



ONTARIO COUNCIL  
FOR TECHNOLOGY  
EDUCATION

# Grade 6 Flight

**ONLINE RESOURCE**

Written By: Joanna Strickland

June 2020

# Understanding Structures and Mechanisms - Flight

## Grade 6

### Activity 1

#### *Development of Curiosity and Wonder - How are we able to fly through the air?*

**Scientific and Technological Concepts:** Although we cannot see air; without it, airplanes and birds couldn't fly. We know that air takes up space, exerts a force (pressure), and has mass. In this activity students will explore the properties of air that make flight possible.

- Air takes up space - This exploration will prove that air really is there.  
<https://www.youtube.com/watch?v=NHV9cYcdkTY>
- Air exerts a force (pressure) - This exploration builds on the last. The force of air pressure in the bottle doesn't allow the balloon to be blown up (showing air exists inside the bottle), until the pressure is released through a vent hole. This hole creates an escape for the air in the bottle to be displaced by the air being blown into the balloon. When the hole is plugged with the balloon inflated in the bottle the pressure inside the balloon is higher than in the bottle which keeps the balloon inflated. <https://www.youtube.com/watch?v=Grziaq-caVE>
- Air has mass - In this investigation students will conduct more of an inquiry to discover this property of air. Students will have to infer from their observations using balloons and a ruler scale that air has mass. The slide for this activity will not have a full title so as not to give away the answer. When the investigation is completed the balloon full of air will tip the scale. While you can't measure the mass directly it shows indirectly that air has mass.  
[https://www.youtube.com/watch?v=o5LT\\_wfI98w](https://www.youtube.com/watch?v=o5LT_wfI98w)

Air is "stuff" that you must fly through, and it produces two forces of flight: lift and drag. In order to achieve flight you need enough **lift** to overcome the **weight** of the aircraft and enough **thrust** to overcome the **drag** of the aircraft.

[Bill Nye - Flight](#) - a full episode on flight that is fun and relevant.

#### Learning Goal:

Students will

- Discover that air has properties that can be used for flight
- Conduct investigations that demonstrate the properties of air
- Draw conclusions about how air enables flight

# Understanding Structures and Mechanisms - Flight

## Grade 6

### Expectations (Overall & specific):

**Overall:** investigate ways in which flying devices make use of properties of air

**Specific:**

- 2.1 follow established safety procedures for using tools and materials and operating flying devices
- 2.2 use scientific inquiry/experimentation skills to investigate the properties of air
- 3.1 identify the properties of air that make flight possible

Equipment & Materials	Personal Protective Equipment (PPE)
<ul style="list-style-type: none"> <li>● Paper towel</li> <li>● A glass</li> <li>● Bowl filled with water</li> <li>● Balloons (at least 3)</li> <li>● A plastic bottle</li> <li>● A pair of scissors</li> <li>● String</li> <li>● A ruler</li> <li>● A small needle or other sharp object</li> </ul>	<ul style="list-style-type: none"> <li>● Protective eyewear</li> </ul>

### Safety Considerations:

- Students should be careful when using items made of glass.
- Students should be careful when using scissors to cut plastic.
- Balloons that become over inflated can rupture creating flying debris.
- Students should be careful when using sharp items such as scissors and needles.

What does the teacher do?	What do the students do based on the Technological Problem-Solving Skills Continuum?
<ol style="list-style-type: none"> <li>1. The teacher will post the Slide deck (see Appendix A or refer to separate file) on the online platform of choice. Students should view in present mode but complete the work in edit mode.</li> </ol>	<p><b>Initiating and Planning</b></p> <ul style="list-style-type: none"> <li>● Gather materials</li> <li>● Hypothesize what the result of each investigation will be prior to performing the investigation</li> </ul>

# Understanding Structures and Mechanisms - Flight

## Grade 6

<p>2. Teachers may choose to add videos of explanation for each investigation either through use of video or voice notes.</p> <p>Sample accommodations:</p> <ul style="list-style-type: none"> <li>• Provide videos of the investigations for students to view if they are unable to perform them at home.</li> <li>• Work can be completed on paper and uploaded as a picture to show completion.</li> </ul> <p>Sample Troubleshooting:</p> <ul style="list-style-type: none"> <li>• Teachers may wish to use Screencastify to make a movie of the slides if students are having difficulty accessing them.</li> </ul>	<p><b>Performing and Recording</b></p> <ul style="list-style-type: none"> <li>• Follow the steps outlined in the investigations to explore the principles of air</li> <li>• Record any observations or wonderings during and after the investigation</li> </ul> <p><b>Analysing and Interpreting</b></p> <ul style="list-style-type: none"> <li>• Use their observations to draw conclusions about how air enables flight</li> </ul> <p><b>Communicating</b></p> <ul style="list-style-type: none"> <li>• Record any questions they still have about air, its properties and flight.</li> </ul>
---	---

**Opportunities for assessment (Links to assessment pieces, organizers):**

- Anecdotal Notes - The answers to the investigation questions that students complete as part of the slide deck can be used for formative assessment of students' understanding of air and flight.
- The questions and wonderings that students complete in the slide deck can be used to drive further instruction and gauge interest.

**Cross Curricular Opportunities:**

**Math**

**Measurement:** estimate, measure, and record length, area, mass, capacity, and volume, using the metric measurement system.

Students could determine the volume of a space in their home such as their room and then calculate the mass of air filling the room using this formula. *volume of space x 1.6 = mass in kg of air in the space*

**Language**

**Writing:** 1.3 gather information to support ideas for writing, using a variety of strategies and a range of print and electronic resources

**Media Literacy:** 3.4 produce a variety of media texts for specific purposes and audiences, using appropriate forms, conventions, and techniques

# Understanding Structures and Mechanisms - Flight

## Grade 6

### Extensions:

Students could research the history of flight, people influential in flight, or any number of related topics and produce a video, website or media text of their choice to share their findings.

### References:

Anonymous. (n.d.). Forces of Flight. Retrieved from <https://howthingsfly.si.edu/forces-flight>

Balloon in a Bottle. (n.d.). Retrieved from <https://www.scienceworld.ca/resource/balloon-bottle/>

Is Air Really There? (n.d.). Retrieved June 1, 2020, from <https://howthingsfly.si.edu/sites/default/files/attachment/IsAirReallyThere.pdf>

Oblack, R. (n.d.). Does Air Have Mass? A Weather Experiment. Retrieved from <https://www.thoughtco.com/demonstrate-air-has-mass-3444021>

### **Appendix A**

#### **[Properties of Air Slide Deck](#)**

# Understanding Structures and Mechanisms - Flight

## Grade 6

### Activity 2 - The Forces of Flight and Exploring Bernoulli's Principle

*Structured to develop technological problem solving skills*

**Scientific and Technological Concepts:** Air is “stuff” that you must fly through, and it produces two forces of flight: lift and drag. In order to achieve flight you need enough **lift** to overcome the **weight** of the aircraft and enough **thrust** to overcome the **drag** of the aircraft. An airplane pushes air out of the way as it flies. That air must go somewhere, so it squeezes between the wings and the surrounding air. A wing is shaped and tilted so the air moving over it has less room than the air moving below it. Because it has less room, the air moving over the wing speeds up more and loses more pressure than the air below the wing. The higher air pressure below pushes the wing and the airplane up (**Bernoulli's Principle**). This push is a force called lift.

#### [How Do Airplanes Fly?](#)

Flight can only occur when the **design** of the structure you want to fly takes advantage of these properties of air.

#### Learning Goal:

Students will

- Investigate, through experimentation, the four forces of flight.
- Draw conclusions about how design affects flight in paper airplanes
- Design build and test paper airplanes to experiment with the forces of flight and design

#### Expectations (Overall & specific):

**Overall:** investigate ways in which flying devices make use of properties of air

**Specific:**

2.1 follow established safety procedures for using tools and materials and operating flying devices

2.4 use technological problem-solving skills to design, build, and test a flying device

2.5 use appropriate science and technology vocabulary, including aerodynamics, compress, flight, glide, propel, drag, thrust, and lift, in oral and written communication

3.3 identify and describe the four forces of flight – lift, weight, drag, and thrust

3.4 describe, in qualitative terms, the relationships between the forces of lift, weight, thrust, and drag that are required for flight

# Understanding Structures and Mechanisms - Flight

## Grade 6

Equipment & Materials	Personal Protective Equipment (PPE)
<ul style="list-style-type: none"> <li>● Paper (printer paper)</li> <li>● Items to be used as weights (paper clips or small washers)</li> <li>● Scissors</li> <li>● Tape</li> <li>● Tape measure or metre stick</li> <li>● Stopwatch or timer</li> <li>● Forces of Flight Recording Sheet (See Appendix B)</li> </ul>	<ul style="list-style-type: none"> <li>● Protective eyewear (optional)</li> </ul>

**Safety Considerations:**

- Students should be mindful of their surroundings when launching paper airplanes, ensuring they are not throwing them at others or towards obstacles such as powerlines.

What does the teacher do?	What do the students do based on the Technological Problem-Solving Skills Continuum?
<p>Pre-teach vocabulary and the parts of a plane. Post the slide deck (See link below or refer to the separate file). <a href="#">Forces of Flight</a></p> <p>You may wish to post the following video after the investigation for students as an illustration of the challenge. <a href="#">Paper Airplanes: Building, Testing, Improving</a> Or create your own consolidation video.</p> <p>Sample accommodations: You may wish to provide students with sample airplane folding instructions. There are many</p>	<p><b>Initiating and Planning</b></p> <ul style="list-style-type: none"> <li>● Explore the forces of flight using simulation websites</li> <li>● Tinker and experiment with different designs of paper airplanes by testing and trying them out. Record their findings on the “Forces of Flight Recording Sheet” (see Appendix B)</li> <li>● Decide on the design that they think will be most successful in meeting the design challenge.</li> </ul> <p><b>Performing and Recording</b></p> <ul style="list-style-type: none"> <li>● Build their design</li> <li>● Test the design: testing (3 trials), make</li> </ul>

# Understanding Structures and Mechanisms - Flight

## Grade 6

available online but here is a sample  
[Paper Airplane Designs](#)

adjustments or changes and test again (3 trials) and exploration testing with adding weights to their design. Record the data from their tests on the “Forces of Flight Recording” Sheet (See Appendix B)

### Analysing and Interpreting

- From the data, calculate the average distance of each plane over 3 trial flights
- Determine why the design was successful and what factors they think made it successful or draw conclusions as to why it was not successful
- Analyse how the weights changed the forces acting on the plane and draw conclusions about how weights changed the performance of the plane

### Communicating

- Communicate their conclusions
- Use unit vocabulary in their communications

### Opportunities for assessment (Links to assessment pieces, organizers):

Forces of Flight Recording Sheet ( See Appendix B)

Photo evidence of completed plane uploaded to the slide deck

Student answers to Investigation Conclusion and Analysing Questions

### Cross Curricular Opportunities:

**Language:** Students could engage in a Biographies unit with notable persons involved in the development of flight (Amelia Earhart, The Wright Brothers, Christine Darden etc.) Then write a biography of their own.

1.1 read a wide variety of texts from diverse cultures, including literary texts (e.g., short stories, poetry, myths, legends, fantasies, novels, plays), graphic texts (e.g., graphic novels, advertisements, atlases, graphic organizers, charts and tables), and informational texts (e.g., biographies, textbooks, and other non-fiction materials; articles and reports; print and online editorials, various electronic texts, webquest texts)

# Understanding Structures and Mechanisms - Flight

## Grade 6

1.6 extend understanding of texts by connecting, comparing, and contrasting the ideas in them to their own knowledge, experience, and insights, to other familiar texts, and to the world around them

2.8 produce revised draft pieces of writing to meet identified criteria based on the expectations

3.8 produce pieces of published work to meet identified criteria based on the expectations

### Mathematics:

**Data Management and Probability** - Students could use the trials from the investigation as a Data Management Unit and graph their trial data and draw conclusions of probability based on the data they collect.

- collect and organize discrete or continuous primary data and secondary data and display the data using charts and graphs, including continuous line graphs;
- read, describe, and interpret data, and explain relationships between sets of data;
- determine the theoretical probability of an outcome in a probability experiment, and use it to predict the frequency of the outcome.

**Measurement:** Students could explore measurement as well. They are measuring the distance of the flights but could also do a separate activity involving conversions.

- estimate, measure, and record length, area, mass, capacity, and volume, using the metric measurement system
- solve problems requiring conversion from larger to smaller metric units

### References

Anonymous. (n.d.). Forces of Flight.

Retrieved from <http://howthingsfly.si.edu/forces-flight>

Norwry. (n.d.). Flight. Retrieved from

<https://stjohnpaulii.dcdsb.ca/en/teacher-resources/Flight-Powerpoint-MS.-NORWRY.pdf>

Paper Airplanes: Building, Testing, & Improving. Heads Up! - Activity. (2019, April 11).

Retrieved from [https://www.teachengineering.org/activities/view/cub\\_airplanes\\_lesson06\\_activity1](https://www.teachengineering.org/activities/view/cub_airplanes_lesson06_activity1)

# Understanding Structures and Mechanisms - Flight

## Grade 6

### Appendix B - Forces of Flight Recording Sheet

#### Paper Airplane Design Recording and Observations

##### **Part A**

**Before** you decide on which design you will use as the prototype for Boeing, do some research by exploring different paper airplane designs. Using your knowledge or knowledge you gathered construct at least 3 paper airplane designs (you may do as many as you wish but a minimum of three is required) that you think will fly the farthest. You may experiment with shape, materials, and make adjustments to the design such as adding wing or tail flaps. Record in the chart below any changes or adjustments you made to your designs as you were experimenting with them. Also record how those changes affected the flight of the paper airplane.

<b>Paper Airplane Design</b>	<b>Observations of Flight</b> (i.e. the plane went straight up, or it went straight down, it curved to the left)	<b>Changes or Adjustments made to the Design</b> (i.e. I folded the edges of the wing up to make a flap)	<b>How Did the Adjustment Affect the Flight of the Plane</b> (i.e. Last time it went straight up, now it flies straight for a few seconds then goes straight down)
#1			
#2			
#3			

##### **Part B**

Now choose the most successful design of the planes you tried in Part A. This will be your prototype. Your prototype needs testing now to be sure it performs the way you would like it to. Follow the steps on the slide deck to complete the test. Record your results in table 1.

# Understanding Structures and Mechanisms - Flight

## Grade 6

Table 1

Flight #	Time (seconds)	Distance (metres)	Flight Observations - describe how your plane flew during the trials.
1			
2			
3			
Average Add together the three numbers and divide by 3 for both columns			

### Part C

Take the knowledge you have gained from the first test and make any changes to your design that you think will improve your plane's performance. Record the changes you have made below.

Record your design changes here.

Now test your improved plane in the exact same way that you tested it in Part B. Record your results below in Table 2.

# Understanding Structures and Mechanisms - Flight

## Grade 6

Table 2

Flight #	Time (seconds)	Distance (metres)	Flight Observations - describe how your plane flew during the trials.
1			
2			
3			
Average Add together the three numbers and divide by 3 for both columns			

### Part D

Now let's experiment with how weight affects the flight of your plane.

Try four different arrangements of paperclips on your successful design. Record your observations below.

Location of Weight	Observations (i.e. flight path changes, distance changes)

# Understanding Structures and Mechanisms - Flight Grade 6

## **Part E**

Complete the Concluding and Analysing questions on the slide deck.

# Understanding Structures and Mechanisms - Flight

## Grade 6

### Activity 3 - Mythical Flying Creature

#### *Guided development of technological problem solving skills*

Scientific and Technological Concepts: Flying animals have several adaptations that allow for them to use the principles of air and the forces of flight to fly. The videos below are great to share with students (or for your own knowledge) to help them see and understand how the adaptations of animals and insects allow these creatures to make use of the forces involved in flight in order to be able to fly.

[How Do Birds Fly?](#) - this is a great “kid-friendly” explanation of the anatomy of birds and how they achieve flight.

[The Anatomy of Flight](#) - this video discusses in detail all of the anatomical adaptations that allow birds to be such successful fliers.

[How Do Insects Fly?](#) - this is an explanation of how insects fly and how this process compares to helicopter and airplane flight.

[How Physics Helps Animals Fly](#) - this video explains how animals use physics to get off the ground

[Bats Take Flight](#) - This is a great video showing in great detail how bats fly and how their flight and adaptations are different from other flying animals.

#### Learning Goal:

Students will

- **Design a creature of their choosing that has the ability to fly using paper or a variety of design software options**
- **Build a model of their creature using found materials**
- **Create a written explanation of their creature and how its adaptations would allow it to fly**
- **Create an oral/visual presentation of their creature and its flying adaptations**

#### Expectations (Overall & specific):

**Overall:** explain ways in which properties of air can be applied to the principles of flight and flying devices.

**Specific:**

2.1 follow established safety procedures for using tools and materials and operating flying devices

2.3 investigate characteristics and adaptations that enable living things to fly

2.4 use technological problem-solving skills to design, build, and test a flying device

# Understanding Structures and Mechanisms - Flight

## Grade 6

3.5 describe ways in which flying devices or living things use unbalanced forces to control their flight

Equipment & Materials	Personal Protective Equipment (PPE)
<ul style="list-style-type: none"> <li>• Found materials for building such as construction paper, cloth or light weight material, straws, popsicle sticks, hot glue</li> <li>• Materials for adding decorations such as google eyes, feathers etc.</li> <li>• Computer and design software program such as TinkerCad (optional)</li> </ul>	<ul style="list-style-type: none"> <li>• Safety Goggles</li> </ul>

### Safety Considerations:

- Students should be careful when using hot glue guns. Hot glue guns should be used on a stable work surface. Students should be aware of the cord. Adult supervision is recommended.

What does the teacher do?	What do the students do based on the Technological Problem-Solving Skills Continuum?
<ul style="list-style-type: none"> <li>• Provide students with the “Creative Flying Creature Checklist for Success!” (See Appendix C) and Rubric (See Appendix D) when introducing the investigation</li> <li>• Provide students with relevant background information on different flying animals or insects.</li> <li>• Create and share a “How to” video for the design software of choice if you wish to have students use this for design.</li> <li>• Provide feedback and consultation after the design is completed to ensure students are on the right track.</li> <li>• If/When appropriate create a sharing space</li> </ul>	<p><b>Initiating and Planning</b></p> <ul style="list-style-type: none"> <li>• Students should begin by exploring different flying animals, noticing how the structure and adaptations of the animal allows for flight (hollow bones, bat wing is a thin membrane stretched over the bone and rotating wings)</li> <li>• Begin developing their creature by drawing, or using a computer design software to design what their creature will look like. The design should be labelled with the relevant adaptations for flying and how these parts would function in order to enable their creature to fly</li> <li>• Create a list of materials they will need to</li> </ul>

# Understanding Structures and Mechanisms - Flight

## Grade 6

<p>for either pictures or the video presentations for students to share their creatures.</p> <p>Sample accommodations:</p> <ul style="list-style-type: none"> <li>• Provide specific instruction or direct students who are experiencing difficulty creating a “creature”. You may direct students to a specific list of pre-selected creatures.</li> </ul>	<p>build a model of their creature</p> <p><b>Performing and Recording</b></p> <ul style="list-style-type: none"> <li>• Students should build a model of the design using found materials from their list.</li> <li>• At this point in the activity students can make and record any modifications to their design as they build on the “Creature Design Modification Recording” sheet (See Appendix C)</li> </ul> <p><b>Analysing and Interpreting</b></p> <ul style="list-style-type: none"> <li>• Students will complete a 1-2 paragraph written explanation of their creature explaining how it’s adaptations make use of the forces of flight</li> </ul> <p><b>Communicating</b></p> <ul style="list-style-type: none"> <li>• Students make a short video or audio presentation of their creature and how it’s adaptations would enable it to fly</li> </ul>
---	--

**Opportunities for assessment (Links to assessment pieces, organizers):**

Assessment FOR Learning: Conferences with students after their initial design

Assessment OF Learning: Creative Flying Creature Rubric (See Appendix B)

**Cross Curricular Opportunities:**

**Language**

**Specific:**

**Oral Communication:**

2.3 communicate orally in a clear, coherent manner, using appropriate organizing strategies and formats to link and sequence ideas and information

2.7 use a variety of appropriate visual aids, to support or enhance oral presentations

**Writing:**

1.1 identify the topic, purpose, and audience for a variety of writing forms

**Media Literacy:**

# **Understanding Structures and Mechanisms - Flight**

## **Grade 6**

3.4 produce a variety of media texts for specific purposes and audiences, using appropriate forms, conventions, and techniques

# Understanding Structures and Mechanisms - Flight

## Grade 6

### Appendix C

### Success Criteria Checklist

Use this checklist to be sure you have completed ALL of the components of the task.

You will be successful at this task if you...

- Have a completed design (on paper or using the computer) of your creature
- The plan for your creature is labelled with the adaptations for flying and an explanation of how these adaptations would function in order to enable your creature to fly
- You have made a list of materials you will need to build a model of your creature
- You shared your design with the teacher and made use of any feedback to improve your design
- You have built a model of your creature and recorded and changes or modifications that you made that were different from the original design
- You have written a 1 - 2 paragraphs explaining how your creatures adaptations make use of the forces of flight in order to fly
- You have created a short audio clip or video of you and your creature and how it's adaptations would enable it to fly
- You have checked this list to make sure you have checked everything 😊 off



# Understanding Structures and Mechanisms - Flight

## Grade 6

### Appendix D- Creative Creature Assessment Rubric

Expectation	Level 1	Level 2	Level 3	Level 4
<b>2.3 investigate characteristics and adaptations that enable living things to fly</b>	The completed creature demonstrates a limited knowledge and understanding of the characteristics and adaptations of living things that enable them to fly.	The completed creature demonstrates some knowledge and understanding of the characteristics and adaptations of living things that enable them to fly.	The completed creature demonstrates a considerable knowledge and understanding of the characteristics and adaptations of living things that enable them to fly.	The completed creature demonstrates a thorough knowledge and understanding of the characteristics and adaptations of living things that enable them to fly.
<b>2.4 use technological problem-solving skills (see page 16) to design, build, and test a flying device</b>	The student demonstrated limited planning, processing and critical thinking skills to design and build a creature that had adaptations as part of its design that would allow it to fly.	The student demonstrated some planning, processing and critical thinking skills to design and build a creature that had adaptations as part of its design that would allow it to fly.	The student demonstrated considerable planning, processing and critical thinking skills to design and build a creature that had adaptations as part of its design that would allow it to fly.	The student demonstrated thorough planning, processing and critical thinking skills to design and build a creature that had adaptations as part of its design that would allow it to fly.
<b>2.6 use a variety of forms to communicate with different audiences and for a variety of purposes</b>	When sharing the reasons and purposes for their creature's selected adaptations, the student expressed and organized his/her ideas and information with limited effectiveness.	When sharing the reasons and purposes for their creature's selected adaptations, the student expressed and organized his/her ideas and information with some effectiveness.	When sharing the reasons and purposes for their creature's selected adaptations, the student expressed and organized his/her ideas and information with considerable effectiveness.	When sharing the reasons and purposes for their creature's selected adaptations, the student expressed and organized his/her ideas and information with a high degree of effectiveness.
<b>3.5 describe ways in which flying devices or living things use unbalanced forces to control their flight</b>	The student was able to make connections between their knowledge of forces in flight and how their creature could use those forces to control its flight with limited effectiveness.	The student was able to make connections between their knowledge of forces in flight and how their creature could use those forces to control its flight with some effectiveness.	The student was able to make connections between their knowledge of forces in flight and how their creature could use those forces to control its flight with considerable effectiveness.	The student was able to make connections between their knowledge of forces in flight and how their creature could use those forces to control its flight with a high degree of effectiveness.

# Understanding Structures and Mechanisms - Flight

## Grade 6

### Appendix C

#### Creature Design Modification Recording Sheet

In the space below please record any changes or adjustments you made to your design as you were building your model. This could include changes in the size of something on your design, a change of material if you realize the material you selected was not the best choice or any other change that needed to be made to build your model successfully. Explain **why** you made the change or adjustment.

Design Changes or Adjustments	Explanation