Grade 6 Learning Experiences: Technology and Its Influence on Flight Machines

Experience 1 - Designing and Building a Flying Machine

Grade 6 Long Range Model 2L February/March/April

Overview

Students will learn about the four forces of air that are applied to flying machines. Students will create their own flying machine to demonstrate these forces and then make an improvement in the design to impact one or more force(s).

Overview of learning experiences	Students will learn about the four forces of air acting in the flying machine process followed by a short activity that is discussed as a class. Students will then use the engineering design process to create their own flying machine and then develop one improvement in its performance. This improvement will interact with one or more of the four forces of air. Students will then share their flying machine with the class. Grade 6 Long Range Model 2L February/March/April Students participate in STEM activities and experiments related to basic flight properties and the four forces of air, such as blowing over a piece of paper under their lower lip to demonstrate how lift works.
Prior Knowledge / Prior Skill Set(s)	**Background Knowledge and Concepts (Teacher**) - Additional teacher concept support **Knowledge:** ● Aware of health & safety procedures (i.e. PPE & MDMS) ● Maintain safe facilities & laboratory equipment ● Identify potential workplace hazards & mitigation measures ● The properties of air that can be related to flight related applications **Concepts:** ● Aware of Global Competencies & Transferable Skills Aware of Culturally Relevant & Responsive Pedagogy ● Understand how to implement the UDL framework

	● Understand how to engage in an Engineering Design Process **Background Knowledge and Skills (Students) – Addressing misconceptions and preconceptions** **Knowledge:** ● The properties of air that can be related to flight-related applications. ● Aware of safety procedures ● Follow safe work or preventative measures as instructed ● Familiar with "Norms of Collaboration" ● The properties of solids ● The concept of forces acting on mechanisms and causing movement **Skills:** ● Research and understand a problem ● Generate possible solutions ● Select an option and develop a prototype ● Test the prototype ● Evaluate and review the prototype ● Communicate the solution or results ● Summarize findings ● Identify and select resources ● Record and analyse information ● Summarize findings ● Critical thinking ● Problem solving ● Creativity ● Self-directed learning
Strand A - STEM Investigation and Communication Skills	Students can design and investigate the forces of flight by creating a variety of paper airplanes and then adding cargos to see how they fly.  A1.3 use an engineering design process and associated skills to design, build, and test devices, models, structures, and/or systems  A1.4 follow established health and safety procedures during science and technology investigations, including wearing appropriate protective equipment and clothing and safely using tools, instruments, and materials Incorporate STEM activities to allow students to investigate the properties of

	air which allows students to develop skills needed to understand the concept of air properties in relation to flight (examples: hot air rises, air has mass, etc).  A1.2 use a scientific experimentation process and associated skills to conduct investigations  A1.4 follow established health and safety procedures during science and technology investigations, including wearing appropriate protective equipment and clothing and safely using tools, instruments, and materials
Overview / Big Ideas/Fundamental Concepts	**Overview** Students will view a video on designing different types of flying machines and the concept of the four forces of air. A class activity with a paper plane followed by their own activity with paper will further illustrate the four forces of air. Students will complete a worksheet (see Appendix A: The Four Forces of Flight) activity to be discussed as a class. This is an engineering design activity that students can engage in. Teachers can decide to model for the class a design with materials for a flying machine. Alternatively, the students can, with their partner/group, develop their own flying machine through the engineering design process. They will then introduce a particular design feature that improves flight performance considering the four forces that are acting. Students will then present their flying machine to the class. **Fundamental Concepts** Structure and Function: The interrelationship between the function or use of a natural or human-made object and the form that the object takes. Sustainability and Stewardship: Meeting the needs of the present without compromising the ability of future generations to meet their needs. **Big idea:** D1. Assess the environmental impacts of flying machines D2 Demonstrate an understanding of the ways in which properties of air can be applied to the principles of flight and flying machines
Learning Goals / Success Criteria	**Learning Goal #1:** We are learning to design and/or build a flying machine to demonstrate the four forces of flight.

	Educators are encouraged to co-create success criteria with students and share “I Can Statements” based on the curricular expectations. See Appendix E: Assessment of Learning for suggestions for co-creation of success criteria with students. Sharing options can include: In-person: ● Gallery walk ● Presentation ● Video Online: ● Presentation ● Poster ● Breakout Room Showcase **Ministry of Key Points:** The key points below will be addressed within these experiences. **STEM Skills and Connections** – perspectives and approaches that provide opportunities for students to investigate and apply concepts and skills from all areas of learning. **Research Process and experimentation processes** – provide students with the scientific literacy skills needed to approach scientific questions that are becoming a part of everyday life **Engineering Design** – provide students with support to plan and build solutions to problems or address needs that connect to the curriculum and the world around them **Experiential Learning** – engage in a virtual experiential learning experience that includes hands-on opportunities that engage curiosity
Learning Experience(s)	**The Four Forces of Flight** **Minds On (20 minutes)** Watch the English or French video as a class The Science of Flight, Ontario Science Centre THEN

	1. Demonstrate for the class a paper plane being sent across the room. Explain how there are 4 forces acting on the plane - drag, lift, thrust and weight. Try taping two different weights that are about the weight of a paperclip on the plane to test again and connect to the four forces. In pairs, students compare an object of their choice and a piece of paper crumpled up to see what happens when they drop at the same time. Discuss what 4 forces are acting on each object. 2. Students have an opportunity to complete the worksheet (see Appendix A: The Four Forces of Flight) in their group and then take it up as a class. **Action (70 minutes)** Students build a model of their flying machine with an improvement to its design that impacts one or more of the four forces of flight in the event that different weights would be carried. This could be a 3D hand-drawn diagram, a model created from materials, or another representation of their choice. (see Appendix B: Design a Flying Machine) Possible flying machines - rocket, glider, hot air balloon, jet airplane, helicopter, kite, parachute, supersonic airplane, propeller airplane, space plane, hovercraft, drones, dirigibles, paper airplane Note: Teachers could also follow the direction of sourced videos to model how to create a flying machine and then the students create an improvement that impacts the four forces considering different weights would be carried. The Science of Flight, Ontario Science Centre **Consolidation** (30 minutes**)** Each group/partner presents their flying machine and their researched information, or the class can participate in a Gallery Walk. This could be a digital presentation, a poster, diagram, video, data graphing or other product of their choice. Students complete a reflection on their learning (see Appendix C: Reflection on Learning). The teacher can then assess student achievement using the sample rubric as a guide (see Appendix D: Assessment of Engineering Design Process or Appendix E: Assessment of Learning)
 **A1.3, A.1.4, A.1.5**	
 **A.1.4, A.1.5**	

Science and Technology Expectations	**Science - Structures and Mechanisms: Flight** Demonstrate an understanding of the ways in which properties of air can be applied to the principles of flight and flying machines D2 Exploring and Understanding Concepts D2.2 describe the relationships between the four forces of flight - lift, weight, thrust, drag that make flight possible D2.4 Describe ways in which the four forces of flight can be altered
Science and Technology Vocabulary	Specific vocabulary that will be used and/or covered in this learning experience Force – a push or pull acting on an object Aviation – the flying or operation of aircraft Lift – a force that directly opposes the weight of an airplane and holds the airplane in the air Thrust – the force which moves an aircraft through the air to overcome drag and the weight of a rocket Drag – a aerodynamic force that opposes an aircraft's motion through the air and is generated by every part of the airplane Weight – the force generated by the gravitational attraction of the earth on the airplane which could include the weight of the plane, fuel, passengers, cargo and crew
Equipment and Materials	**Common science lab resources:** computer/tablet with access to the Internet, glue gun, paper, popsicle sticks, scissors, elastics, ruler, calculator, lightweight fabric/material, cardboard **Common/Household Items and 'Specialty Items:** recycled materials for engineering design process activities **Online Resources** Canadian Aviation and Space Museum Youthspace, Canadian Council for Aviation and Aerospace, The Science of Flight, Ontario Science Centre LRP Grade 6 Model 2 LRP Grade 6 Model 1

	Science and Technology (2022), Ministry of Education English Language Curriculum, Ministry of Education Assessment and Evaluation, Ministry of Education Health and Safety, Ministry of Education Fundamental Concepts, Ministry of Education The Strands and Topics in the Science and Technology Curriculum
Timeline and Preparation	Time required for preparation – be ready to teach after the lesson on properties of air and all necessary materials are gathered. Approximate time for the learning experience(s) 120 minutes/3 periods **Minds-on** 20 minutes **Experience 1** Engineering Design 70 minutes **Consolidation** 30 minutes Can be extended based on student engagement/interest/driving questions/inquiry.
Safety Considerations	Safety procedures for this lesson **What does the teacher do?** ● follow established safety procedures and/or safety plan ● identify possible safety concerns ● accommodate or modify program expectations as needed based on student needs ● adhere to student alternative program with alternative expectations **What do the students do?** ● maintain a well-organized and uncluttered workspace ● carefully follow the instructions and example of the teacher Refer to these safety resources:

	• Safety in Elementary Science and Technology (STAO) • Safe Activity Foundations in Education Document (SAFEdoc) Science and Technology, Grades 1-8 (OCTE)
Opportunities For Assessment	According to the Ministry of Education Growing Success Document (2010) assessment is about improving student learning! **Assessment FOR Learning:** Occurs frequently and in an ongoing manner during instruction, while students are still gaining knowledge and practicing skills and is used by teachers to monitor students' progress towards achieving the overall and specific expectations, so that teachers can provide timely and specific descriptive feedback to students, scaffold next steps, and differentiate instruction and assessment in response to student needs. **Assessment AS Learning:** Occurs frequently and in an ongoing manner during instruction, with support, modeling, and guidance from the teacher and is used by students to provide feedback to other students (peer assessment), monitor their own progress towards achieving their learning goals (self-assessment), make adjustments in their learning approaches, reflect on their learning, and set individual goals for learning. **Assessment OF Learning:** Occurs at or near the end of a period of learning, and may be used to inform further instruction and is used by the teacher to summarize learning at a given point in time. This summary is used to make judgements about the quality of student learning on the basis of established criteria, to assign a value to represent that quality, and to support the communication of information about achievement to students themselves, parents, teachers, and others **NOTE:** The assessment in the learning experiences are intentionally assessment for learning and assessment as learning. The assessment modality is intentionally conversations and observations. This is to help move away from only product based assessment. Throughout the learning experiences students will have many opportunities to demonstrate their understanding through doing, talking and engaging in self-assessment. By collecting assessment for/as learning data teachers can be responsive and provide meaningful feedback. Teachers have been provided with assessment tools to collect evidence of student learning. Assessment opportunities are embedded throughout the learning experiences.

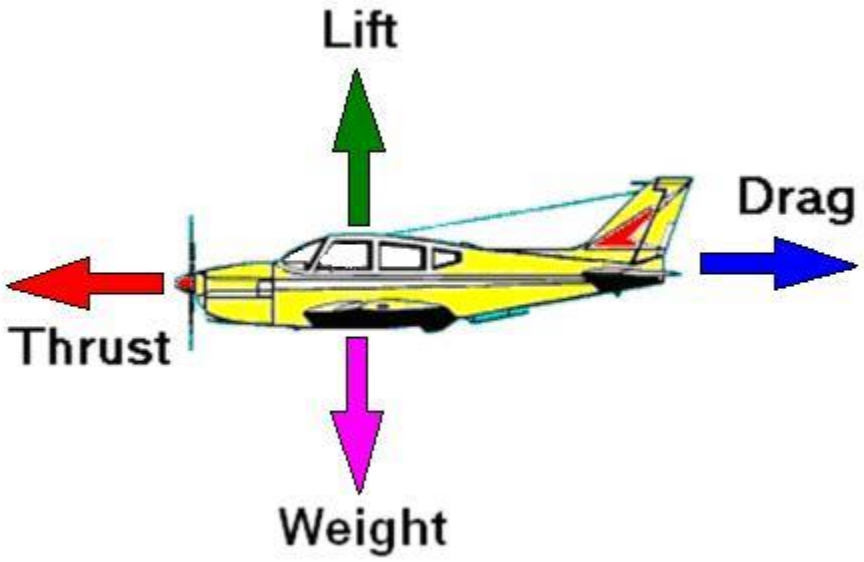
	Consult the Sample Achievement Charts and Growing Success https://www.dcp.edu.gov.on.ca/en/assessment-evaluation/sample-achievement-charts https://www.edu.gov.on.ca/eng/policyfunding/growsuccess.pdf
Instructional Strategies and Adaptability	**Instructional Strategies** ● Create a learning environment in which students feel safe, supported, and valued ● Embed culturally responsive student-centered instructional practices as well as diverse readings from a variety of voices and perspectives, particularly those voices which may fall outside of traditional canons ● Encourage students to ask good questions and give them the opportunity to find answers and/or solutions ● Support students as they carry out the engineering design process **Transferable Skills** – problem solving, innovation, creativity, self-directed learning, collaboration, communication, digital literacy **Instructional Adaptability** ● Students work collaboratively with a partner or group that can provide a cross section of skills to support each other (Universal Design of Learning) ● Students who have IEP modifications may benefit from a very structured version of the activity with modified worksheets with more intensive support ● Students who are ELL may benefit from translated materials and/or images with access to translation software or a peer who can interpret ● Students may benefit from accommodations such as extra time
Additional Supporting Resources	Learning games and activities for support ● Activity books can be downloaded from this site - Youthspace - Canadian Council for Aviation and Aerospace, ● Grade 6 Flight Activities Science North – Airplane Design Challenge – Coding
Cross-Curricular Opportunities	**English Language** **Reading** demonstrate an understanding of a variety of literary, graphic, and informational texts, using a range of strategies to construct meaning

	Writing generate, gather, and organize ideas and information to write for an intended purpose and audience **Media Literacy** create a variety of media texts for different purposes and audiences, using appropriate forms, conventions, and techniques English Language Curriculum
Future Opportunities / Next Steps	#1 Explore what is a wingsuit by Let's Talk Science #2 Virtual Learning – Science North – E- Workshops Grade 6 Flight #3 Read "Four Forces of Flight" by Let's Talk Science and share new information learned #5 Flight Virtual Program - Canadian Aviation and Space Museum - virtual field trip in English and French - 1 hour - includes building a glider

Appendix A: The Four Forces of Flight

Name: _____

The Four Forces of Flight



Answer the following questions with your group or partner.

1. How do these four forces enable a flying machine to move through the air?

Drag

Thrust

Lift

Weight

2. What role does a propeller have in the flying machine moving through the air?

3. How is flight a push and pull force?

4. What force is acting when a parachute is falling through the air?

Appendix B: Design a Flying Machine

Name: _____ Appendix B

Action – The Four Forces of Flight – Design a Flying Machine

Learning Goal: We are learning to design and/or build a flying machine to demonstrate the 4 forces of flight.

1. **Design Process**

What is the problem?

What do I know? What do I need to know?

How and where will I find it?

2. **Possible Solutions**

Solution #1	Solution 2	Solution #3

3. **Success Criteria** – how do we know our chosen solution resulted in a flying machine?

I can
I can

4. **Record**

Test each solution and record issues for further testing.	Results and Issues
Test #1	
Test #2	

5. **Modification** – what improvement did you make to your flying machine?

6. **Communicate Results**

Summarize how results will be communicated…

Appendix C: Reflection on Learning

Suggested Reflection

3-2-1 Four Forces Reflection   Name:

Three significant ideas that I took away about aviation.	
What is squared away in my mind?	
One questions that is still circling in my head.	

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Appendix D: Assessment Tools for Engineering Design Process

Suggested Assessment Tools for Engineering Design Process

Assessment for Learning

Feedback to Improve Excel	Success Criteria The Student	Feedback to
	Criteria #1 Appropriate science and technology vocabulary.	
	Criteria #2 Flying machine design demonstrates the four forces.	
	Criteria #3 Completed graphic organizer and necessary information and format for oral presentation	
	Criteria #4 Change to flying machine is an improvement in flight.	

Assessment as Learning

Feedback to Improve Excel	Success Criteria The Student	Feedback to
	Criteria #1 I can use appropriate science and technology vocabulary.	
	Criteria #2 I can investigate with depth a flying machine design demonstrating examples of the four forces.	
	Criteria #3 I can communicate with clarity in written and oral format for specific audiences and purposes.	
	Criteria #4 I can provide thorough rationale for what changes to my flying machine support its improved flying ability.	

Appendix E: Assessment of Learning

Assessment of Learning

Student Criteria	Level 4	Level 3 (success)	Level 2	Level 1	Feedback
Criteria #1: Appropriate science and technology vocabulary.		Considerable effectiveness in science terminology.			
Criteria #2: Flying machine design demonstrates the four forces.		Considerable effectiveness in summarizing relevant information.			
Criteria #3: Completed graphic organizer and necessary information and format for oral presentation		Considerable effectiveness in expressing and organizing of information.			
Criteria #4: Change to flying machine is an improvement in flight.		Considerable effectiveness in explaining key facts.			