TATA CONSULTANCY SERVICES | Discovery EDUCATION

IGNITE MY FUTURE

THINK | SOLVE | CREATE | CONNECT

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 class trip (food, clothes, equipment, etc.)

Scales to measure weight (if available)

Tape measurers or rulers

Lined paper

Pencils

Packing List: Dimensions student capture sheet

LESSON TITLE

Destination Exploration

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 class trip. 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**, s, 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-litre backpack.

Copyright © 2020 Discovery Education. All rights reserved.

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 class trip. Read the following scenario to students:

   Imagine you are planning a 4-day, 3-night (modify days/nights to fit your students' situation) class trip with your peers which will happen next spring. First, you have to research the location in order to best prepare. You might encounter extreme weather conditions, protected plants and animals, and other natural phenomena. Space is limited and you will be carrying your bag most of the time so you will have to pack light—all of your packing items must fit within a 60-litre backpack. Can you pack everything you need to have a great time and stay comfortable on your class trip in a small pack? Let's see how you do!

2. **Ask students:** What items would you take on a class trip? 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:
   - Have each student stand up and raise his or her hand.
   - Instruct students circulate the classroom, looking for a partner.
   - Once students have found a partner, instruct them to sit with their partner and await educator instructions.
   - Instruct students to take out a piece of paper and label it "Research on location to be visited and write the following categories on that paper, making sure to leave ample space after each:
     - Weather/climate
     - Activities
     - Potential safety concerns
   - With their current partner, students will have 3 minutes to research the first category, weather/climate, and write what they learn on their paper.
   - Provide 3 minutes for students to research and discuss.
   - When the 3 minutes is up, have students raise their hands and circulate the classroom again to find a new partner.
   - Allow students 3 minutes to research the activities at the location and write their notes.
   - Repeat steps h and i for potential safety concerns.
   - 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.

Copyright © 2020 Discovery Education. All rights reserved.

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 place you are visiting 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 class trip) into smaller, more manageable tasks.

Copyright © 2020 Discovery Education. All rights reserved.

Students will prepare a packing list for a class trip. 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 class trip. They can conduct online research if computers are available. 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 grams (g) of all items that each student is planning to pack for a class trip. Instruct students to multiply the total weight in grams by 1000 to get the total weight in kilograms.

3 **Instruct** students to record the volume of all objects using the appropriate formula:

- **Square/cube:** $V = side^3$
- **Rectangle:** $V = L \times W \times H$
- **Sphere:** $V = 4/3\ \pi r^3$
- **Cylinder:** $V = \pi \times r^2 \times H$
- **Prism:** $V = bh$
- **Cone:** $V = \pi \times r \times side$
- 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 centimetres and can later be converted to metres and centimetres. Explain the terms *cm cubed* and *m cubed*.

- Cubic measurement = the multiple of 3 linear measurements:
  Length (L) x Width (W) x Height (H) or L x W x H
- The product will equal a cubic measurement expressed as:

  _____ $cm.^3$ for centimetres cubed or _____$m.^3$ for metres cubed

Copyright © 2020 Discovery Education. All rights reserved.

Students will work in teams to write a packing list for their class trip 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:

- The trip is over four days and three nights (adjust length to meet student needs).
- Total dimension of packed items cannot exceed 60 litres

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
1	**Packing List**	**Weight**	**Volume**
2			
3	**Clothes**		
4	Shirts		
5	Pants		
6	Shoes		
7	Socks		
8	Underwear		
9	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.

Copyright © 2020 Discovery Education. All rights reserved.

Formula #2:
=(cell + cell + cell + cell)
Example: =B9+I23

	A	B	C
1	**Packing List**	**Weight**	**Volume**
2			
3	**Clothes**		
4	Shirts		
5	Pants		
6	Shoes		
7	Socks		
8	Underwear		
9	Total		
10			
11	**Food/Cooking**		
12	Meats		
13	Vegetables		
14	Grains		
15	Beverages		
16	Total		
17	**Total Weight**	=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.

Extension: You can share effective packing hacks for kids and teens by sharing the Hacking the Packing blog post and video with students.

Extension #2: show your students the connection between storage in the physical world and storage in the digital world:

- An introduction to data measurement
- Crash course of computer data storage

Copyright © 2020 Discovery Education. All rights reserved.

IGNITE MY FUTURE

THINK SOLVE CREATE CONNECT

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 trips. They must be knowledgeable about Transport Canada rules and regulations for travel on land, sea/water and air.

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.

TATA Consultancy Services provides companies with large amounts of digital storage through their cloud services to help keep data safe, secure and easy to retrieve while taking up no space in the workplace of clients.

Find more easy-to-implement resources to integrate computational thinking practices into your classroom by visiting **ignitemyfutureinschool.ca**

Copyright © 2020 Discovery Education. All rights reserved.

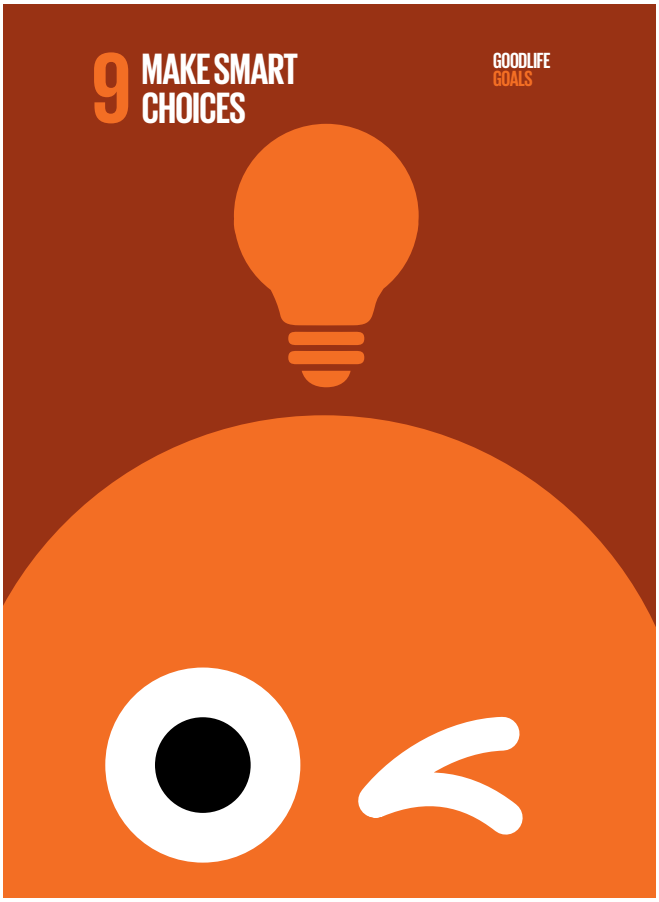
Curriculum Connections

UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

"For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and **people like you**."
—The United Nations

"The Sustainable Development Goals are the blueprint for a better future. And together we can reach them. By following the Good Life Goals, we can all help make tomorrow better than today. Let's do this! #GoodLifeGoals"



Source:
[The Good Life Goals by Futerra Sustainability Communications Ltd and 10-Year Framework of Programmes on Sustainable Lifestyles and Education Programme is licenced under CC BY-ND 4.0.]

Find more easy-to-implement resources to integrate computational thinking practices into your classroom by visiting **ignitemyfutureinschool.ca**

Copyright © 2020 Discovery Education. All rights reserved.

Global Competencies

CMEC (Council of Ministers of Education, Canada) Pan-Canadian Global Competencies Descriptions

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Collaboration	Collaboration involves the interplay of the cognitive (including thinking and reasoning), interpersonal, and intrapersonal competencies necessary to participate effectively and ethically in teams. Ever-increasing versatility and depth of skill are applied across diverse situations, roles, groups, and perspectives in order to co-construct knowledge, meaning, and content, and learn from, and with, others in physical and virtual environments.	Students participate in teams by establishing positive and respectful relationships, developing trust and acting co-operatively and with integrity. Students learn from and contribute to the learning of others by co-constructing knowledge, meaning, and content. Students assume various roles on the team, respect a diversity of perspectives, and address disagreements and manage conflict in a sensitive and constructive manner. Students network with a variety of communities/groups and use an array of technology appropriately to work with others.
Communication	Communication involves receiving and expressing meaning (e.g., reading and writing, viewing and creating, listening and speaking) in different contexts and with different audiences and purposes. Effective communication increasingly involves understanding both local and global perspectives, societal and cultural contexts, and adapting and changing using a variety of media appropriately, responsibly, safely, and with regard to one's digital footprint.	Students communicate effectively in different contexts in oral and written form in French and/or English through a variety of media. Students communicate using the appropriate digital tools and create a positive digital footprint. Students ask effective questions to acquire knowledge, listen to understand all points of view, voice their own opinions, and advocate for ideas. Students gain knowledge about a variety of languages and understand the cultural importance of language.

Copyright © 2020 Discovery Education. All rights reserved.

Global Competencies cont.

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Global Citizenship and Sustainability	Global citizenship and sustainability involve reflecting on diverse worldviews and perspectives and understanding and addressing ecological, social, and economic issues that are crucial to living in a contemporary, connected, interdependent, and sustainable world. It also includes the acquisition of knowledge, motivation, dispositions, and skills required for an ethos of engaged citizenship, with an appreciation for the diversity of people, perspectives, and the ability to envision and work toward a better and more sustainable future for all.	Students understand the ecological, economic, and social forces, their interconnectedness, and how they affect individuals, societies, and countries. Students take actions and responsible decisions that support quality of life for all, now and in the future. Students recognize discrimination and promote principles of equity, human rights, and democratic participation. Students understand Indigenous traditions and knowledge and its place in Canada, learn from and with diverse people, develop cross-cultural understanding, and understand the forces that affect individuals, societies, and nations. Students engage in local, national, and global initiatives to make a positive difference. Students contribute to society and to the culture of local, national, global, and virtual communities in a responsible, inclusive, accountable, sustainable, and ethical manner. Students as citizens participate in networks in a safe and socially responsible manner.

Copyright © 2020 Discovery Education. All rights reserved.

Global Competencies cont.

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Critical Thinking and Problem Solving	Critical thinking and problem solving involve addressing complex issues and problems by acquiring, processing, analysing, and interpreting information to make informed judgments and decisions. The capacity to engage in cognitive processes to understand and resolve problems includes the willingness to achieve one's potential as a constructive and reflective citizen. Learning is deepened when situated in meaningful, real-world, authentic experiences.	Students will solve meaningful, real-life, complex problems by taking concrete steps to address issues and design and manage projects. Students will engage in an inquiry process to solve problems as well as acquire, process, interpret, synthesize, and critically analyse information to make informed decisions (i.e., critical and digital literacy). Students will see patterns, make connections, and transfer what they have learned from one situation to another, including in real world applications. Students will construct, relate, and apply knowledge to all domains of life such as school, home, work, friends, and community. Students will analyze the functions and interconnections of social, economic, and ecological systems.
Innovation, Creativity and Entrepreneurship	Innovation, creativity, and entrepreneurship involve the ability to turn ideas into action to meet the needs of a community. The capacity to enhance concepts, ideas, or products to contribute new-to- the-world solutions to complex economic, social, and environmental problems involves leadership, taking risks, independent/unconventional thinking and experimenting with new strategies, techniques, or perspectives, through inquiry research. Entrepreneurial mindsets and skills involve a focus on building and scaling an idea sustainably.	Students formulate and express insightful questions and opinions to generate novel ideas. Students contribute solutions to complex economic, social, and environmental problems or to meet a need in a community in a number of ways including; enhancing concepts, ideas, or products through a creative process, taking risks in their thinking and creating, making discoveries through inquiry research, and by hypothesizing and experimenting with new strategies or techniques. Students demonstrate leadership, initiative, imagination, creativity, spontaneity, and ingenuity in a range of creative processes and motivate others with an ethical entrepreneurial spirit.

Copyright © 2020 Discovery Education. All rights reserved.

Global Competencies cont.

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Learning to learn and to be self-directed and self-aware	Learning to learn and to be self-directed and self-aware, means: becoming aware and demonstrating agency in one's process of learning, including the development of dispositions that support motivation, perseverance, resilience, and self-regulation. Belief in one's ability to learn (growth mindset), combined with strategies for planning, monitoring and reflecting on one's past, present, and future goals, potential actions and strategies, and results. Self-reflection and thinking about thinking (metacognition) promote lifelong learning, adaptive capacity, well-being, and transfer of learning in an ever-changing world.	Students learn the process of learning (metacognition) (e.g., independence, goal-setting, motivation) and believe in their ability to learn and grow (growth mindset). Students self-regulate in order to become lifelong learners and reflect on their thinking, experience, values, and critical feedback to enhance their learning. They also monitor the progress of their own learning. Students develop their identity in the Canadian context (e.g., origin and diversity) and consider their connection to the environment. They cultivate emotional intelligence to understand themselves and others. They take the past into account to understand the present and approach the future. Students develop personal, educational, and career goals and persevere to overcome challenges to reach these goals. They adapt to change and show resilience to adversity. Students manage various aspects of their lives: physical, emotional (relationships, self-awareness), spiritual, and mental well-being.

Copyright © 2020 Discovery Education. All rights reserved.

Packing List Dimensions

Clothing		
Item	**Volume**	**Weight**
TOTAL:		

Emergency/First Aid		
Item	**Volume**	**Weight**
TOTAL:		

Food/Cooking		
Item	**Volume**	**Weight**
TOTAL:		

Technical Equipment		
Item	**Volume**	**Weight**
TOTAL:		

Health/Hygiene		
Item	**Volume**	**Weight**
TOTAL:		

Entertainment		
Item	**Volume**	**Weight**
TOTAL:		

Total volume of packing list (in cm cubed) = _____

Total weight of packing list (in kilograms) = _____

Find more easy-to-implement resources to integrate computational thinking practices into your classroom by visiting **ignitemyfutureinschool.ca**

Copyright © 2020 Discovery Education. All rights reserved.