



IGNITE MY FUTURE

LESSON TITLE

Drone Delivery

Guiding Question: What will our future look like?

SUBJECTS

Math
Engineering

COMPUTATIONAL THINKING PRACTICE

Recognizing and Defining
Computational Problems

COMPUTATIONAL THINKING STRATEGY

Build Models
Algorithms

MATERIALS

Graph paper

Rulers

Pencils

Whiteboard

[Can You Draw It](#) handout

[Map Out Your Flight Area](#) handout

[Presentation Outline](#) handout

[Presentation Feedback Form](#)

Ignite Curiosity

- If you're good at playing video games, could that lead to a career as a pilot of unmanned air vehicles (UAVs)?
- Could drones help us bring supplies to people in various areas?
- How can cameras on drones help us to see things differently?

In this lesson, students will utilize the computational thinking strategy of building models to sketch a drone that can deliver life-saving medication to Canadians. In **THINK**, students act as robotics engineers challenged by the task of efficiently delivering small packages with medications. They will research current drone models and learn about different applications for unmanned flight devices. In **SOLVE**, students will learn that humans provide directions to computers through the processes of machine learning, computer vision, and deep learning algorithms. They will "program" their drone to perform a task that would be beneficial to the purpose of delivering medication. In **CREATE**, students collaborate in teams to create a technical sketch of the final drone. In **CONNECT**, students explore how drones have become integrated into society and identify how unmanned air vehicle (UAV) technology connects to careers and to problems of tomorrow.

Students will be able to:

- Collect and **analyze** drone data to design improved components,
- **Create** technical sketches of drones that can use algorithms to perform autonomously, and
- **Evaluate** sketch models of drones and provide feedback.



Students act as robotics engineers challenged by the task of efficiently delivering medication in a densely populated city. They research current drone models and learn about different applications for unmanned air vehicles (UAVs).

1 Read the following scenario to students:

"On August 19, 2019, Canada Post, in partnership with London Drugs and InDro Robotics, successfully completed Canada's first-ever Beyond Visual Line-of-Sight (BVLOS) flight carrying pharmaceuticals via Drone from a London Drugs pharmacy to remote Salt Spring Island in British Columbia." - [Source](#)

After this initial success there is a desire to grow the partnership, especially in towns and cities in order to deliver medication to those who are homebound. The team would like to scale up the project and have more drones delivering medication. They are considering using smaller, cheaper drones that are already on the market that can be modified for this task. You are a member of the robotics design team, it is your job to better understand how to provide drones with clear instructions in order to successfully take off, pick up a load, drop it off in the correct location and land safely.

2 Divide students into pairs. Explain that they will begin their training by becoming better at giving and receiving instructions since that will be the key to our success.

3 Provide each pair with 2 pieces of paper and writing tools. Ask one partner to be A and one to be B. Ask partner A to face the board (or wherever you will project your screen or show a picture) and partner B to turn away. Student A will look at the image and instruct partner B how to draw it by only giving instructions. Partner A can't help partner B with the drawing otherwise and partner B can't peek at the image in the front. The partner who is drawing also cannot ask questions to clarify what was said (they have to draw it exactly as they think they hear it).

4 Share the first image in the [Can You Draw It](#) handout and allow 5–7 minutes for partner A to work with partner B. After pairs start to 'finish', partner B can turn around. Don't be surprised if students laugh as the difference between what they tried to draw and what they see on the board can be quite humorous.

5 Ask partners to change roles. Partner B now faces the front and will describe the new image they see to partner A, who in turn will try to draw it. Repeat step 3.

6 Debrief with your students by asking them the following questions:

- When you were giving instructions, what was easy? What was hard? (It was easy because I saw the picture and it was difficult to describe how to draw it exactly.)
- When you were receiving instructions, what was easy? What was challenging? Did you wish you could ask for clarification? (I was glad to be drawing but a lot of the instructions were not clear and I had to guess, my partner was not always patient.)
- What could have been done to make the giving/receiving of instructions clearer? (Ask questions, help them draw the picture, turn around.)

7 Explain to students that when we program any device, it only does what we explicitly tell it to do. It does not guess or assume what we mean, just follows our exact instructions. Therefore, it is important that our instructions are very, very clear and simple and only have 1 possible interpretation.



Students will uncover that computers need humans to provide them with directions in the form of algorithms. They will “program” their drone (partner) to perform a task that would be beneficial to the purpose of delivering medication.

- 1 Show** students this video on how drones work and remind students that humans must provide clear instructions to create effective algorithms for drones to follow.
- 2 Students** will practice being drone pilots. This will require you, the teacher, to set up your classroom as an obstacle course. The student pairs will have to collaborate in order to successfully navigate the course blindfolded.
- 3 Using grid paper**, create a map of the room. Note the location of items such as tables, chairs and desks. Designate one side of the room as the ‘start’, another side as the ‘package pickup’ area a third side as the ‘package drop off area and a fourth side as a ‘landing area.’
- 4 Make copies** of the map and distribute it to each pair. They will have to think about how to guide each other through the classroom from one area to another safely without bumping into the furniture or losing the package. Students should write out a set of instructions that they will use to guide each other during the trial. Students should share their instructions with 2 other pairs and the teachers before they are ready for a ‘test flight’.
- 5 During a ‘test flight’**, partner A is blindfolded and has to follow the instructions of partner B (who is reading from the instruction sheet) in order to navigate the room. Allow students to do several ‘test flights’ in order to test and rework their instructions before the formal flight.
- 6 Once your area is ready** for a ‘formal flight demonstration’ where all pairs will participate, ask the following questions:
 - How did you put your instructions together initially? (We did our best using the map and our experience with giving instructions.)
 - Did your instructions change after your ‘test flights’? (Yes, we improved and simplified our instructions each time.)

Allow each group to showcase their instructions to the rest of the class. At the end of each flight, ask students for ‘glows and grows’ (positive feedback and next steps).



Students collaborate in teams to create a presentation on how to provide instructions to drones.

- 1 Students** will create a 2-minute presentation using a mode of their choice (paper-based, digital or both) to share best practices in giving clear instructions to drones (creating algorithms for flying drones). Students can use the [Presentation Outline](#) to put their work together.
- 2 Students** will share their presentations with classmates, who in turn can provide feedback using the [Presentation Feedback Form](#).

Extension 1: If you have a drone in your class/school, students can take their knowledge and program a real drone to deliver a package (we recommend something small, like a small candy bar, an eraser or a Lego mini-figure) and repeat the obstacle course challenge in [Solve](#) (Start, collect item, drop off item, land).

Extension 2: Use the BlockCAD extension to build a program a drone virtually at the end by following the instructions at the end of this document.



Students explore how drones have become integrated into society and the processes and regulations that have changed as a result and identify how drone technology connects to careers and to problems of tomorrow.

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 likely use remote-like devices such as directional controls and action buttons when using their cell phone or when playing games on a console or in an arcade.

Students have the capacity to build drones in the same way robots are built. They can buy kits and put them together or even 3D print all the parts from scratch to build the drone.

Just like robotics teams in middle and high schools, students will soon be able to compete in competitions using drones to fly around obstacle courses and perform challenging tasks for points.

How does this connect to careers?

Aircraft Mechanical Technicians perform maintenance and inspections on aircraft that have similar parts to drones. They work in air hangars or airfields in repair stations. They study and adhere to the rules and regulations of the Federal Aviation Administration (FAA).

Aerospace Engineers design, build, and test unmanned air vehicles (UAVs) that use the same principles of flight as drones. They will build and test prototypes to find problems and develop solutions related to aircraft. Aerospace engineers work in offices, labs, and sometimes in the field.

Surveying and Mapping Technicians conduct land surveys and collect data that can be analyzed for planning airfields for drones. Drones can also be used to survey the land and collect data for surveying and mapping technicians.

Photographers are using drones to capture images from perspectives that have never been seen before, such as aerial photographs larger aircraft are unable to take. For example, drones can take close-proximity photos and video of fireworks. They can also fly close to tall buildings to capture photos and video of problems that need to be fixed.

How does this connect to our world?

Drones are beginning to take over transportation tasks such as delivery of goods. The military has also used drones for tactical operations.

Business applications that incorporate drones include farming irrigation, 3D rendering for building construction, surveying for engineering design, monitoring environmental conditions, and media coverage via aerial shots.

TATA Consulting Services is using drones to make the world a better place. They are using drones to [protect endangered species](#) and [conserve forests](#).

Curriculum Connections

UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS



“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”



MAKE SMART CHOICES Actions

9

1 Learn about plans for progress in your country

4 Welcome innovations that make the world a better place

2 Stay smart and kind online

5 Demand the benefits from progress are shared

3 Support construction that benefits people and protects the planet



Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SUSTAINABLE DEVELOPMENT GOALS

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

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.	<p>Students participate in teams by establishing positive and respectful relationships, developing trust and acting co-operatively and with integrity.</p> <p>Students learn from and contribute to the learning of others by co-constructing knowledge, meaning, and content.</p> <p>Students assume various roles on the team, respect a diversity of perspectives, and address disagreements and manage conflict in a sensitive and constructive manner.</p> <p>Students network with a variety of communities/groups and use an array of technology appropriately to work with others.</p>
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.	<p>Students communicate effectively in different contexts in oral and written form in French and/or English through a variety of media.</p> <p>Students communicate using the appropriate digital tools and create a positive digital footprint.</p> <p>Students ask effective questions to acquire knowledge, listen to understand all points of view, voice their own opinions, and advocate for ideas.</p> <p>Students gain knowledge about a variety of languages and understand the cultural importance of language.</p>

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.	<p>Students understand the ecological, economic, and social forces, their interconnectedness, and how they affect individuals, societies, and countries.</p> <p>Students take actions and responsible decisions that support quality of life for all, now and in the future.</p> <p>Students recognize discrimination and promote principles of equity, human rights, and democratic participation.</p> <p>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.</p> <p>Students engage in local, national, and global initiatives to make a positive difference.</p> <p>Students contribute to society and to the culture of local, national, global, and virtual communities in a responsible, inclusive, accountable, sustainable, and ethical manner.</p> <p>Students as citizens participate in networks in a safe and socially responsible manner.</p>

Global Competencies cont.

Highlighted sections apply to this lesson

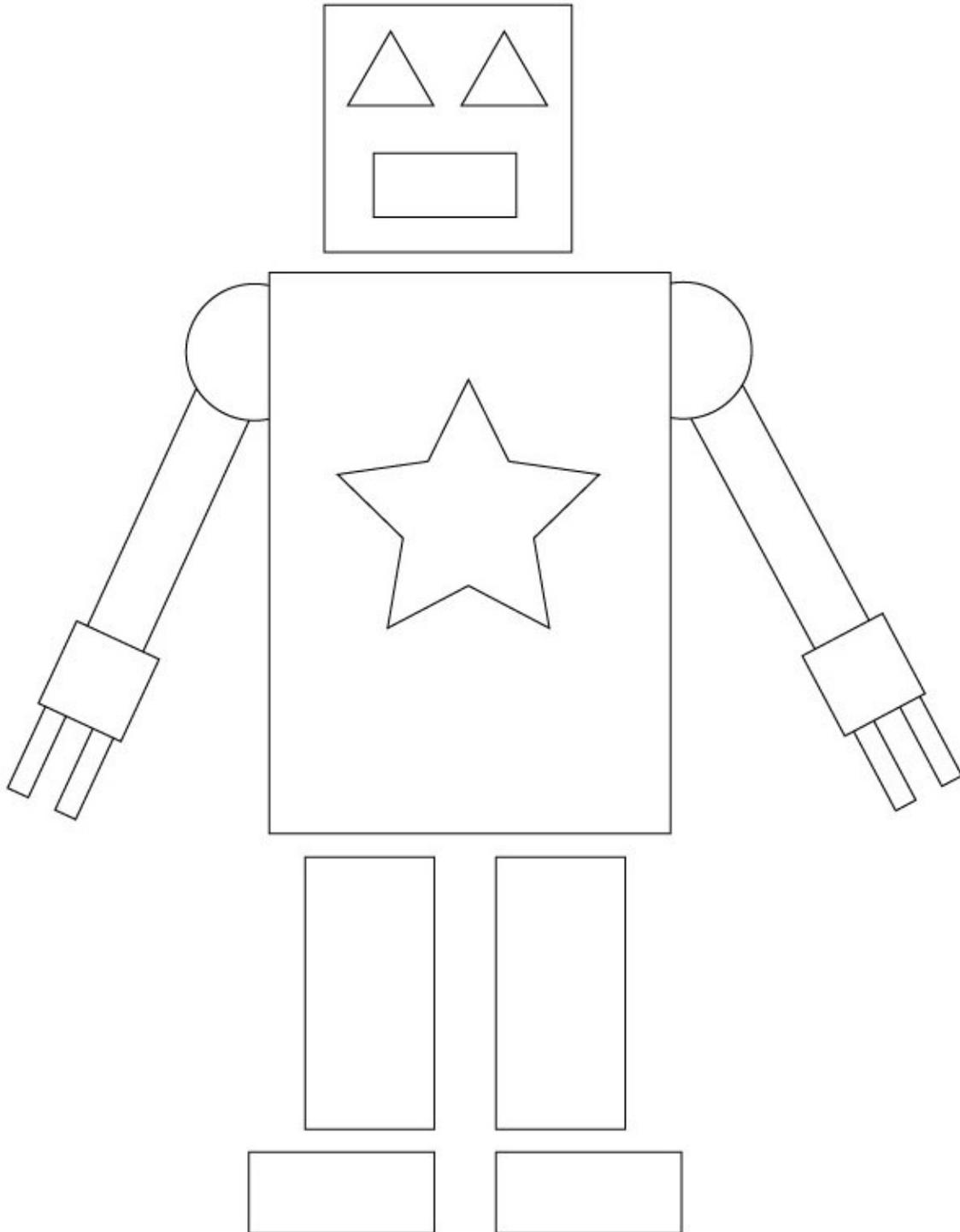
Global Competency	Definition	Student Descriptors
Critical Thinking and Problem Solving	Critical thinking and problem solving involve addressing complex issues and problems by acquiring, processing, analysing, and interpreting information to make informed judgments and decisions. The capacity to engage 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.	<p>Students will solve meaningful, real-life, complex problems by taking concrete steps to address issues and design and manage projects.</p> <p>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).</p> <p>Students will see patterns, make connections, and transfer what they have learned from one situation to another, including in real world applications.</p> <p>Students will construct, relate, and apply knowledge to all domains of life such as school, home, work, friends, and community.</p> <p>Students will analyze the functions and interconnections of social, economic, and ecological systems.</p>
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.	<p>Students formulate and express insightful questions and opinions to generate novel ideas.</p> <p>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.</p> <p>Students demonstrate leadership, initiative, imagination, creativity, spontaneity, and ingenuity in a range of creative processes and motivate others with an ethical entrepreneurial spirit.</p>

Global Competencies cont.

Highlighted sections apply to this lesson

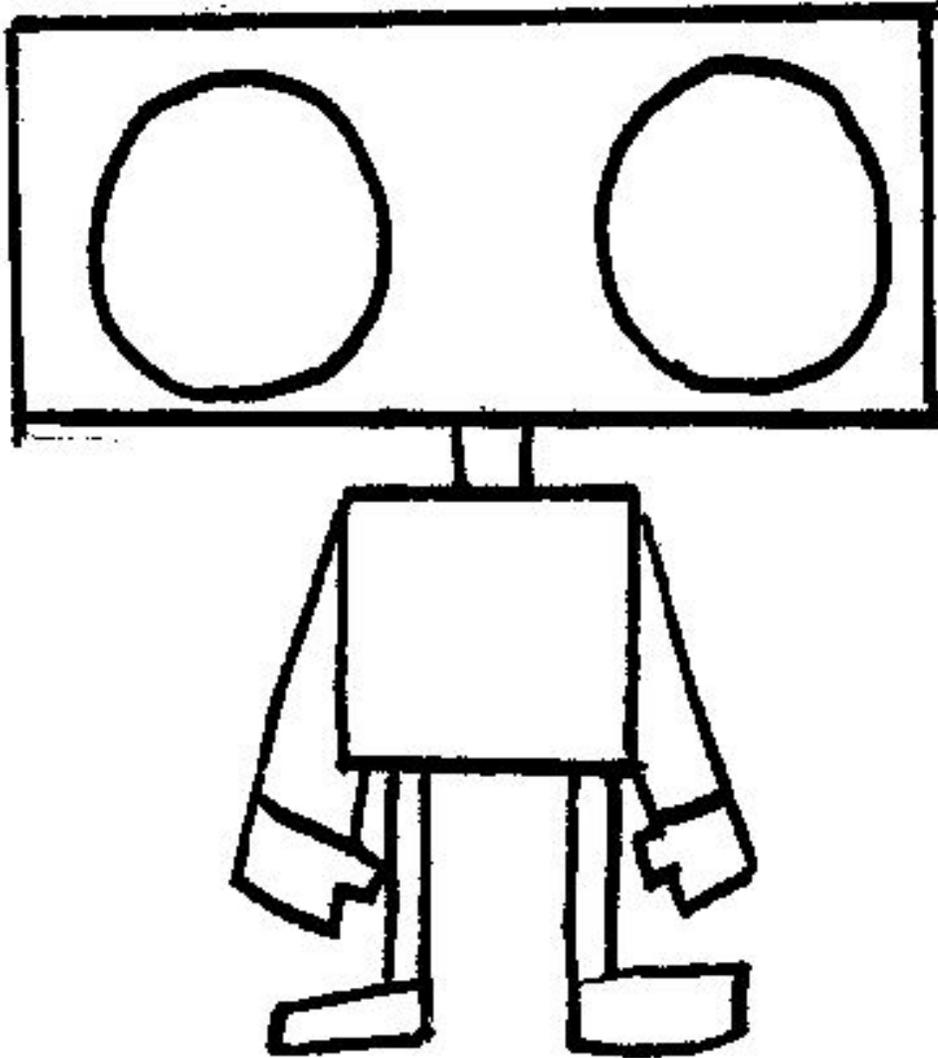
Global Competency	Definition	Student Descriptors
<p>Learning to learn and to be self-directed and self-aware</p>	<p>Learning to learn and to be self-directed and self-aware, means: becoming aware and demonstrating agency in one's process of learning, including the development of dispositions that support 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.</p>	<p>Students learn the process of learning (metacognition) (e.g., independence, goal-setting, motivation) and believe in their ability to learn and grow (growth mindset).</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Students manage various aspects of their lives: physical, emotional (relationships, self-awareness), spiritual, and mental well-being.</p>

Can You Draw Me Handout



Source: www.benscoloringpages.com

Can You Draw Me Handout



Source: <https://images.app.goo.gl/SWWFpmW5yHcSCYMf8>

Map Out Your Flight Area Handout

Example: <https://biology.edgewood.edu/Outreach/Watershed-Education-Connection/Maps-and-Mapping/Map-Examples>

Step 1: Use grid paper to map out your current classroom. Be sure to designate the Start area of your flight, the pickup area, drop off area and landing area.

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4									
5									
6									
7									

Map Out Your Flight Area Handout

Step 2: Create a set of simple, clear and concise instructions to help your 'drone' navigate the classroom.

Instructions to get from the start area to the pickup area:

1.

2.

3.

Instructions to get from the pickup area to the drop off area:

1.

2.

3.

Instructions to get from the drop off area to the landing area:

1.

2.

3.

Presentation Outline Student Capture Sheet

Hook: Start with an unexpected introduction to hook the audience (e.g., a question, a joke, a personal story, a quote, a dance routine, etc.):

Share the question you are answering and give some background on the topic:

Share the details of your findings (pros and cons of each option). Use your research to support your points. Make sure to cite your sources:

List how you can give clear and simple instructions. Use examples from our classroom activity.

Conclude by restating your point and asking for support to get your desired way of giving instructions:

Presentation Feedback Form

Share feedback with the presenters by answering the four prompts below.

Content—Did the speaker/s state their points clearly and persuasively?

Speaking—Was the speaker/s easy to understand?

Engaging—Did you find the presentation interesting and wanted to hear more?