific scenarios. For example, if the national park is located in a hot climate, identify a jacket that would be too bulky and unnecessary for the climate. Refer to the computational thinking strategy of decomposition by explaining that categorizing items into different lists is a form of decomposing a problem (packing for an adventurous vacation) into smaller, more manageable tasks.



Students will prepare a packing list for a vacation to a national park. They will then estimate the weight and dimensions of each object and add the weights and dimensions together to see if the items will fit into a given vehicle.

- 1 Distribute** the [Packing List: Dimensions](#) student capture sheet. Instruct students to conduct research to find the weight of every item they will take on the national park vacation. They can conduct online research if computers are available, or they can use estimated information from the [Average Weights](#) student handout. Additionally, if scales are available to weigh the actual items, allow students to bring in examples or have examples available for students to weigh.
- 2 Instruct** students to record the weight of each item using the sub-groups they created on the [Packing List: Dimensions](#) student capture sheet. Each item or sub-group should be listed in the left column of the handout, and the weight should be listed in the right column. Students will then add the weights in the right column and enter the total weight for each category at the bottom. At the bottom of the handout, students will enter the total weight for each major category and then add these weights. This will result in the total weight in ounces (oz.) of all items that each student is planning to pack for the national park vacation. Instruct students to divide the total weight in ounces by 16 (ounces per pound) to get the total weight in pounds.
- 3 Instruct** students to record the volume of all objects using the appropriate formula:
  - **Square/cube:**  $V = \text{side}^3$
  - **Rectangle:**  $V = L \times W \times H$
  - **Sphere:**  $V = \frac{4}{3} \pi r^3$
  - **Cylinder:**  $V = \pi \times r^2 \times H$
  - **Prism:**  $V = bh$
  - **Cone:**  $V = \pi \times r \times \text{side}$
  - Explain to students that if their object does not conform to one of these shapes, then they can decompose the object into component shapes and add the volumes of those shapes together.
- 4 Volume** should be recorded in inches and can later be converted to feet and inches. Explain the terms cubic inches and cubic feet.
  - Cubic measurement = the multiple of 3 linear measurements: Length (L) x Width (W) x Height (H) or  $L \times W \times H$
  - The product will equal a cubic measurement expressed as:  
\_\_\_\_\_ in.<sup>3</sup> for cubic inches or \_\_\_\_\_ ft.<sup>3</sup> for cubic feet
  - Cubic feet = Cubic inches  $\div$  1,728 (which is  $12 \times 12 \times 12$  inches)



## Students will work in teams to write a packing list for their vacation to a national park in an Excel spreadsheet and then refine the list according to criteria and constraints.

- 1 Inform** students that they have a total weight limit for their trip. Provide the following criteria and constraints:
  - Four people must go for five days.
  - Total weight of packed items cannot exceed 150 pounds (4,000 ounces).
  - Total dimension of packed items cannot exceed 30 cubic feet (51,840 cubic inches).
- 2 Make** sure that each student team has access to a computer with a spreadsheet program. Instruct students to do the following:
  - Open up the spreadsheet program.
  - Create a new workbook.
  - Write the following:
    - In cell A1, write "Packing List"
    - In cell B1, write "Weight"
    - In cell C1, write "Volume"
  - Have students write the items of their packing list in the A column, making sure that they retain the item's category (e.g., clothing, entertainment).
- 3 Explain** that a computer model can be utilized to calculate and refine the packing list to meet a variety of needs and constraints. Refer students to Excel and provide the following formulas in a central location:

### Formula #1:

=sum(beginning cell:ending cell)  
 Example: =sum(B4:B8)

	A	B	C
<b>1</b>	<b>Packing List</b>	<b>Weight (oz.)</b>	<b>Dimension (in3)</b>
<b>2</b>			
<b>3</b>	<b>Clothes</b>		
<b>4</b>	Shirts	120	
<b>5</b>	Pants	400	
<b>6</b>	Shoes	200	
<b>7</b>	Socks	20	
<b>8</b>	Underwear	20	
<b>9</b>	Total	=sum(B4:B8)	

Explain that "=" tells Excel to compute a formula in that cell. Explain that "sum" tells Excel to add up all the cells from the beginning cell placed before the colon to the last cell placed after the colon. The parentheses are required. Students can type the formula into the cell and then press ENTER. The formula will also show at the top formula bar, and students can edit it there after clicking the cell in which they entered it.



## Formula #2:

=(cell + cell + cell + cell)

Example: =B9+I23

	A	B	C
<b>1</b>	<b>Packing List</b>	<b>Weight (oz.)</b>	<b>Dimension (in3)</b>
<b>2</b>			
<b>3</b>	<b>Clothes</b>		
<b>4</b>	Shirts	120	
<b>5</b>	Pants	400	
<b>6</b>	Shoes	200	
<b>7</b>	Socks	20	
<b>8</b>	Underwear	20	
<b>9</b>	Total	760	
<b>10</b>			
<b>11</b>	<b>Food/Cooking</b>		
<b>12</b>	Meats	120	
<b>13</b>	Vegetables	300	
<b>14</b>	Grains	240	
<b>15</b>	Beverages	2000	
<b>16</b>	Total	2660	
<b>17</b>	<b>Total Weight</b>	=B9+I23	

- 4 Guide** students in creating a spreadsheet that lists all items to be packed. Place all items in column A and bold the categories. Place weights in column B and volumes in column C. Using Formula #1 and Formula #2, calculate the total weight and total dimensions.

**Check-in:** Float and provide technical and content assistance as needed. Guide students to understand that decomposing the problem of packing items according to the limitations is a real-life application of the computational thinking skill of decomposing large problems.



## Students will learn how the computational thinking strategy of decomposing problems into smaller sub-problems is useful in many aspects of their lives.

Select one of the strategies listed below to help students answer these questions:

- **How do this problem and solution connect to me?**
- **How do this problem and solution connect to real-world careers?**
- **How do this problem and solution connect to our world?**

- 1 Write** the three questions on PowerPoint or flip chart slides and invite students to share out responses.
- 2 Display** pieces of chart paper around the room, each with one question written on it. Ask students to write down their ideas related to the questions on each sheet.
- 3 Assign** one of the questions to three different student groups to brainstorm or research, and then share out responses.
- 4 Invite** students to write down responses to each question on a sticky note, and collect them to create an affinity diagram of ideas.

### How does this connect to students?

Students will likely go on a trip at some point in their lives if they have not already. Using the computational thinking strategy of decomposing a problem will help them not only select what to take, but also select where to go.

Thinking about space and weight can apply to many everyday scenarios, such as packing a backpack for school. Knowing the weights of items can help students reduce the amount they carry to avoid injury. Students can pack different items depending on the size of the book bag. Computational thinking will provide a more efficient approach to packing.

Middle school students will perform better in geometry with a solid background in measurements and volume.

### How does this connect to careers?

**Travel Agents** prepare information and sell packages to consumers for vacations. They must be knowledgeable about the TSA (Transportation Security Administration) restrictions for flights, including limitations of liquids in ounces. They must also know different airlines' limitations on baggage weight and dimensions.

**Automobile Engineers** rely on their knowledge of spatial relationships to measure volume and weight and calculate risk factors when designing cars. The safety of travelers relies on the accuracy of engineers who work for car manufacturers. Technical Service Bulletins continually force changes to improve safety such as airbag recalls, safety restraints, and requirements for other car parts.

**Transportation, Storage, and Distribution Managers** must be aware of dimensions and weights of products that are shipped around the world. They must also be knowledgeable of laws that regulate the safe handling of certain materials like chemicals and hazardous items. The shipping routes around the globe could easily be disrupted if they make mistakes.

### How does this connect to our world?

Storage needs of companies around the world are increasing rapidly. The computational thinking strategy of decomposition can enable creation of more efficient means of storing material items and data. This affects businesses of all kinds, including medical, shipping, trade, and entertainment.

As automobiles around the world improve, the space inside is used more efficiently. This can result in lower car prices for consumers. Safety is also a possible improvement as components of vehicles fit better or react more efficiently to forces of impact.

 Find more easy-to-implement resources to integrate computational thinking practices into your classroom by visiting [ignitemyfutureinschool.org](http://ignitemyfutureinschool.org)

## National Standards

### COMMON CORE STATE STANDARDS CONNECTIONS

- [CCSS.MATH.CONTENT.7.EE.B.4](#)  
Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
- [CCSS.MATH.CONTENT.7.G.B.4](#)  
Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.
- [CCSS.MATH.CONTENT.7.G.B.6](#)  
Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

### K-12 COMPUTER SCIENCE FRAMEWORK

#### **Practice 4. Developing and Using Abstractions**

Abstractions are formed by identifying patterns and extracting common features from specific examples to create generalizations. Using generalized solutions and parts of solutions designed for broad reuse simplifies the development process by managing complexity.

## Average Weights

Category	Items				
<b>Clothing</b>	Shirt 6 ounces	Pants 20 ounces	Shorts 10 ounces	Shoes 25 ounces	Underclothes 1 ounce per garment
<b>Food/ Cooking</b>	Meats 6 ounces per person per day	Dry Grains/Pasta 12 ounces per person per day	Canned Vegetables 15 ounces per person per day	Water 100 ounces per person per day	1 Dehydrated Prepared Meal 2 ounces
<b>Health/ Hygiene</b>	Soap 4 ounces	Toothpaste 3 ounces	Deodorant 5 ounces	Sunscreen 16 ounces	Makeup/ Skincare 5 ounces
	Travel Shampoo 5 ounces	Travel Conditioner 5 ounces	Floss 1 ounce	Toothbrush 1 ounce	Mouthwash 6 ounces
<b>Emergency/ First Aid</b>	Band-Aids box 3 ounces	Medical Tape 1 ounce	Gauze Pack 1 ounce	Alcohol Wipes Box 3 ounces	Antibiotic Ointment 2 ounces
<b>Technical Equipment</b>	Tent 32 ounces per person	Sleeping Bag 36 ounces	Camp Chair 80 ounces	Camp Stove and Fuel 32 ounces	Lantern 20 ounces
<b>Entertainment</b>	Smartphone 4 ounces	Soccer Ball 15 ounces	Camera 5 ounces	Bike 350 ounces	Guitar and Case 400 ounces
<b>Other</b>					

## Packing List Dimensions

Clothing		
Item	Volume	Weight
<b>TOTAL:</b>		

Emergency/First Aid		
Item	Volume	Weight
<b>TOTAL:</b>		

Food/Cooking		
Item	Volume	Weight
<b>TOTAL:</b>		

Technical Equipment		
Item	Volume	Weight
<b>TOTAL:</b>		

Health/Hygiene		
Item	Volume	Weight
<b>TOTAL:</b>		

Entertainment		
Item	Volume	Weight
<b>TOTAL:</b>		

Total volume of packing list (in square inches) = \_\_\_\_\_

Total weight of packing list (in pounds) = \_\_\_\_\_

Find more easy-to-implement resources to integrate computational thinking practices into your classroom by visiting [ignitemyfutureinschool.org](http://ignitemyfutureinschool.org)