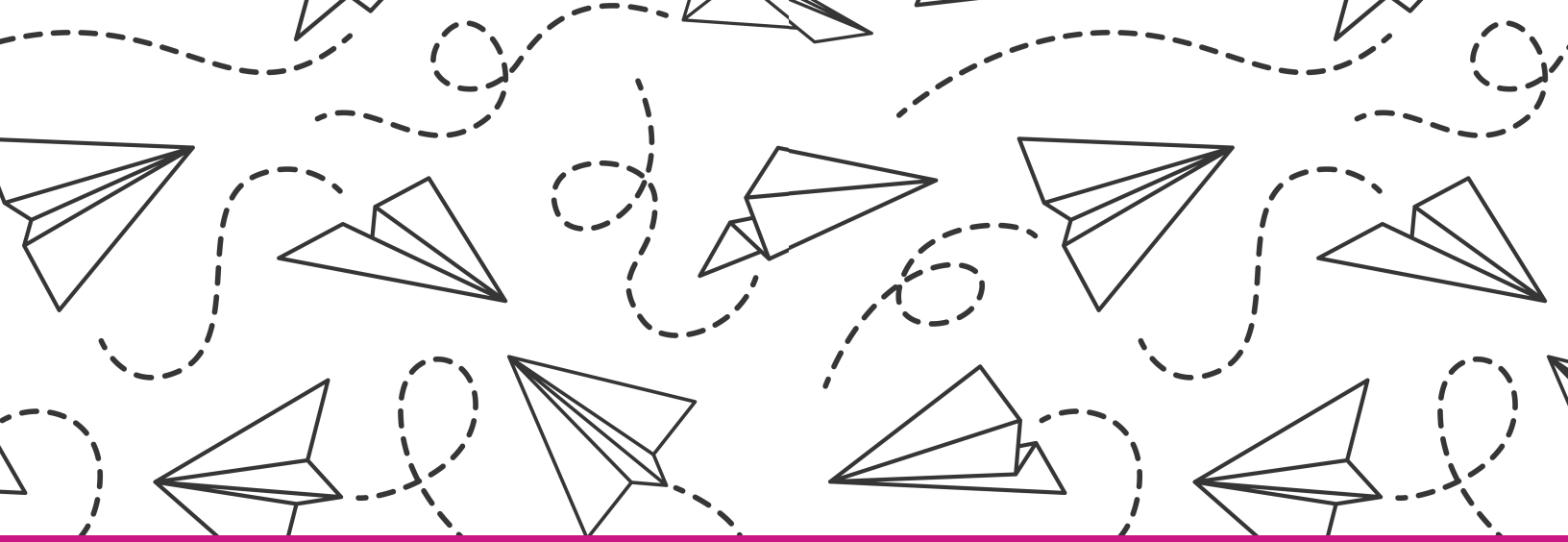
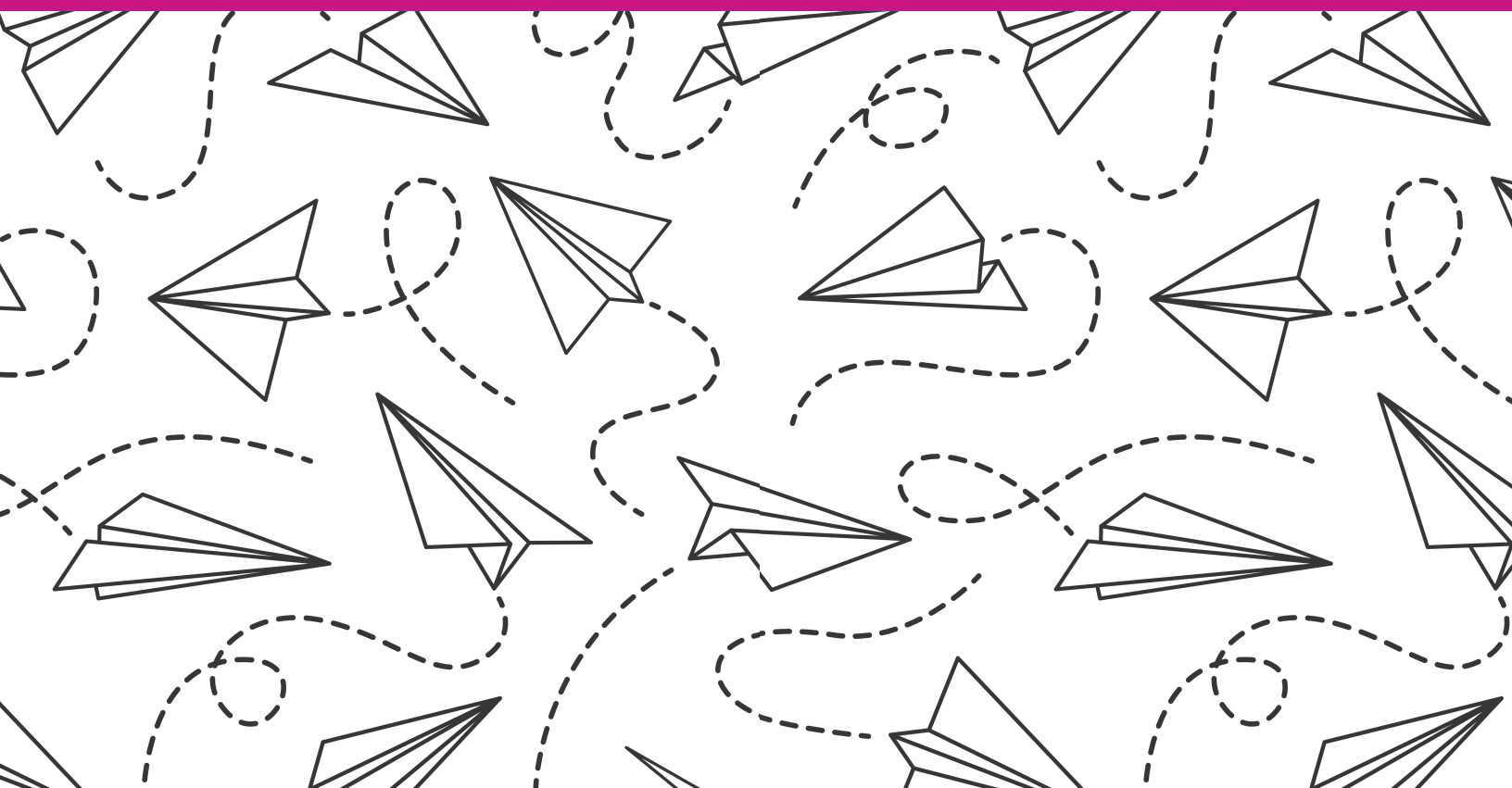


FLIGHT

UNDERSTANDING STRUCTURES AND MECHANISMS

Grade 6 Ontario



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INTRODUCTION

madly learning inquiry based units

Dear Teacher,

This unit has a lot of hands on experiments that will keep students excited and engaged while learning about flight. Wherever possible, I have tried to ensure that all of the experiments use common and safe materials to accomplish the learning goals. However, an important aspect of these experiments is the ability for students to reflect on their learning because some of the concepts are theoretical and some students may struggle with making these connections without your guidance. This is especially true with understanding concepts of flight that are hard for students to see due to size within the classroom.

This unit uses an inquiry based approach to learning. This means that the role of the teacher is ideally that of a guide to help students learn the concepts in the lessons contained herein. We know that good teaching provides our students with a variety of learning activities. Effective instruction must go beyond the passive consumption of read and respond worksheets or repetitive centres activities. This is the reason that you will find a limited amount of these tasks in Madly Learning units.

We know teachers have a wide variety of experiences with inquiry, and we have worked to make the teaching components flexible and adaptable to your needs as a teacher but also to the wide variety of needs of students in your classroom. Through every Madly Learning unit, we hope to bring you a wider variety fun and engaging lessons that fit it all together to make learning meaningful.

As always, if you have any questions, concerns, or comments you would like to share with me, I am always available to support you. Send me an email and I will get back to you promptly. I appreciate when buyers contact me directly about any issue prior to leaving feedback.

Enjoy the unit!
Sincerely,
Patti
@MadlyLearning
EMAIL : info@MadlyLearning.com

FOCUS ON inquiry

Inquiry is an approach to teaching that takes the teacher out of the role of lecturer and transitions the teacher into the guide on the side. By implementing an inquiry approach, you are giving up some of the control in your classroom and over the learning.

Getting Started:

Start your unit getting to know how much your students know and what they are interested in. This is the goal of lesson one. They will review the images of the Wonder Wall to activate prior knowledge and inspire thinking. Their thinking will elicit questions that will serve to guide your exploration through the remaining components of the unit. Capture student questions and post them on a chart as they share their ideas with the class.

At this point, students will ask questions—but don't give them answers; just write the questions down and ask a question back that makes them think more deeply about the topic they are curious about. Get an idea about what they are interested in and what they know. Once you have captured their questions, look at their list and group their questions into topics.

The photos were designed to foster student thinking related to the content of the curriculum. These will serve as questions that will lead into your lessons.

Make a list of themes that students want to know more about. These will generally follow the lessons as they are planned out in this unit, except now you have let them choose why they are learning about them.

FOCUS ON inquiry

The Lessons:

The lessons in this resource reflect the typical goals of an initial student inquiry.

You will work through these lessons by always referring to these as being a part of the student goals. They do not have to be done in exactly this order, and you can add in other information based on student interest. You will notice that many of the pages either activate prior knowledge or are a reflection about a hands-on learning activity to ensure that students are learning what they are supposed to learn from the activities. This is where your guidance becomes an important part of the learning process.

You are no longer just giving information. You are leading discussions through questioning techniques that help students to draw conclusions.

Conferencing and knowledge-building circles will be important activities for this to occur. Assess who is doing most of the talking? It should be the students doing the talking about their learning, not just listening.

This is the goal for learning. However this may be new to many of them as they learn to listen to each other instead of just you. So train them, train them, train them by gradually releasing the control of the conversation away from you and more to them.

Final Inquiry Project:

This is the application piece of all of their learning and should take up the most of your teaching and learning time. During this time, you are not teaching and lecturing. Instead, you are supporting, questioning, and conferencing with students.

FOCUS ON inquiry

If this is one of your first inquiry units, you can consider a guided inquiry approach where you walk them through each step and limit their choices. Alternatively, you can allow students to work as a group based on interest and use a guided reading for science model to help guide them through their inquiry.

Assessment

Assessment has three elements along the journey.

Diagnostic - *Assess students about their initial knowledge. This is not a formal assessment but will give you a baseline of student understanding. Quickly level student knowledge based on three levels of understanding: limited, developing, and good.*

Formative Assessment - *Through each lesson, there are guides for how to collect formative assessment of your students. Gather information for your assessment from a balance of your conversations, observations, and the products produced by students.*

Summative *- At the end of the unit, students will participate in a culminating activity of the inquiry project. This project will have them apply their learning from the smaller parts of the unit to complete this inquiry project. Allow for an open-ended approach to how students present their information. Your assessment will be of the knowledge and skills demonstrated, not on specific methods of how this is demonstrated.*

Inquiry is a journey, and wherever you are on your inquiry journey as a teacher is an okay place to be. Start with one inquiry task and with every new experience release a bit more control to students letting them lead. This happens over time, not overnight.

CROSS CURRICULAR connections

There are many other opportunities to connect this unit with other subjects that you teach. Here are some ideas about how you can connect the learning in this unit with other subject areas.

OTHER SCIENCE	Relate this to the study of astronauts who were first pilots and then moved into space exploration. Look at how these two science explorations are similar.
SOCIAL STUDIES	The invention of flight impacted immigration around the world. Compare the timeline of the adoption of commercial aircraft with immigration trends within Canada.
MATH	Create math problems that relate to flight: graphing, measurement, location, and movement. Have students plan a trip including a flight related to financial literacy.
LANGUAGE	Explorations of famous explorers, inventors, and innovators can be used for many reading and writing tasks.
ARTS	Look at the blueprints of different flying machines and inventions. Create blueprints of everyday objects or decorate their own flying machines, like paper airplanes or hot air balloons.
PHYS ED HEALTH	Look at some of the health concerns for people during flight. How does flight impact your health? How do various flying technologies help or hinder your own personal health?

FLIGHT
table of contents

ONTARIO

Grade 6

unit checklist

Checklist of curriculum expectations covered by lesson.

Curriculum Expectations	1	2	3	4	5	6	7	8	9	10	11	12
1.1 Assess the benefits and costs of aviation technology for society and the environment, taking different social and economic perspectives into account.	■	■	■	■	■	■	■	■	■	■	■	
2.1 Follow established safety procedures for using tools and materials and opening flying devices.	■	■	■	■	■		■	■	■	■	■	■
2.2 Use scientific inquiry/experimentation skills to investigate the properties of air.	■	■	■	■	■	■	■			■	■	■
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.	■	■	■	■	■		■	■	■	■	■	■
2.5 Use appropriate science and technology vocabulary.	■		■	■	■	■	■	■	■	■	■	■
2.6 Use a variety of forms to communicate with different audiences for a variety of purposes.	■	■	■	■	■	■	■	■	■	■	■	
3.1 Identify the properties of air that make flight possible.	■	■				■	■	■	■	■		■
3.2 Identify common applications of the properties of air, such as its compressibility and insulating qualities.	■	■				■	■	■	■	■		■
3.3 Identify and describe the four force so flight—lift, thrust, weight, and drag.	■	■	■	■	■					■		■
3.4 Describe, in qualitative terms, the relationships between the forces of lift, weight, thrust, and drag that are required for flight.	■	■	■	■	■					■		■
3.5 Describe ways in which flying devices or living things use unbalanced forces to control their flight.	■	■	■	■	■	■						■
3.6 Describe ways in which the four forces of flight can be altered.	■	■	■	■	■	■	■			■		■
OTHER												
Follow safety procedures.												
Communicate their understanding with others in a variety of ways.												
- group discussions												
- student participation in small groups												
- student notebook and reflection pages												
- student/teacher conferences												

grade 6

LEARNING GOAL SUMMARY

Student Name: _____

Lesson	Learning Goal	1	2	3	4
1	We are gathering information and wonderings about flight and flight forces.				
2	Students will understand the basic scientific flight vocabulary to assist in their understanding of flight concepts.				
3	We are learning what the six forces of flight are through hands-on experiments and how they can be impacted by outside forces.				
4	We are learning what the six forces of flight are through hands-on experiments and how they can be impacted by outside forces.				
5	We are learning what the six forces of flight are through hands-on experiments and how they can be impacted by outside forces.				
6	We are learning what the forces of flight are and how they help objects to take flight.				
7	We are learning how animals are able to fly in comparison to objects, such as planes				
8	Determine how manipulating the design of aircraft changes the size and direction of flight forces, and link those changes to changes in the aircraft's motion.				
9	Determine how manipulating the design of aircraft changes the size and direction of flight forces, and link those changes to changes in the aircraft's motion.				
10	We are learning the history of flight and how flight has adapted and changed over the past 300 years.				
11	We are reviewing the key components of flight we have learned in the unit.				
12	We are learning what the benefits and costs of aviation technology are for society and the environment through the eyes of different stakeholders.				

LESSON ONE

Wonder Wall and Diagnostic Assessment

6 L1

All pages through this resource are marked similar to above to show the Grade (6) and Lesson number (L1).

INTRODUCTION

Notes to Teacher:

Access to technology is highly recommended for teachers to use this resource. A ratio of 1 technology device for every 4-5 students is a recommended minimum. At this age level, many students already have these devices and employing a BYOD (Bring Your Own Device) often helps to help increase your access to technology. If you do not have this access, then this unit is still possible. Many of the web links can be printed by the teacher so students have access to them. A link to resources is provided at the end of this document.

Unfortunately, due to copyright issues, I cannot provide the online research sources in a paid TPT product. But they are linked for you in the product LiveBinder.

Format

Lessons are structured in a way that allows the teacher to model student activities first before letting students do the activities on their own.

Lessons are structured for a 40 min. period.

Teacher Directed Lessons – Although the focus in the new curriculum is on inquiry, there is still a place for direct instruction. This unit is balanced between direct instruction and inquiry learning. Using a variety of lesson formats, teaching styles, and student activities, the direct instruction component of this unit will help to give students the basis for understanding the complexities of their inquiry project.

Inquiry Project - Students are more engaged in learning if they buy into what they are learning about. Inquiry activities are integrated into this unit throughout in smaller, more manageable and focused activities. Students begin to explore environmental issues in Canada. Students are guided to discover a topic of interest through an interest inventory. Then, they are given some suggestions that relate to their various interests. With the other corresponding pages, the inquiry process is scaffolded to help you guide students through their inquiry.

grade 6

LESSON ONE

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

We are gathering information and wonderings about flight and flight forces.

Preparation

- Print and post Wonder Pictures to your Wonder Wall.
- Print Wonder Wall Walking Notes and Wonder Wall Question Page.

Lesson Part A

- Students will begin by looking at the images posted on the Wonder Wall.
- Encourage students to think about what the images are, what they have to do with flight, and how they can help us learn more about the topic.
- Provide each student with Wonder Wall Walking Notes and Wonder Wall Question Page. Here, they will record things they observe, know, think, and wonder. They will also come up with questions they have (Example Questions have been provided).
- Students can do this independently or with a partner, depending on their readiness to work independently in partnerships while you teach the other group.

Lesson Part B

- Students join the teacher and share their wonderings.
- A Question/Answer page has been provided to promote discussion.
- Encourage students to share what they are wondering about the unit.
- Ask them what they want to learn and what intrigues them about flight.

Assessment

Judge students on their prior knowledge of this topic, interest, and engagement in different pictures.

NOTES

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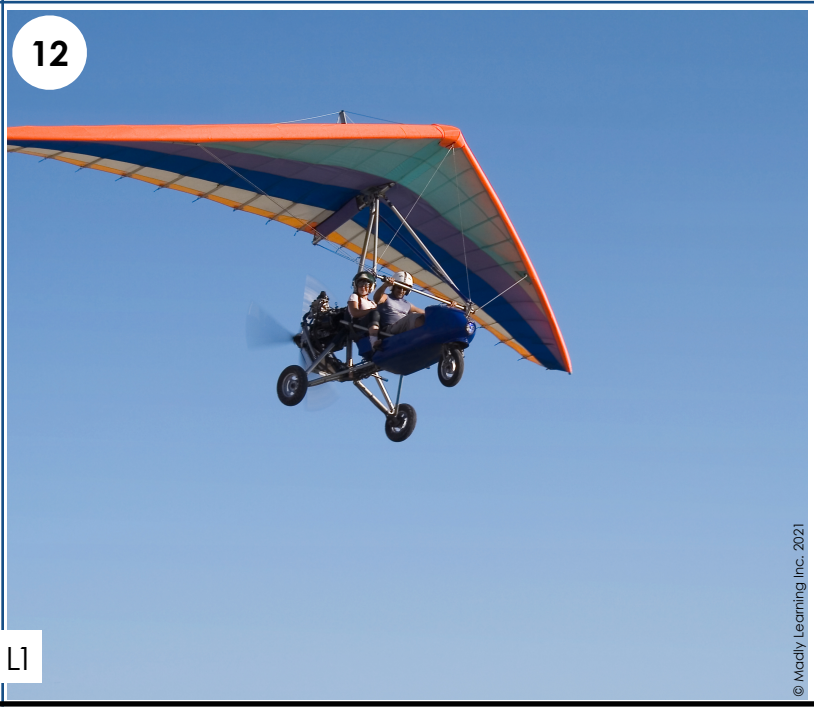
12



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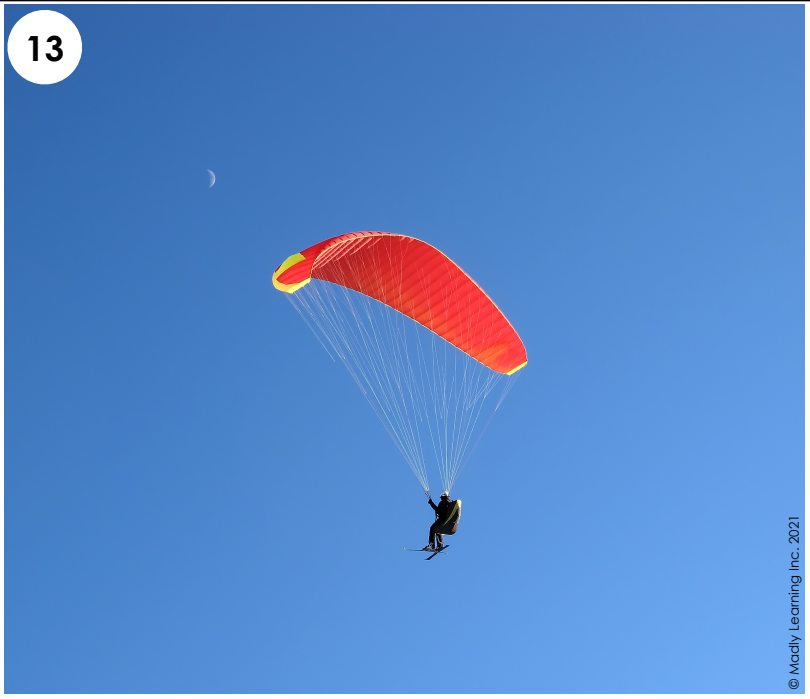

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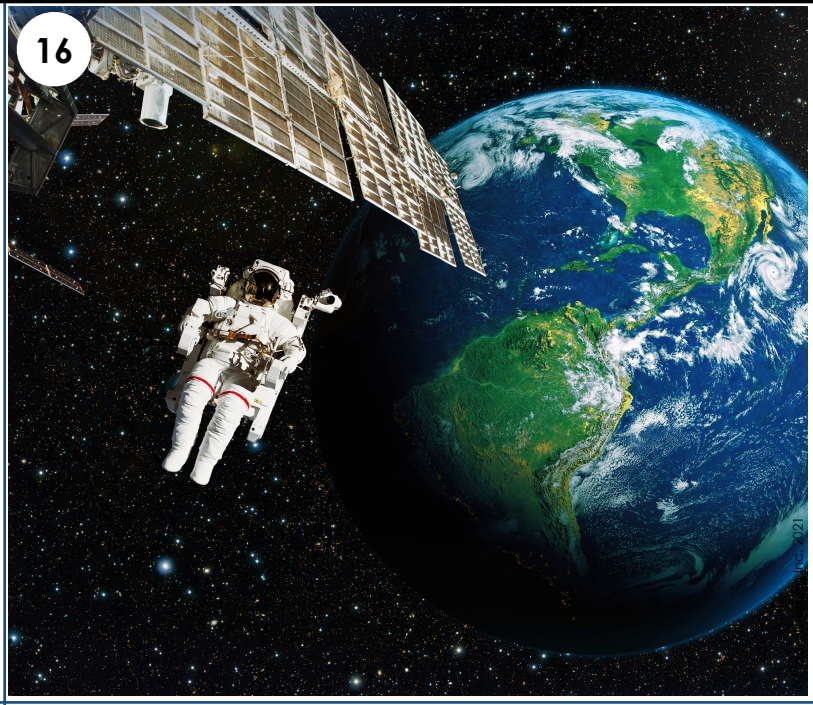

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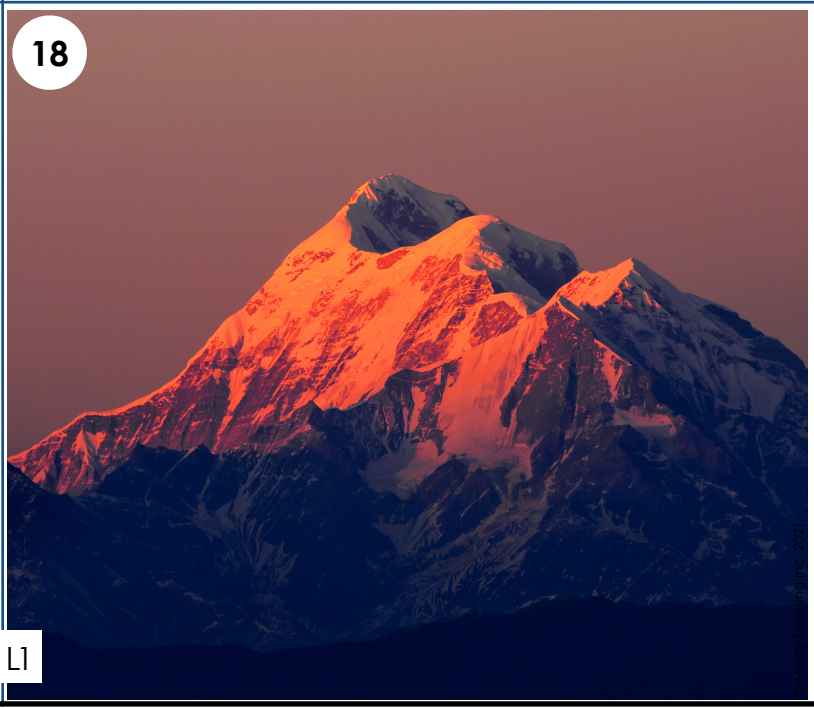


WONDER WALL ANSWERS

1. hot air balloons rising
2. balloons staying in air
3. airplane wing use for flight
4. paper airplane
5. propellor plane
6. birds flying
7. jet airplane
8. bird flying
9. airplane in high altitude
10. cockpit
11. birds soaring
12. glider
13. parachute
14. floating/ buoyancy
15. bat flying
16. astronaut in space
17. pressure metre
18. mountain range

WONDER WALL WALKING NOTES

i observe...

i know...

i think...

i wonder...

WONDER WALL QUESTIONS

Example Questions

WONDER WALL QUESTIONS

How do airplanes get into the air and stay in the air?

Why do my ears pop when I am on an airplane?

How do animals use their wings to fly?

Why is there no gravity in space but there is on earth?

How do airplanes fly with a propellor?

What is air made of?

LESSON TWO

Flight Vocabulary

grade 6

LESSON TWO

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Students will understand the basic scientific flight vocabulary to assist in their understanding of flight concepts.

Preparation

- Print and cut out SCOOT cards.
- Print Flight Vocabulary pages and SCOOT Answer cards (one per student).

Lesson Part A

- Post the Inquiry Question for students and review the goals of the lesson.
- Students will work independently or in partners to define the Flight Vocabulary terms provided. An Answer Key is provided.
- They do not need to write a complicated definition. A simple explanation is fine. They will need these definitions for Part B of this lesson.
    - Google, dictionaries, or science textbooks will be useful for this. Spots have been left blank for students to add words throughout the unit.

Website for Definitions: http://wordcentral.com/

Lesson Part B

SCOOT

- Students will play a game of SCOOT as a class.
- Place the SCOOT cards around the classroom and give each student a SCOOT Answer Card.
- Review the SCOOT game rules provided.
- Collect SCOOT sheets at the end for assessment purposes.

Reading

- Once students are done and have handed in their SCOOT cards, provide them with the reading: The Wright Brothers Take Flight.

Assessment

- Review definitions with students to ensure understanding.
- Collect SCOOT cards and review to ensure understanding.

NOTES

If needed, you can display the SCOOT cards on the board and have students answer.

INQUIRY QUESTION

What are key terms that will help us understand the aspects of flight?

6 L 2

FLIGHT

FLIGHT VOCABULARY

Define the terms below and draw a picture to represent them.

TERM	DEFINITION	PICTURE
LIFT		
THRUST		
DRAG		
AIR		
FLUID		

FLIGHT VOCABULARY

TERM	DEFINITION	PICTURE
PRESSURE		
DENSITY		
BUOYANCY		
GRAVITY		
AERODYNAMICS		

FLIGHT VOCABULARY

TERM	DEFINITION	PICTURE
WEIGHT		
WINGS		

Answer Key

FLIGHT VOCABULARY

Define the terms below and draw a picture to represent them

TERM	DEFINITION	PICTURE
LIFT	to move to a higher position or rise from the ground	
THRUST	to push or drive with force	
DRAG	something that slows down a motion or the force acting on a body to slow it down	
AIR	the invisible mixture of odourless, tasteless gasses that surrounds the earth	
FLUID	flowing liquid or gas OR tending to change or move	

Answer Key

FLIGHT VOCABULARY

TERM	DEFINITION	PICTURE
PRESSURE	the application of force to something by something else in direct contact with it	
DENSITY	the mass of a substance per unit volume	
BUOYANCY	the tendency of an object to float or to rise when in a fluid OR the power of a fluid to put an upward force on a body placed in it	
GRAVITY	force of attraction between particles or bodies that occurs because of their mass	
AERODYNAMICS	a science that deals with the motion of fluids	

Answer Key

FLIGHT VOCABULARY

TERM	DEFINITION	PICTURE
WEIGHT	the amount something weighs	
WINGS	part that extends from the side of an airplane AND means of which a bird, bat, or insect flies	

SCOOT INSTRUCTIONS

SCOOT RULES

Print out the **SCOOT Cards** and distribute them around the classroom.

Give students a **Blank Answer Card**.

There will be a couple students at each SCOOT card, depending on the size of the class. They will record the card letter on their page and write down the term that matches the definition on the card.

After about one minute, students will switch cards when the teacher calls, "SWITCH!"

Collect the completed recording pages for assessment. An **Answer Guide** is provided.

SCOOT A

definition

to move to a higher position or rise from the ground

Term

lift **drag**

weight **wing**

SCOOT B

definition

to push or drive with force

Term

fluid **gravity**

thrust **drag**

SCOOT C

definition

something that slows down a motion or the force acting on a body to slow it down

Term

gravity **lift**

pressure

aerodynamics

SCOOT D

definition

the invisible mixture of odourless, tasteless gasses that surrounds the earth

Term

density **air**

gravity **fluid**

SCOOT E

definition

flowing liquid or gas OR tending to change or move

Term

buoyancy **air**

fluid **pressure**

SCOOT F

definition

the application of force to something by something else in direct contact with it

Term

gravity **pressure**

thrust **lift**

SCOOT G

definition

the mass of a substance per unit volume

Term

density **air**

pressure **Fluid**

SCOOT H

definition

the tendency of an object to float or to rise when in a fluid OR the power of a fluid to put an upward force on a body placed in it

Term

buoyancy **air**

fluid **pressure**

SCOOT I

definition

force of attraction between particles or bodies that occurs because of their mass

Term

gravity **pressure**

thrust **lift**

SCOOT J

definition

a science that deals with the motion of fluids

Term

gravity **lift**

pressure

aerodynamics

SCOOT K

definition

The amount something weighs

Term

air **weight**

pressure **buoyancy**

SCOOT L

definition

Part that extends from the side of an airplane AND means of which a bird, bat or insect flies

Term

buoyancy **lift**

wings **flight**

SCOOT ANSWER CARD

LETTER	TERM

Answer Key

SCOOT ANSWER CARD

LETTER	TERM
A	LIFT
B	THRUST
C	DRAG
D	AIR
E	FLUID
F	PRESSURE
G	DENSITY
H	BUOYANCY
I	GRAVITY
J	AERODYNAMICS
K	WEIGHT
L	WINGS

THE WRIGHT BROTHERS TAKE FLIGHT

One hundred and twenty years ago, Wilbur and Orville Wright left their hometown in Ohio. Where did they go? They traveled to Kitty Hawk, North Carolina. Why did they decide to pack up and make this move? Well, this small town on the outer banks had large sandy beaches and high winds. It was an ideal place for the men to experiment on their designs for human flight.

That's right, or *Wright*, in this case. We're discussing the Wright brothers—pioneers of aviation and inventors of the first practical airplane.

People had been dreaming of flying for centuries before the Wright brothers were even born, of course. However, it was this duo's ingenuity and hard work that made it possible for human beings to take to the skies in a controlled, powered form of transportation.

Wilbur and Orville had been interested in flying vehicles since they were young. They studied flying toys and learned about mechanics from the printing press and bicycle shop that they owned as young men. In 1900, they traveled to Kitty Hawk in order to build their dream—a flying machine that could be controlled by a pilot.

First, they experimented with kites and gliders and observed the flight patterns of birds. Then, the Wright brothers designed and built an airplane they called the *Wright Flyer I*. It took them many attempts, but finally, in December 1903, they managed to get the aircraft to fly. The *Wright Flyer I* was the first plane powered by an engine and driven by a pilot to be successful.

THE WRIGHT BROTHERS TAKE FLIGHT

For the next few years, Wilbur and Orville perfected their designs and built several other airplanes. The press didn't believe them at first, but their achievements were soon hard to ignore. They sold a plane to the US Army and another to investors in France. Wilbur then traveled to Europe. He piloted the first public flight of one of their planes in 1908. The business that the brothers established grew, and their names became known around the globe.

It wasn't all smooth flying for the Wright brothers, though. Aviation was a dangerous business. One of their passengers died during a test flight for the Army, and Orville was injured in the crash. They also had to fight in court against other inventors who tried to copy their designs and technology. Sadly, Wilbur passed away in 1912 of typhoid fever. Orville would live for another four decades. He made many more accomplishments in human flight.

Since the Wright brothers first flew their piloted, engine-powered aircraft in Kitty Hawk, there has been speedy progress in aviation. The military has expert pilots that man super fast jets. Hundreds of people can fly in a single plane across vast oceans in a timely manner. Sixty-five years after the flight of the *Wright Flyer I*, we even sent astronauts to the moon!

Engineers and aviators continue to develop amazing feats when it comes to flying. They owe their thanks to the Wright brothers and other early pioneers of flight. It was these people who created a new way to travel around the world. They even inspired the exploration of whole new worlds far above the skies.

LESSON THREE

Identifying Properties of Air
Part 1

grade 6

LESSONS THREE

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

We are learning what the six forces of flight are through hands-on experiments and how they can be impacted by outside forces.

Preparation

Prepare all experiment materials for each of the six experiment centres and place in baskets. Glue the instructions to the outside a large envelope and place the observation pages inside.

- Break students into four groups (they will be in these groups for the next three lessons).
- Two groups will complete an experiment with you at the same time—for scheduling, review the Experiment Notes. Please also review the Teacher Experiment Notes prior to starting.

Student Led

- Post the Inquiry Question for students and review the goals of the lesson.
- Review any specific safety procedures which may apply with students prior to starting any experiment centres.
- Students in the student led activities will work in their groups.
- They will read the instructions and complete the steps of either Experiment #1 or Experiment #2.
- As they are working they should record their work on their Student Observation page.
- Post the Properties of Air page on the board. As you work through the experiments, add in the correct word to complete the key term. An Answer Key has been provided.

With The Teacher

- Gather two groups with you in a central place in your classroom.
- Distribute materials.
- Distribute the materials and walk your students through the steps of the experiments, stopping as necessary to record their observations on the observation pages.

Consolidation /Assessment

- Discuss with students what they learned and what they observed. Record anecdotal observations about student understanding of how experiments demonstrated the properties of air on chart paper.
- At the end of the day's centres time, collect the student observation pages to review.

NOTES

- Student groupings for independent work are 4-6 students. If required for independent student led experiments, allow students to break their group into smaller sub groups.
- If required, all experiments can be teacher led but this is not recommended.

INQUIRY QUESTION

flight

What are the four forces of flight and how do the forces allow planes to fly?

6 L 3

FLIGHT

EXPERIMENT NOTES

Break students into four groups. Two of the groups will be doing the same experiment at the same time. The experiments will be run like centres, and they will complete both experiments in the same day. One of the experiments will be teacher directed. Here is an example of the layout below.

	Rotation #1		Rotation #2	
Day	**Student Led**	**With Teacher**	**Student Led**	**With Teacher**
DAY 1	EXPERIMENT #1 (groups 1&3)	EXPERIMENT #2 (groups 2&4)	EXPERIMENT #1 (groups 2&4)	EXPERIMENT #2 (groups 1&3)
DAY 2	EXPERIMENT #3 (groups 2&4)	EXPERIMENT #4 (groups 1&3)	EXPERIMENT #3 (groups 2&4)	EXPERIMENT #4 (groups 1&3)
DAY 3	EXPERIMENT #5 (groups 1&3)	EXPERIMENT #6 (groups 2&4)	EXPERIMENT #5 (groups 2&4)	EXPERIMENT #6 (groups 1&3)

You will need TWO sets of materials for each experiment. For example, for experiment #1 you will need two balloons and two narrow neck plastic bottles. For the most part, these materials can be reused, however have some extras on hand, just in case.

TEACHER EXPERIMENT NOTES

As the teacher, you will be leading three out of the six experiments for students. The teacher directed experiments require more hands-on activities. You will also use this as an opportunity to assess student knowledge, brainstorming, group work, and understanding. A teacher overview page for each experiment has been provided. Here you will find step by step instructions for each experiment and questions to ask students to develop conversation as well as check for understanding. There is also a student notes page provided to record student's thinking.

By the end of the six experiments, students should understand the six forces of flight. A page has been provided for students to fill in the blank for each force.

After the 20-minute experiment block, students will take the 20-minute independent block to review their findings and observations independently or with group members. They will also have the opportunity to read about each force of flight with the readings.

PROPERTIES OF AIR

1. Air takes up _____.

2. Air has _____.

3. Air is affected by _____.

4. Air exerts _____.

5. Air can be _____.

6. Air is affected by _____.

Answer Key

PROPERTIES OF AIR

1. Air takes up space.
2. Air has mass/weight.
3. Air is affected by heat.
4. Air exerts pressure.
5. Air can be compressed.
6. Air is affected by altitude.

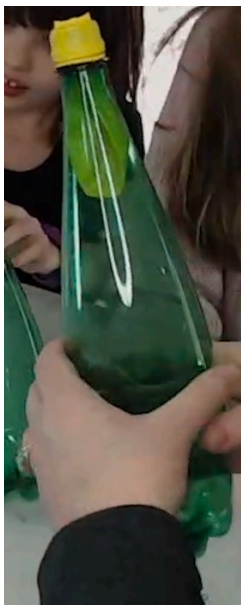
EXPERIMENT VIDEOS

Experiment #1	**Experiment #2**
Experiment #3	**Experiment #4**
Experiment #5	**Experiment #6**

EXPERIMENT #1

Materials:

- deflated balloon
- plastic pop bottle



Question: Does air take up space?

Make a hypothesis/prediction: Read through the procedure. What do you think is going to happen?

Procedure:

1. Push the deflated balloon into the bottle and stretch the open end of the balloon back over the bottle's mouth.
2. Without removing the balloon from the bottle, try to blow it up (only one person try this).

Remember to write down your **observations** during the experiment.

Once completed, record your conclusions. Did you answer the question? Did your hypothesis come true? Record what **Air Property** you think this experiment represents.

INQUIRY QUESTION

experiment #1

Does air take up space?

6 L 3

FLIGHT

EXPERIMENT #1 OBSERVATIONS

Inquiry Question: _____

_____

Hypothesis: _____

_____

_____

Procedure:

1. Push the deflated balloon into the bottle and stretch the open end of the balloon back over the bottle's mouth.
2. Without removing the balloon from the bottle, try to blow it up (only one person try this).

Materials:

- deflated balloon
- plastic pop bottle with a narrow neck

Observations: _____

_____

_____

_____

_____

_____

Inquiry Question Answer:_____

_____

_____

_____

Questions:

_____

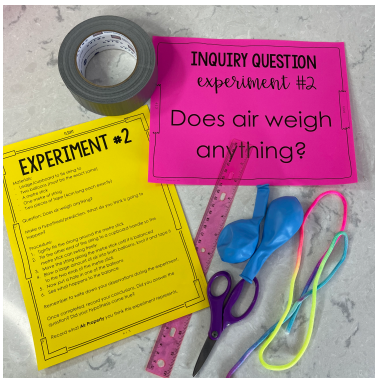
_____

_____

EXPERIMENT #2

Materials:

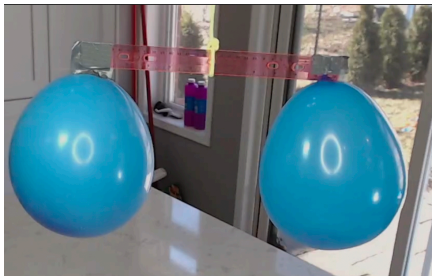
- Ledge/cupboard to tie string to
- Two balloons (must be the exact same)
- Metre stick
- One metre of string
- Two pieces of tape



Question: Does air weigh anything?

Make a hypothesis/prediction: Read through the procedure. What do you think is going to happen?

Procedure:



1. You will be making a type of pan balance with the ruler and the balloons.
2. Blow up two balloons so that they are the same size. Tape each balloon to the end of the ruler.
3. Tie a string around the middle of the ruler.
4. You will now suspend your ruler/balloon pan balance so that the ruler and balloon hang freely.

Remember to write down your **observations** during the experiment.

Once completed, record your conclusions. Did you answer the question? Did your hypothesis come true?

Record what **Air Property** you think this experiment represents.

EXPERIMENT #2 TEACHER NOTES

inquiry question: does air weigh anything?

Materials:
- Ledge/cupboard to tie string to
- Two balloons (must be the exact same)
- Metre stick
- One metre of string
- Two pieces of tape (each exactly 4cm)

Prep:
- Have materials set out and ready for students when they come to the station
- Set up close to a ledge or cupboard so you have somewhere to hang the metre stick

Before beginning the experiment, have students record the inquiry question and make a hypothesis.

Step/Procedure	Question
1.Tightly tie the string around the metre stick. 2.Tie the other end of the string to a cupboard handle so the metre stick can swing freely.	Do you think air weighs anything? Why or why not? Do you have an example?
3.Move the string along the metre stick until it is balanced.	When you blow air into a balloon, does it feel heavier?
4.Blow a large amount of air into both balloons, then knot and tape them to the two ends of the metre stick.	What do you notice? Is the metre stick balanced? How do we know it is balanced? Does this answer our question?
5.Now put a hole in one of the balloons. 6.See what happens to the balance.	What happened to the metre stick? Did the weight of the one balloon change? How? Does this answer our question? How can we explain if air weighs something?

INQUIRY QUESTION

experiment #2

6 L 3

FLIGHT

Does air weigh anything?

EXPERIMENT #2 OBSERVATIONS

Inquiry Question: _____

_____

Hypothesis: _____

_____

_____

Procedure:

1. You will be making a type of pan balance with the ruler and the balloons.
2. Blow up two balloons so that they are the same size. Tape each balloon to the end of the ruler.
3. Tie a string around the middle of the ruler.
4. You will now suspend your ruler/balloon pan balance so that the ruler and balloon hang freely.

Materials:

- Ledge/cupboard to tie string to
- Two balloons (must be the exact same)
- Metre stick
- One metre of string
- Two pieces of tape

Observations: _____

_____

_____

_____

_____

_____

Inquiry Question Answer:_____

_____

_____

_____

Questions:

_____

_____

_____

LESSON FOUR

Identifying Properties of Air
Part 2

grade 6

LESSONS FOUR

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

We are learning what the six forces of flight are through hands-on experiments and how they can be impacted by outside forces.

Preparation

Prepare all experiment materials for each of the six experiment centres and place in baskets. Glue the instructions to the outside a large envelope and place the observation pages inside.

- Break students into four groups (they will be in these groups for the next three lessons).
- Two groups will complete an experiment with you at the same time—for scheduling, review the Experiment Notes. Please also review the Teacher Experiment Notes prior to starting.

Student Led

- Post the Inquiry Question for Experiment #3, and Experiment #4 for students and review the goals of the lesson.
- Review any specific safety procedures which may apply with students prior to starting any experiment centres.
- Students in the student led activities will work in their groups.
- Students will read the instructions for their assigned experiment and complete the steps of the experiment.
- As they are working, they should record their work on the appropriate observation page.

With The Teacher

- Gather two groups with you in a central place in your classroom.
- Distribute materials.
- Distribute the materials and walk your students through the steps of the experiments, stopping as necessary to record their observations on the observation pages.

Consolidation /Assessment

- Discuss with students what they learned and what they observed. Record anecdotal observations about student understanding of how experiments demonstrated the properties of air on chart paper.
- At the end of the day's centres time, collect the student observation pages to review.

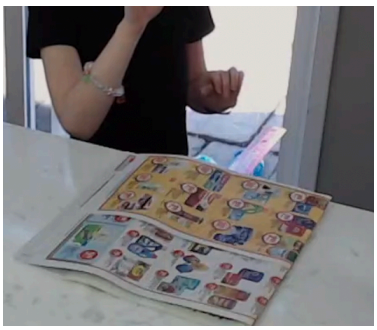
NOTES

- Student groupings for independent work are 4-6 students. If required for independent student led experiments, allow students to break their group into smaller sub groups.
- If required, all experiments can be teacher led but this is not recommended.

EXPERIMENT #3

Materials:

- Ruler (non flexible)
- Sheet of newspaper



Question: How strong is air pressure?

Make a hypothesis/prediction. What do you think is going to happen?

Procedure:

1. Put the ruler on a table with one end over the edge.
2. Cover the portion of the ruler on the table with newspaper.
3. Try to lift the paper off the table by striking the free end of the ruler.
4. What is holding the newspaper down?

Remember to write down your **observations** during the experiment.

Once completed, record your conclusions. Did you answer the question? Did your hypothesis come true?

Record what **Air Property** you think this experiment represents.

INQUIRY QUESTION

experiment #3

6 L 4

FLIGHT

How strong is air pressure?

EXPERIMENT #3 OBSERVATIONS

Inquiry Question: _____

_____

Hypothesis: _____

_____

_____

Procedure:

1. Put the ruler on a table with one end over the edge.
2. Cover the portion of the ruler on the table with newspaper.
3. Try to lift the paper off the table by hitting the free end of the ruler.
4. What is holding the newspaper down?

Materials:

- Ruler
- Sheet of newspaper

Observations: _____

_____

_____

_____

_____

_____

Inquiry Question Answer:_____

_____

_____

_____

Questions:

_____

_____

_____

EXPERIMENT #4

Materials:

- Two balloons
- Two tubs for holding water
- Hot water
- Two, 2L bottles
- Bag of ice

Question: How does temperature affect air?

Make a hypothesis/prediction. What do you think is going to happen?

Procedure:

1. Start with the hot water. Fill one tub with boiling water.
2. Secure the balloon over the top of one of the 2L bottles and place it in the tub of the hot water.
3. Watch to see what happens to the bottle/balloon. Record your observations.
4. Fill the other tub with ice water.
5. Place the other 2 L bottle with a balloon on top into the tub.
6. Watch to see what happens to the bottle/balloon. Record your observations.

Remember to write down your **observations** during the experiment.

Once completed, record your conclusions. Did you answer the question? Did your hypothesis come true?

Record what **Air Property** you think this experiment represents.

EXPERIMENT #4 TEACHER NOTES

inquiry question: how does temperature affect air?

Materials:
- Two balloons
- Two tubs for holding water
- Hot water
- Two, 2L bottles
- Bag of ice

Prep:
- Have a plug in kettle available
- Have ice in a cooler to prevent melting
- This should be done promptly for best results

Before beginning the experiment, have students record the inquiry question and make a hypothesis.

Step/Procedure	Question
1.Start with the boiling water. Fill one tub with the boiling water.	Do you think the temperature of the water is going to do anything to the air surrounding it?
2.Secure the balloon over the top of one of the 2L bottles. 3. Watch to see what happens to the bottle/balloon. Record your observations.	What do you notice happening to the balloon in the boiling water? What does this tell us? Is the air in the bottle hot or cold? What conclusions can we draw?
4.Fill the other tub with ice and water. 5.Place the other 2L bottle with a balloon on top into the tub.	What differences do we see from the boiling water to the ice water? What does this tell us about the air?
6.Watch to see what happens to the bottle/balloon. Record your observations.	Does air change with temperature?

INQUIRY QUESTION

experiment #4

How does temperature affect air?

6 L 4

FLIGHT

EXPERIMENT #4 OBSERVATIONS

Inquiry Question: _____

_____

Hypothesis: _____

_____

_____

Procedure:

1. Start with the ice. Fill one tub with water and add the ice.
2. Secure the balloon over the top of one of the 2L bottles.
3. Watch to see what happens to the bottle/balloon. Record your observations.
4. Fill the other tub with boiling water (teacher assistance).
5. Place the other 2L bottle with a balloon on top into the tub.
6. Watch to see what happens to the bottle/balloon. Record your observations.

Materials:

- Two balloons
- Two tubs for holding water
- Hot water
- Two, 2L bottles
- Bag of ice

Observations: _____

_____

_____

_____

_____

_____

Inquiry Question Answer:_____

_____

_____

_____

Questions:

_____

_____

LESSON FIVE

Identifying Properties of Air
Part 3

grade 6

LESSONS FIVE

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

We are learning what the six forces of flight are through hands-on experiments and how they can be impacted by outside forces.

Preparation

Prepare all experiment materials for each of the six experiment centres and place in baskets. Glue the instructions to the outside a large envelope and place the observation pages inside.

- Break students into four groups (they will be in these groups for the next three lessons).
- Two groups will complete an experiment with you at the same time—for scheduling, review the **Experiment Notes**. Please also review the **Teacher Experiment Notes** prior to starting.

Student Led

- Post the Inquiry Question for **Experiment #5**, and **Experiment #6** for students and review the goals of the lesson.
- Review any specific safety procedures which may apply with students prior to starting any experiment centres.
- Students in the student led activities will work in their groups.
- Students will read the instructions for their assigned experiment and complete the steps of the experiment.
- As they are working, they should record their work on the appropriate observation page.

With The Teacher

- Gather two groups with you in a central place in your classroom.
- Distribute materials.
- Distribute the materials and walk your students through the steps of the experiments, stopping as necessary to record their observations on the observation pages.

Consolidation /Assessment

- Discuss with students what they learned and what they observed. Record anecdotal observations about student understanding of how experiments demonstrated the properties of air on chart paper.
- At the end of the day's centres time, collect the student observation pages to review.

NOTES

- Student groupings for independent work are 4-6 students. If required for independent student led experiments, allow students to break their group into smaller sub groups.
- If required, all experiments can be teacher led but this is not recommended.

EXPERIMENT #5

Materials:

- 2 paperback books
- 1 large plastic bag
- 1 straw
- Duct Tape

Question: Can air hold weight under compression?

Make a hypothesis/prediction: What do you think is going to happen?

Procedure:

1. Place two books on the edge of a table. Blow on them. Do they move? Record your observations.
2. Put the straw half inside the bag and seal the bag with tape.
3. Place the two books on top. Leave the open end of the bag sticking out over the edge of the table.
4. Blow into the straw to inflate the balloons.
5. What do you notice?

Remember to write down your **observations** during the experiment.

Once completed, record your conclusions. Did you answer the question? Did your hypothesis come true?

Record what **Air Property** you think this experiment represents.

INQUIRY QUESTION

experiment #5

What happens when air is compressed?

EXPERIMENT #5 OBSERVATIONS

Inquiry Question: _____

_____

Hypothesis: _____

_____

_____

Procedure:

1. Place two books on the edge of a table. Blow on them. Do they move? Record your observations.
2. Put the straw half inside the bag and seal the bag with tape.
3. Place the two books on top. Leave the open end of the bag sticking out over the edge of the table.
4. Blow into the straw to inflate the balloons.
5. What do you notice?

Materials:

- 2 paperback books
- 1 large plastic bag
- 1 straw
- Duct Tape

Observations: _____

_____

_____

_____

_____

_____

Inquiry Question Answer:_____

_____

_____

_____

Questions:

_____

_____

EXPERIMENT #6

Materials:

- Small jar
- Balloon
- Scissors
- Toothpicks (flat)/straw
- Glue
- Larger clear jar or 2L bottle with top cut off tall enough for the small jar to fit inside

Question: How can we measure changes in air pressure?

Make a hypothesis/prediction: What do you think is going to happen?

Procedure:

1. Cut off the bottom part of the balloon.
2. Stretch the balloon over the top of the container (secure with a rubber band if necessary)
3. Put a small dap of glue in the center of the stretched balloon. Attach the end of the toothpick on the glue. Let it dry.
4. Place the jar inside the larger clear container.
5. Cut the top off a balloon and stretch it over the mouth of the larger container with the mouth piece of the balloon sticking up.
6. Holding the mouth of the balloon, pull and push it out and in of the jar. Look at what is happening to the ballon stretched over the smaller jar

Remember to write down your **observations** during the experiment.

Once completed, record your conclusions. Did you answer the question? Did your hypothesis come true?

Record what **Air Property** you think this experiment represents.

EXPERIMENT #6 TEACHER NOTES

inquiry question: does altitude affect air pressure?

Procedure:

1. Cut off the bottom part of the balloon.
2. Stretch the balloon over the top of the container (secure with a rubber band if necessary)
3. Put a small dap of glue in the center of the stretched balloon. Attach the end of the toothpick on the glue. Let it dry.
4. Place the jar inside the larger clear container.
5. Cut the top off a balloon and stretch it over the mouth of the larger container with the mouth piece of the balloon sticking up.
6. Holding the mouth of the balloon, pull and push it out and in of the jar. Look at what is happening to the ballon stretched over the smaller jar

Materials:

- Small jar
- Balloon
- Scissors
- Toothpicks (flat)/ Straw
- Glue
- Larger clear jar or 2L bottle with top cut off tall enough for the small jar to fit inside

Before beginning the experiment have students **record** the inquiry question and make a hypothesis.

Step/Procedure	Questions/Notes
1. Cut off the bottom part of the balloon. 2. Stretch the balloon over the top of the jar/ container (put a rubber band around the top of the jar if the balloon is not tight).	Do you know the name of the device we are making? (barometer) Do you know what it is used for? (scientific instrument that is used to measure air pressure in a certain environment)
3. Glue the flat toothpick to the top of the jar/ balloon so that half of the toothpick is leaning over the side (do not use too much glue).	Have you ever been hiking up a hill or skiing on a mountain? Did you feel like it was a bit harder to breathe at the top? Why is this?
4. Let the glue dry. Put the small container inside the larger one. Cut the top off of a balloon. Stretch it over the mouth of the larger container with the mouth piece of the balloon sticking up.	Do you think the toothpick will move at all on the barometer? Why or why not? If I was to bring a bag of chips from the bottom of the mountain to the top, what would happen to my bag?
5. Holding the mouth of the balloon, pull and push it out and in of the jar. Look at what is happening to the ballon stretched over the smaller jar	Once students see the toothpick moving, explain that the air has added pressure and is pushing down on the balloon (the top of the balloon will be flexed in). How does this represent air at a high altitude?

NOTES: To track air pressure over time place a piece of tape vertically on the larger container. Place a mark on the tape to indicate where the toothpick is pointing. As the air pressure changes the toothpick will move up when the air pressure is low and down when the air pressure is high.

INQUIRY QUESTION

experiment #6

Does altitude affect air pressure?

EXPERIMENT #6 OBSERVATIONS

Inquiry Question: _____

_____

Hypothesis: _____

_____

_____

Procedure:

1. Cut off the bottom part of the balloon.
2. Stretch the balloon over the top of the container (secure with a rubber band if necessary)
3. Put a small dap of glue in the center of the stretched balloon. Attach the end of the toothpick on the glue. Let it dry.
4. Place the jar inside the larger clear container.
5. Cut the top off a balloon and stretch it over the mouth of the larger container with the mouth piece of the balloon sticking up.
6. Holding the mouth of the balloon, pull and push it out and in of the jar. Look at what is happening to the ballon stretched over the smaller jar

Materials:

- Small jar
- Balloon
- Scissors
- Toothpicks (flat)/ straw
- Glue
- Larger clear jar or 2L bottle with top cut off tall enough for the small jar to fit inside

Observations: _____

_____

_____

_____

_____

_____

Inquiry Question Answer:_____

_____

_____

_____

Questions:

_____

_____

LESSON SIX

Forces of Flight

grade 6

LESSON SIX

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

We are learning what the forces of flight are and how they help objects to take flight.

Preparation

- Print the Inquiry Question for the lesson.
- Print one Paper Airplanes Experiment page for each student.
- Have paper on hand for airplane creation (GOOS is fine).

Lesson Part A

- Post the inquiry question for students and review the goals of the lesson.
- Break students into four groups and give each student in the group one piece of paper (it can be GOOS paper!).
- As a group, students will create a paper airplane.
- Provide students with the QR codes and assign each of group a paper airplane to create.
- Once the airplanes have been created, bring the students back together as a class.
- Invite each group to come up and demonstrate their airplane and share some details about it (different folds, etc.).
- While groups are presenting, the other groups will be recording their observations on their Paper Airplanes Experiment recording page.
- A sample answer key is provided, but you want students to notice the differences in length of time in the air, distance, etc. for each paper airplane and why it differs.

Lesson Part B

- Students will read the provided reading Learning About Flight.
- Also provide students with the Annotating a Text page. They can use these strategies to annotate the text while they read.
- Once they are done reading, students will fill in the blanks on the Four Forces of Flight and Parts of an Airplane pages.
- An answer key for Forces and Parts have been provided.
- Using the reading, they must figure out where each of the four forces go in regards to the airplane, as well as the different parts of an airplane
- A terminology page has been provided for the Forces of Flight and Parts of an Airplane. Students can cut out the strips of words and paste them in the appropriate places on their worksheet.

Assessment

- Have each student complete a Forces of Flight Exit Slip and hand it in for assessment.

NOTES

INQUIRY QUESTION

lesson #6

What parts of an airplane help it to fly?

PAPER AIRPLANES

Airplane #1

Airplane #2

Airplane #3

Airplane #4

PAPER AIRPLANES EXPERIMENT

Airplane #1:
Observations: _____

_____

_____

Airplane #2:
Observations: _____

_____

_____

Airplane #3:
Observations: _____

_____

_____

Airplane #4:
Observations: _____

_____

_____

What makes the best paper airplane and why?

_____

_____

_____

_____

Answer Key

PAPER AIRPLANES EXPERIMENT

Airplane #1: Dart Plane
Observations: Very fast and easy flow in the air. Does not stay in the air very long. Falls to the floor quickly.

Airplane #2: Simple Plane
Observations: Smaller than other planes. More wing space than other planes. Stays in the air longer than others.

Airplane #3: World's Best
Observations: Very flat and boxy. Stays in the air much longer than other planes. Not as fast (less aerodynamics). Relate to a glider.

Airplane #4: Best Plane
Observations: Fast and stays in the air. Bigger wing span to help it glide. Works with aerodynamics

What makes the best paper airplane and why?

- way it if folded
- type of paper used
- wing span
- aerodynamics
- shape of the front of the airplane

LEARNING ABOUT FLIGHT

How do planes fly? This is a common question that has many answers! The most important part of understanding how something flies is to understand the four forces of flight.

To begin, let's take a look at Sir Issac Newton. He discovered the force of gravity. While he was sitting under a tree, an apple fell onto his head! He began to wonder why and how this could happen and discovered gravity. The force of gravity is what attracts things towards the earth.

Weight is the force created by the pull of gravity. If you jump up from the floor right now, you will feel the force pulling you back down to the ground! Your **weight** will force you back down to the Earth.

Airplanes fly because they are able to generate a force called **lift**. This is what moves an airplane upwards. **Lift** is created by the forward motion of the airplane through the air. The **lift** must be stronger than the force of gravity.

The next aspect of flight is the motion of **thrust**. Thrust is the motion of moving forward. This is created by the engines/propeller. When you push or move something, you are using **thrust**. In order for something to fly, the **thrust** must be greater than the **drag**.

Think about driving a car. When the driver wants to stop, they push on the break. Same thing in a boat, to stop or slow down, an anchor is thrown in the water. These things that stop the motion of moving forward are called a **drag**.

For something to fly, the **thrust** must be greater than the **drag**.

LEARNING ABOUT FLIGHT

There are many ways for thrust to be generated in airplanes. The most common are propellers and jet engines. A jet plane does not have propellers. They use jet engines to move the plane forward. A propeller plane uses a propeller that is turned by an engine. The propellers are shaped like wings which help to lift the plane up.

If the lift becomes greater than weight, then the plane will accelerate upward.

If the weight is greater than the lift, then the plane will accelerate downward.

When the thrust becomes greater than the drag, the plane will accelerate forward.

If drag becomes greater than the thrust, a deceleration will occur.

It took the Wright brothers four years of painstaking research to create their first flying machine in 1903. Since then, airplanes have advanced in many ways. Scientists and engineers now design airplanes of all sizes that can transport people and cargo across the globe. But no matter the size, all airplanes have the same basic parts. These parts take advantage of scientific forces in order to get the plane off the ground and keep it in the air.

The main body of a plane is called the fuselage. This is the long, narrow, tube-shaped portion of the airplane. The pilot sits in the front of the fuselage; the passengers or cargo are positioned throughout the rest of the length of the tube. The fuselage is smooth and rounded, making it quite aerodynamic. This means that air can easily travel around it, resulting in less drag. Drag is the resistance of air that occurs when an object (like an airplane) moves through it. Most rounded surfaces have less drag than flat surfaces. In addition to its aerodynamic shape, the plane's fuselage also holds its landing gear.

LEARNING ABOUT FLIGHT

The landing gear consists of two main wheels on both sides of the fuselage, a wheel at the front of the plane, and brakes. The landing gear can fold into the fuselage when the plane is in the air (since these parts aren't necessary in flight).

All airplanes also need wings. The wings are smooth and slightly curved from front to back. This curved shape allows air to move faster over the top of the wing and slower below it. When air moves faster, air pressure decreases. But when air moves slower, pressure increases. This means that the slow-moving air under the wings creates enough pressure to lift the plane into the air. The wings also rely on hinged parts that help control and steer the airplane. Flaps and ailerons are the hinged panels that move along the wings to create more surface area. The flaps slide to create more lift at takeoff and a sturdy, controlled landing. Ailerons move down to make the wings tilt up and help the plane turn in the air.

The back part of the airplane is called the tail. The tail is necessary to keep the airplane stable. If a gust of wind comes along, the tail prevents the plane from moving side-to-side and off course. The vertical portion of the tail is called the fin. On the fin is a rudder that can move side-to-side to control the plane's left or right movement. Also positioned on the tail are elevators. Just like elevators in tall buildings, airplane elevators move up and down. They do not, however, carry things or people. Instead, the elevators rise or fall to make the airplane lift higher or lower in the air.

Airplanes also need power to create enough thrust to fly. Thrust is the force that allows an object to move through the air even as gravity is acting upon it. Airplanes use engines and sometimes propellers to create thrust. Propellers are like screws that spin when attached to an engine. Like wings, propellers create a pressure difference. But instead of lifting the plane up, propellers drive the plane forward. Other planes don't use propellers, but rely on powerful engines to create thrust.

LEARNING ABOUT FLIGHT

Large jets have turbine engines that suck in air with a fan, then squeeze it with fast-spinning blades to create pressure. The air is then mixed with fuel and an electric spark, causing gases to expand and burst through an opening at the back of the engine. As the gas shoots out, force is created to thrust the plane forward.

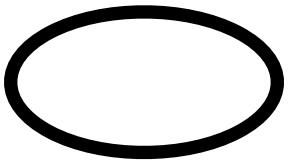
Of course, all parts of an airplane cannot work without a skilled pilot. Pilots go through extensive training to learn about the science of flight and how the parts of the plane work together. They are also trained to make sure all of the parts are in working condition prior to takeoff. This ensures that everyone and everything that flies on an airplane arrives safely back on the ground.

ANNOTATE A TEXT

This is important. 

I have a question. ?

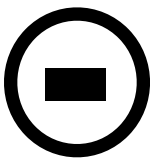
I have a connection. 

I don't know what this means. 

I have a prediction. 

This is evidence. It helps me answer a question. E#

I agree with this. 

I disagree with this 

FOUR FORCES OF FLIGHT

Answer Key

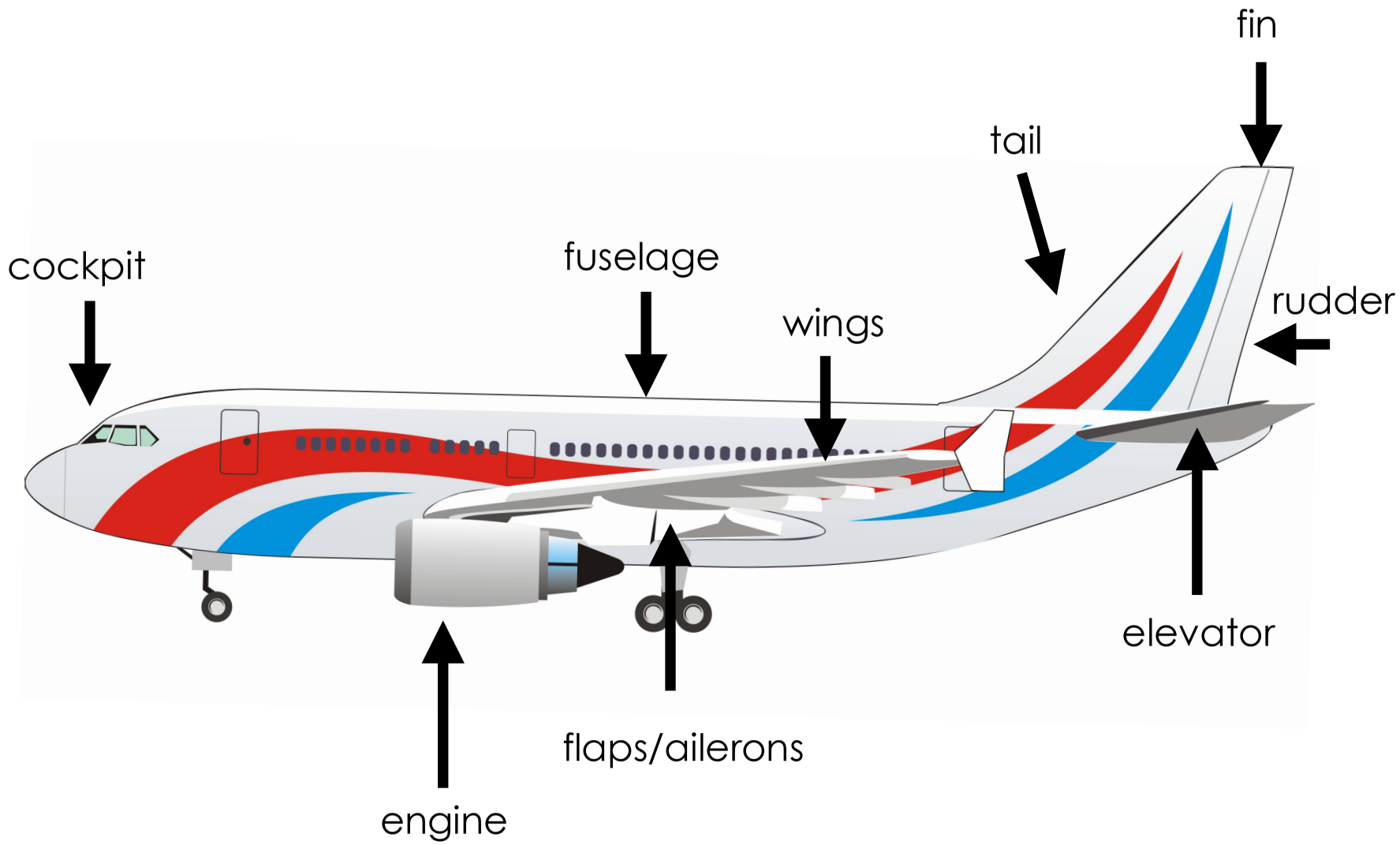
FOUR FORCES OF FLIGHT

LIFT	DRAG	THRUST	WEIGHT
LIFT	DRAG	THRUST	WEIGHT
LIFT	DRAG	THRUST	WEIGHT
LIFT	DRAG	THRUST	WEIGHT
LIFT	DRAG	THRUST	WEIGHT
LIFT	DRAG	THRUST	WEIGHT
LIFT	DRAG	THRUST	WEIGHT
LIFT	DRAG	THRUST	WEIGHT
LIFT	DRAG	THRUST	WEIGHT
LIFT	DRAG	THRUST	WEIGHT

PARTS OF AN AIRPLANE

Answer Key

PARTS OF AN AIRPLANE



FLIGHT

6 L 9

cockpit	cockpit	cockpit	cockpit	cockpit
tail	tail	tail	tail	tail
engine	engine	engine	engine	engine
elevator	elevator	elevator	elevator	elevator
flaps/aileron	flaps/aileron	flaps/aileron	flaps/aileron	flaps/aileron
wing	wing	wing	wing	wing
fuseluge	fuseluge	fuseluge	fuseluge	fuseluge
fin	fin	fin	fin	fin
rudder	rudder	rudder	rudder	rudder

FORCES OF FLIGHT EXIT SLIP

Name: _____

Fill in the blanks below with the force of flight the definition represents.

_____ is to move to a higher position or rise from the ground.

_____ is to push or drive with force.

_____ is something that slows down a motion or the force acting on a body to slow it down.

_____ is the force of attraction between particles or bodies that occurs because of their mass.

FORCES OF FLIGHT EXIT SLIP

Name: _____

Fill in the blanks below with the force of flight the definition represents.

_____ is to move to a higher position or rise from the ground.

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LESSON SEVEN

Animals in Flight

grade 6

LESSON SEVEN

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

We are learning how animals are able to fly in comparison to objects such as planes.

Preparation

- If possible, get a copy of the book *Animals in Flight* (YouTube link).
- Print ***Animals In Flight* Wonder Questions** for each student.
- If possible, have access to a computer for each student or group of students

Lesson Part A

- Post the **Inquiry Question** for students and review the goals of the lesson.
- Students will learn about animals that fly with *Animals in Flight*.
- While reading, follow the **Read Aloud Guide** provided.
- Give students the ***Animals in Flight* Wonder Questions** page. A **Question Exemplar** has been provided.
- Students will record questions/wonders that they have which will be used in the second part of the lesson.

The book is available on **YouTube** if you do not have a hard copy. **Alternate books** have been provided and are available on EPIC.

Lesson Part B

- After you have completed the read aloud, tell students they will now research their questions/wonders that they recorded.
- Students can use technology or books to help them find answers.
- After about 15 minutes, have students meet with their elbow partner to share their wonders and findings.
- Finish the lesson with students sharing a wonder and a finding with the class.

Assessment

- Have students share aloud their **Wonder Questions** and the answers they found. Take notes on the quality of questions and answers the students had.

NOTES

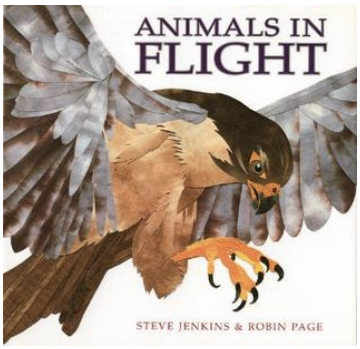
INQUIRY QUESTION

lesson #7

How are animals able to fly?

READ ALOUD

animals in flight by steve jenkins

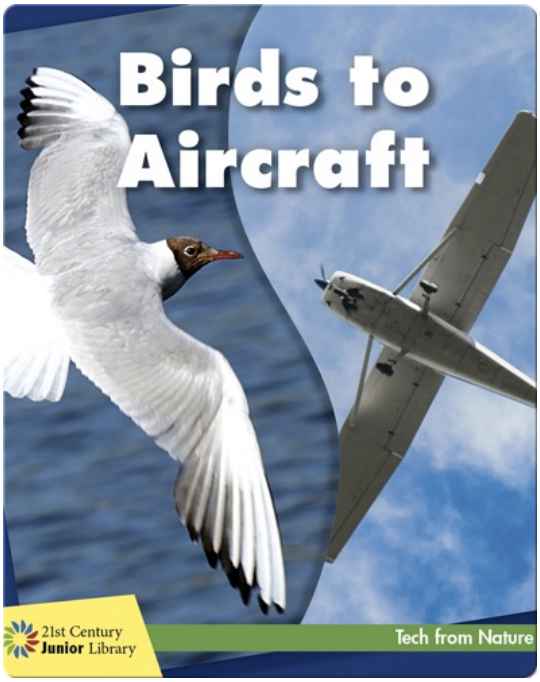


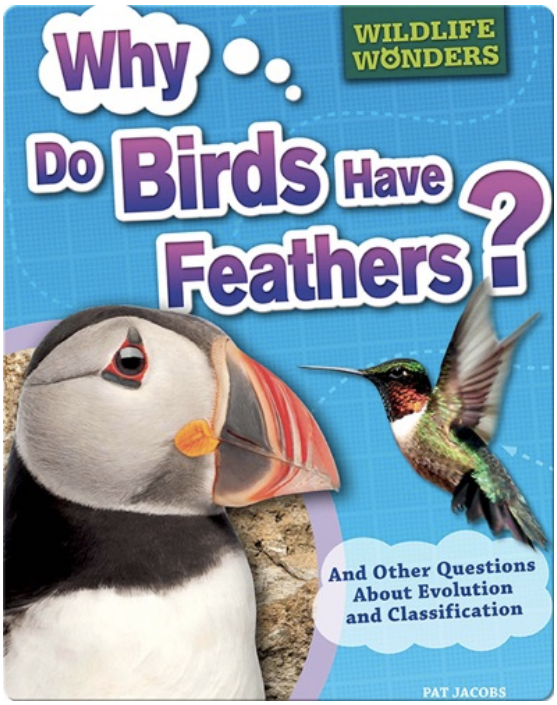
Page #	***Animals in Flight***
	Before we start reading, I want you to think about how animals fly. How are they different from airplanes and other flying mechanisms?
2	How do birds stay in the air that long? Do you think they get tired?
4	Why do you think dragon flies have four wings? Did you know they used to have wings 2.5 feet long?
4	Did you know that cockroaches fly? I didn't!
6	What is the name of the dinosaur on the page? Why did this dinosaur need to fly?
6	Do you think having longer and bigger wings helps the animal to fly or makes it harder?
8	Why do animals need to fly? *(Ask before reading this page)*
10	How do you think flying animals create lift? Think about what we have learned about airplanes.
10	Do you think the different types of wings change the way an animal flies?
14	Do you know why ducks fly in a V formation? I wonder if there is an important reason.
16	What are some birds that cannot fly? Why do you think they can't fly?
18	Did you know that a wasp's wings can turn upside down? I didn't.
22	How can we relate flying squirrels, fish, and frogs to gliders humans use?
24	*Before reading page:* Can we predict what the largest fly is? What about the smallest?
28	How did animals inspire humans to fly? Did they learn anything from animals?

READ ALOUD

other options

Can be found on EPIC.





ANIMALS IN FLIGHT

wonder questions

As you are listening to the book, write down some things you are wondering about. You will find the answers later.

Example Page

ANIMALS IN FLIGHT
wonder questions

As you are listening to the book, write down some things you are wondering about. You will find the answers later.

Do different bird wings impact their ability to fly? (speed, height, length of time)
Were birds and insects always able to fly? Did something change over the years?
What is the purpose of animals flying? Do they need to be able to fly to survive?
Why can't penguins fly?
Did researchers and scientists use birds flight to create flying devices and machines?

LESSON EIGHT

Altering Forces of Flight
Part 1

grade 6

LESSON EIGHT

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Determine how manipulating the design of aircraft changes the size and direction of flight forces and link those changes to changes in the aircraft's motion.

Preparation

- Gather the **materials** for the egg drop creations.
- Have scissors available for group work.
- Print **Egg Drop Design** for each group.

Lesson Part A

- Post the **Inquiry Question** for students and review the goals of the lesson.
- Prep a piece of chart paper with the title: *How can flight be altered?*
- Ask students to brainstorm ways flight can be altered (with materials, different construction materials, birds wings, etc.). An **Answer Key** has been provided.
- Explain to students they will be completing the egg drop challenge.
- Review the **Experiment page** with students.
- Break students into groups of 3-4 and allow them 10 minutes to start their design (no creating at this time, only designing) using the **Egg Drop Design** page.

Lesson Part B

- Students will use this 20-minute block to create their egg drop creation.
- Ensure students are using authorized materials only.
- Remind students they are not only being assessed for their design, but also how well they work with group members.
- They should pay attention to things that will alter the forces of flight (remind them of your chart paper on the board).

Assessment

NOTES

INQUIRY QUESTION

lesson #8

How does manipulating the design of an aircraft change the size and direction of flight forces?

Answer Key

HOW ARE THE FORCES OF FLIGHT ALTERED?

lift - increase the angle

weight - lightweight materials to keep the overall mass down

thrust - jet engines can change the amount of thrust

drag - using flaps on the airplane wings changes the amount of drag

insects - turn and twist their wings to help with hovering in the air, landing, or flying backwards

WHAT OBJECTS CAN HELP TO ALTER FORCES OF FLIGHT?

- parachutes
- shape of wings
- flaps on an airplane
- feathers on a bird

ALTERING FLIGHT EXPERIMENT

MATERIALS ALLOWED:

- plastic bags
- string
- tape
- cardboard
- paper
- coffee filters

MATERIALS NOT ALLOWED:

- egg cartons
- styrofoam
- padded materials
- heavy duty plastic cups

THE CHALLENGE

Create a housing device to keep the **egg** from breaking as it decelerates.

THE RULES

1. Work with your group members.
2. Design your idea before you create (10 minutes).
3. Create your design as a group (20 minutes).
4. Use only allowed materials.
5. Remember, the teacher will be dropping the egg device.

EGG DROP DESIGN

Group #: _____

Name of Device: _____

Materials Used:

Our Design:

LESSON NINE

Altering Forces of Flight
Part 2

grade 6

LESSON NINE

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Determine how manipulating the design of aircraft changes the size and direction of flight forces and link those changes to changes in the aircraft's motion.

Preparation

- Find an area for egg drop competition to take place(stairwell, if possible).
- Ensure students have named/numbered their egg houses.
- Print out an Egg Drop Observation Sheet for each student.

Lesson Part A

- Post the Inquiry Question for students and review the goals of the lesson.
- Give students a couple minutes to go over their egg drop creation before you begin the drop (have them name/number their device).
- It is recommended you find a stairwell for the drop (if not available, find a high enough place).
- The teacher will be dropping each group's device to ensure fairness.
- While the drops are happening, students will be recording their observations on the Egg Drop Observation Sheet provided.

Lesson Part B

- Once all the drops have been completed, have students read the provided reading about Bernoulli's Principle.
- Encourage students to use the annotation guide provided to help them decode the reading and identify what they do not understand.
- Have students complete the Altering Forces of Flight exit slip provided.
    - *What impacts the forces of flight?*

Assessment

- Students will complete the Exit Slip provided and hand in for assessment.
- Watch/listen to students while they are working/discussing and take notes.

NOTES

INQUIRY QUESTION

lesson #9

How does manipulating an aircraft change the aircraft's motion?

EGG DROP OBSERVATIONS

Group Name/ Numbers	Observations

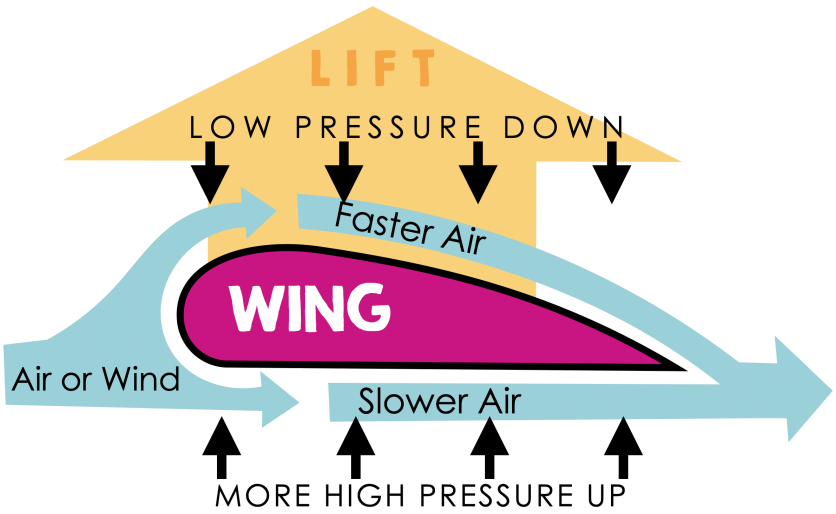
BERNOULLI'S PRINCIPLE

Have you ever wondered how airplanes can lift from the ground and soar into the clouds? Just like birds, airplanes rely on their wings to take flight. Airplane wings are designed in a specific way to take advantage of an amazing scientific discovery. It is called Bernoulli's principle.

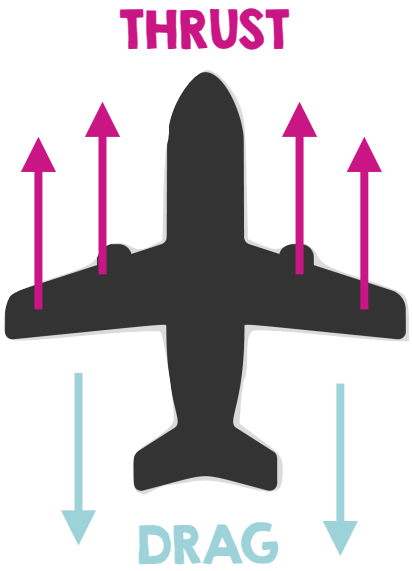
The principle is named after Daniel Bernoulli, an eighteenth-century scientist and mathematician from Switzerland. One of his most important areas of study was in fluid dynamics. Fluid dynamics is an area of physics which looks at how gasses and liquids work and move. Bernoulli learned that as a fluid or gas gains speed, pressure decreases. Likewise, as a fluid or gas loses speed, pressure increases. This phenomenon became known as Bernoulli's principle (or sometimes Bernoulli's theorem).

So, how does Bernoulli's principle apply to airplanes? What does it have to do with a plane's wings? Well, the principle was vital to early aircraft designers in getting the shape of an airplane's wings just right.

Bernoulli's principle explains how air must flow over and under an airplane's wings to achieve flight. Aviators realized that a plane's wings must allow air to flow faster over the top and slower underneath. Remember, Bernoulli's principle states that fast-moving air creates low pressure and slow-moving air creates high pressure. When the air moves slower underneath the wing, high pressure is created. This high pressure works to push the airplane up into the sky and through the lower pressure on top of the wing. This is called lift.

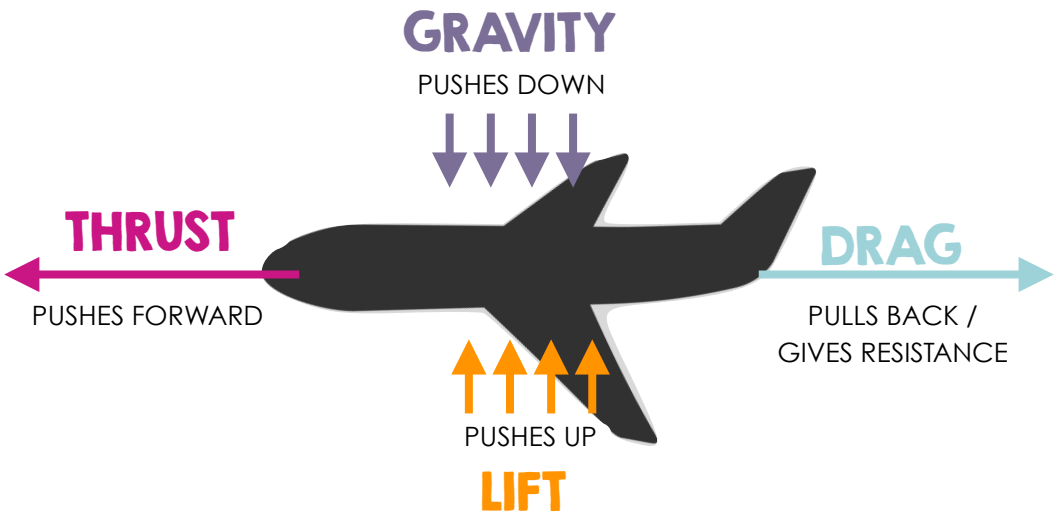


BERNOULLI'S PRINCIPLE



Although Bernoulli's principle explains how an airplane can get into the sky, another scientific force is needed to keep it there. Thrust is the force that allows an object to move through the air even as gravity is acting upon it. In an airplane, thrust is created by an engine. Thrust also acts against the force of drag. Drag is the resistance of air that occurs when an object (like an airplane) moves through it. As long as the thrust is greater than the drag, the airplane can move through the sky without gravity taking over. The same is true for birds, although they don't use an engine for thrust. They use their muscles.

There is no doubt that Daniel Bernoulli's work within the field of fluid dynamics allowed for amazing advancements in technology. Not only did his work influence the world of science, but also the world of travel. Think about how many airplanes soar throughout the world each day thanks to his discovery! The next time you see one in the sky, be sure to give a nod of thanks to Daniel Bernoulli.



ALTERING FORCES OF FLIGHT *exit slip*

Name: _____ Date: _____

What alters the forces of flight?
Use observations from the egg drop challenge to answer.

_____

_____

_____

What is Bernoulli's Principal? Use your own words.

_____

_____

_____

Name: _____ Date: _____

What alters the forces of flight?
Use observations from the egg drop challenge to answer.

_____

_____

_____

What is Bernoulli's Principal? Use your own words.

_____

_____

_____

LESSON TEN

History of Flight

grade 6

LESSON TEN

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

We are learning the history of flight and how flight has adapted and changed over the past 300 years.

Preparation

- Print and cut out 5-6 copies of the Large Timeline pages—a different coloured paper for each set is recommended.
- Print the following pages for each student.
  - History of Flight (timeline tags to cut/glue)
  - History of Flight (blank timeline)

Lesson Part A

- Post the Inquiry Question for students and review the goals of the lesson.
- Break students into 5-6 groups
- As a group, students will attempt to put together the history of flight timeline.
- Cards and Dates have been provided, ensure to cut and mix up the cards.
- They will work in their groups to organize the events into proper order. They may need to do this on the floor.
- Once students believe they are complete, review(an Answer Key is provided).
- When they have each event in the correct spot, have them cut out the answers and paste onto the Timeline page.

Lesson Part B

- If students are not done copying the timeline and dates, allow them to finish.
- Once done, students can read the History of Flight.

Assessment

- Students will identify the history of flight.
- Students will understand how flight has changed and adapted over the years.

NOTES

INQUIRY QUESTION

lesson #10

How has flight changed and adapted over the past 300 years?

6 L10

FLIGHT

HISTORY OF FLIGHT TIMELINE

The first hot air balloon flies over Paris.

Hypersonic planes are designed and travel at high speed.

Hydrogen balloons fly in the Civil War.

Drones become common. They are used by the military and firefighters.

HISTORY OF FLIGHT TIMELINE

The Zeppelin airship is tested.

The B-2 stealth bomber first flies.

The Wright Flyer I plane flies for the first time.

The first Boeing 747 jumbo jet takes flight.

HISTORY OF FLIGHT TIMELINE

World War I is fought in Europe with air warfare.

Concorde flies for the first time.

The Royal Aircraft Factory dog fighter is used in WWI.

The X-1 plane flies faster than the speed of sound.

HISTORY OF FLIGHT TIMELINE

Airships take passengers across the Atlantic Ocean.

Flying boats are used by wealthy people.

1783

1860s

HISTORY OF FLIGHT TIMELINE

1900

1903

1914-1918

1917

HISTORY OF FLIGHT TIMELINE

1920s

1930s

1940s

1968

HISTORY OF FLIGHT TIMELINE

1970

1989

2000s

2010s

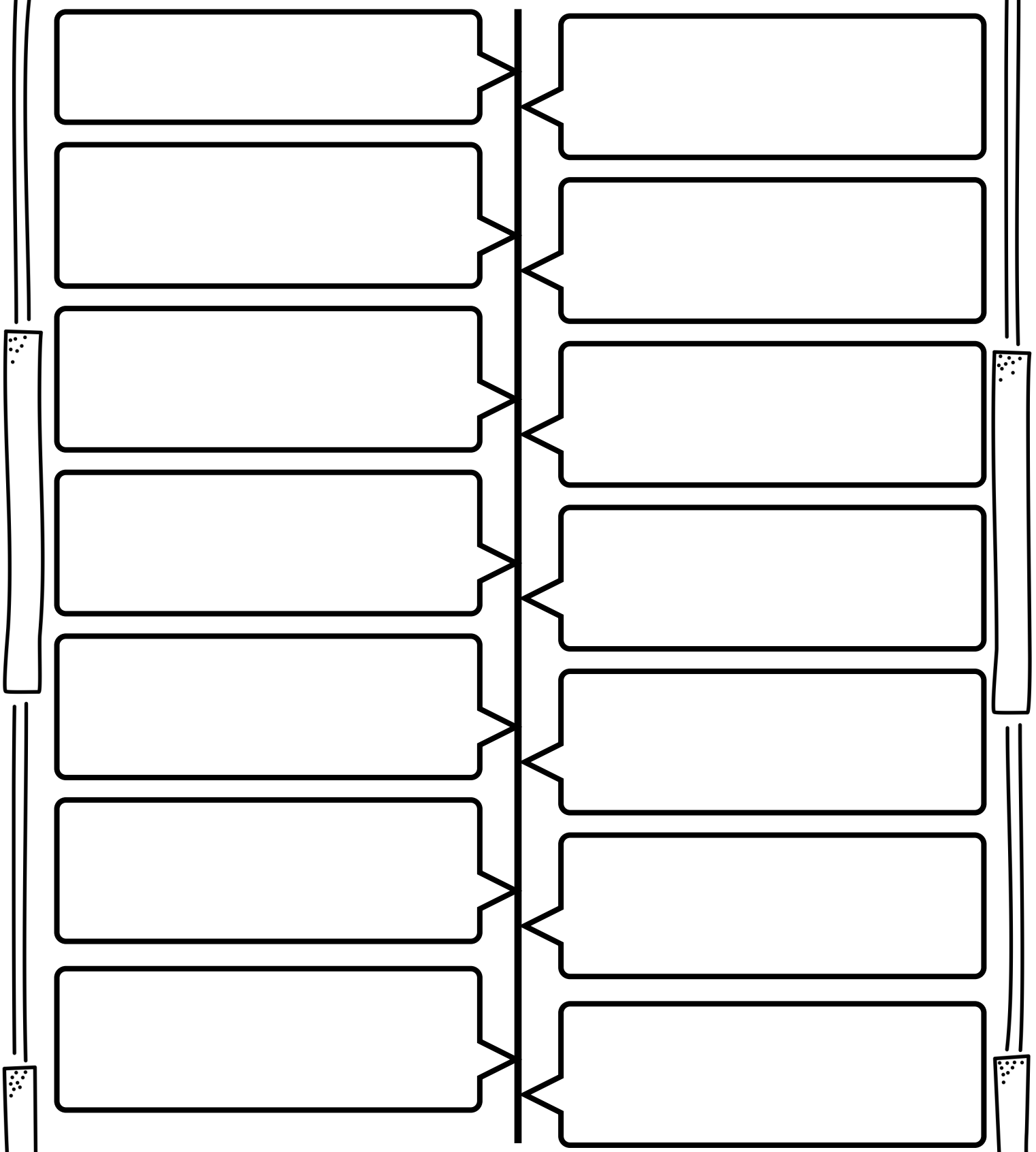
HISTORY OF FLIGHT TIMELINE

Cut out the boxes below and glue in the correct order on the History of Flight Timeline page.

Add in the year after you have glued everything on your page

The Zeppelin airship is tested.	The X-1 plane flies faster than the speed of sound.
The first Boeing 747 jumbo jet takes flight.	The Wright Flyer I plane flies for the first time.
Concorde flies for the first time.	World War I is fought in Europe with air warfare.
The Royal Aircraft Factory dogfighter is used in WWI.	Hypersonic planes are designed and travel super fast.
The first hot air balloon flies over Paris.	Flying boats are used by wealthy people.
The B-2 stealth bomber first flies.	Drones become common. They are used by the military and firefighters.
Hydrogen balloons fly in the Civil War.	Airships take passengers across the Atlantic Ocean.

HISTORY OF FLIGHT TIMELINE



Answer Key

HISTORY OF FLIGHT TIMELINE

1783: The first hot air balloon flies over Paris.

1860's: Hydrogen balloons fly in the Civil War.

1900: The Zeppelin airship is tested.

1903: The Wright Flyer I plane flies for the first time.

1914-1918: World War I is fought in Europe with air warfare.

1917: The Royal Aircraft Factory dogfighter is used in WWI.

1920's: Airships take passengers across the Atlantic Ocean.

1930's: Flying boats are used by wealthy people.

1940's: The X-1 plane flies faster than the speed of sound.

1969: Concorde flies for the first time.

1970: The first Boeing 747 jumbo jet takes flight.

1989: The B-2 stealth bomber first flies.

2000's: Drones become common. They are used by the military and firefighters.

2010's: Hypersonic planes are designed and travel super fast.

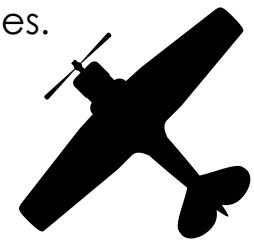
HISTORY OF FLIGHT

Transportation has always been a priority for human beings and it has evolved throughout history. Different goals have been achieved in speed and efficiency. People built chariots, carriages, and cars to get across land. They constructed boats and ships to cross the seas. During all this, they never stopped dreaming about crossing the skies.

Human flight seemed impossible for hundreds of years. Flying was only for birds, insects, and bats. That didn't stop people from trying, though. In ancient times, the Chinese developed kites from bamboo, paper, and silk. This led to people doing experiments with balloons and gliders. Leonardo da Vinci was a famous inventor who studied birds. He came up with theories about flight, and drew many aircraft designs in the 1480s. Three hundred years later, the Montgolfier brothers designed the first hot air balloon. Soon afterward, several gliders were built. A man named Otto Lilienthal created the first glider to carry a person and go long distances.

Two American brothers were inspired by Otto Lilienthal. Their names were Orville and Wilbur Wright, and they wanted to fly. After many years of studying, they designed and built the Wright Flyer I. This airplane made the Wright brothers famous when it completed the first successful flight of an engine-powered craft in 1903.

From that point on, long-held dreams of human flight came to be reality. Aviation technology advanced at a rapid pace. Many countries began research into planes for their militaries. Airlines and airports were established, as well as airmail services. Engine and wing designs continued to be improved, and planes kept going farther and farther distances.



HISTORY OF FLIGHT

Around the globe, pilots were breaking records in human flight throughout the 1920s and '30s. In 1927, Charles Lindbergh flew nonstop from New York to Paris. Amelia Earhart was the first female aviator to fly solo across the Atlantic five years later. The first practical helicopter, built by Igor Sikorsky, flew in 1939. It was inspired by one of Leonardo's flying machines that he drew all those years ago.

Along with airplanes, several airships were built. However, one of them caught fire in 1937 and thirty-six people were killed. This tragedy put an end to the development of airships.

The 1940s brought World War II. Many different types of planes were flown by air forces during this war. When it was over, more people than ever before were able to travel by airplane. They flew to other cities and countries for work, school, and vacation.

Now that there were plenty of airplanes, the next goal was for humans to travel to space. Inventors began working on design for spacecraft. In 1961, the first man traveled to space. Just eight years later, Neil Armstrong and Buzz Aldrin landed on the moon. Neil Armstrong even brought a piece of the original Wright Flyer I to the moon. It was a great tribute to the Wright brothers and other early pioneers of aviation.

Air and space travel continue to evolve. Planes today are much faster and safer than in the early days. Astronauts are training for longer trips to space in order to explore the galaxy. The achievements in early aviation have paved the way for modern day flyers. Look how far we've come in such a short time. Imagine where people will be able to fly one day relatively soon.

LESSON ELEVEN

Flight Review

grade 6

LESSON ELEVEN

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

We are reviewing the key components of flight we have learned in the unit.

Preparation

- Print 4-6 copies of the Board Game, Board Game Cards and Answer Key (put each set into a folder or large bag).
- Include one die for each group.

Lesson Part A

- Post the Inquiry Question for students and review the goals of the lesson.
- Take some time to review the Rules of the Board Game with students. They may have questions, take time to answer these.
- Once questions have been answered, break students in 4-6 groups depending on the number of students in your class.
- Give each group 1 Game Board, 1 set of Game Cards, and 1 Answer Key.
- Explain to students the Answer Key is used by a player when they are NOT answering a question.

Lesson Part B

- Students will play the board game with their groups.
- Ensure students are working cooperatively (it can get competitive).

Assessment

- Students will review concepts learned throughout the unit to promote a thorough understanding of flight.

NOTES

INQUIRY QUESTION

lesson #11

What are the key components of flight?

L11

FLIGHT

GET IT WRIGHT BOARD GAME

rules

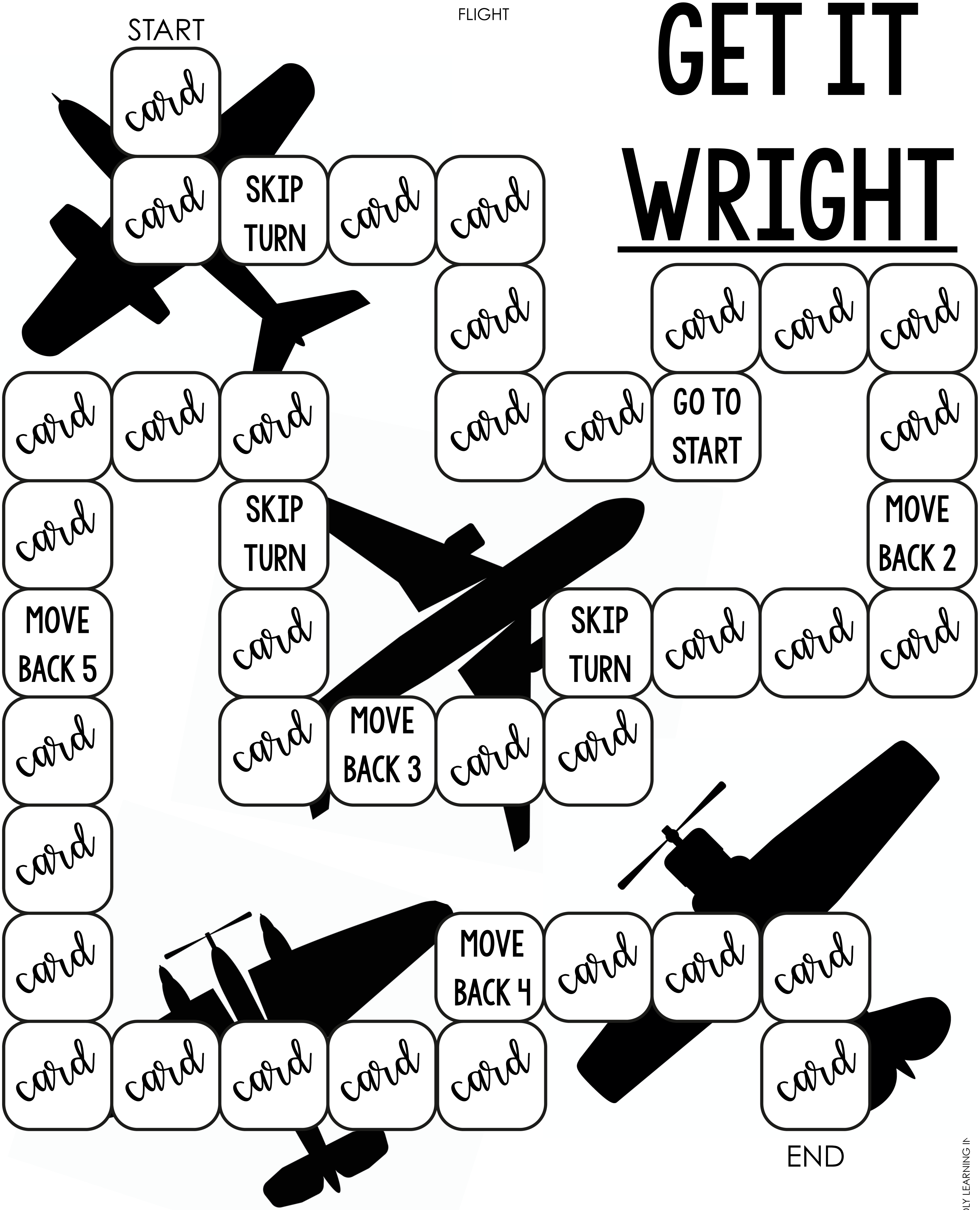
Materials needed:

- one board game
- one set of question cards
- one die
- markers for each player (bingo chips)

How to Play:

1. Each player rolls the die once. Whoever has the highest number goes first.
2. The first player rolls the die and moves the number of spaces indicated on their roll.
3. If they land on a card spot, they take a card and answer the question on it. If they answer correctly, they keep the card and stay in their spot. If they answer incorrectly, the card goes back in the pile, and they move back to where they started.
4. If a player lands on a skip turn, they skip their turn and stay on the spot. If a player lands on a move back spot, they must move back the amount of spaces.
5. The player with the most cards at the end of the game wins.
6. The answer card must only be consulted by a player who is NOT answering a question at the time.

GET IT WRIGHT



GAME CARDS

True or False: Thrust is to move to a higher position or rise from the ground. 1	What is does buoyancy mean? You can use examples to explain. 2
What are the four forces of flight? 3	What two brothers invented the airplane? 4
How are a bird flying and an airplane flying similar? 5	How are a bird flying and an airplane flying different? 6
Name one thing that can alter a force of flight. 7	_____ is created by the forward motion of the airplane through the air. 8

GAME CARDS

_____ is the force of attraction between particles or bodies that occurs because of their mass. 9	What year did the Wright brothers first fly a plane? 10
True or False: Planes were not used in WWI. 11	True or False: Air is affected by temperature. 12
Explain how altitude affects air pressure. 13	What year did the first hot air balloon fly? 14
Does air have weight? Explain. 15	Name one thing that can alter a force of flight. 16

GAME CARDS

What is the force that slows a plane down is? 17	When an airplane is taking off, lift is _____ weight. greater than, less than, the same as 18
What force is created when the air rushes over the top of the wings and pushed up. 19	What are the hinged panels that move along the wings to create more surface area on an airplane? 20
What is the name of the principle that describes why flight is possible? 21	Bernoulli's principle states… 22
Which force of flight do parachutes rely on to fall to the ground more slowly? 23	True or False: Air consists mostly of oxygen? 24

GAME CARDS

True or False: Gliders have engines? 25	Explain how a hot air balloon rises. 26
What is the part of an airplane that generates thrust? 27	Name a bird that cannot fly and explain why. 28
If the lift becomes greater than weight, then the plane will accelerate _____. 29	What happens when air is compressed? 30
Does air take up space? 31	Who was the first woman to fly a plane solo across the Atlantic? 32

FLIGHT GAME ANSWER KEY

card #	answer
1	False. Lifting to a high position is lift.
2	The tendency of an object to float or to rise when in a fluid OR the power of a fluid to put an upward force on a body placed in it.
3	lift, thrust, weight, drag
4	the Wright brothers
5	They both use the shape and movement of wings to help lift, thrust, and drag. They are both impacted by gravity/weight.
6	Airplanes do not flap their wings for lift.
7	increase of angle (lift)
8	thrust
9	gravity
10	1903
11	FALSE
12	TRUE
13	Air density is higher at lower altitudes. There is more space between air molecules at higher altitudes.
14	1783
15	Yes, air has a weight. explanation of experiment or wind
16	Drag - Using flaps on the airplane wings changes the amount of drag.

FLIGHT GAME ANSWER KEY

card #	answer
17	drag
18	greater than
19	weight
20	flaps/ailerons
21	Bernoulli's principle
22	The faster air flows, the less pressure it has.
23	drag
24	FALSE
25	FALSE
26	Hot air rises while cold air sinks. This means the balloons fly because the hot air inside weighs less than the air on the outside - causing it to float upwards.
27	engines
28	Penguin. Their wings are too short and their bodies are too heavy.
29	upward
30	the pressure and temperature of the air increases
31	Yes, because it is made of particles.
32	Amelia Earhart

LESSON TWELVE

Inquiry Project

grade 6

LESSON TWELVE

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

We are learning what the benefits and costs of aviation technology are for society and the environment through the eyes of different stakeholders.

Preparation

- Prepare Inquiry Booklets with students. This can be done in one of two ways.
  - Print out the pages double-sided on an 8.5 x 11 piece of paper and bind papers together in a booklet with the staples up the left side.
  - Using the settings of your printer, select only the pages of the inquiry booklet from the PDF to print. In the print dialog box, select the option to print as a double-sided booklet.

Lesson Part A

- Depending on your students' comfort with independent inquiry, you may choose to do a model or guided inquiry first with your students.
- Go over the assignment details given on the Student Inquiry Project.
- Explain to students they will be choosing 2-3 stakeholders from the Inquiry Project Choice Board and 1 Issue Related to Flight to research.
- Students will then explore the topics they have chosen and how they relate/affect the stakeholder.
- Inquiry booklets have been provided for student research.

Lesson Part B

Students:

- Choose 2-3 stakeholders from the choice board.
- Choose 1 issue from the choice board.
- Record what you wonder about your topic and what you already know.
- Begin researching your chosen Issue Related to Flight topic(one link per topic has been provided as a starting point, if needed).
-

Assessment

- An Assessment Rubric has been provided and should be given to all students
- Students will choose how to deliver their research and will be assessed based on the rubric criteria.

NOTES

- Students will have two weeks to complete the inquiry project.
- If students are presenting their findings, this will take an additional week to prepare.

INQUIRY PROJECT

FAQ

Question	Answer
What if my students are below grade level and struggle with research?	Links have been provided for each issue to assist in the research component. Students that are below grade level may need to work with a partner or with the teacher for assistance.
Can I help my students with the project?	Yes! Teachers are encouraged to assist their students along the way. This might look like stopping for mini lessons on researching, taking notes, and synthesizing. This is a new learning experience for students.
How long will this project take students?	The research and creation should take approximately two weeks. Depending on the form students decide to present their information, you may need an extra week for presentations.
Can my students do a topic not listed?	Yes! This is encouraged. If students find a topic that relates, they can get it approved by the teacher before they begin.
Do I need to do a pre-lesson before students start their research?	This depends on your students. If you have not taught researching, taking notes, or finding sources, you might want to do a mini lesson on this before they begin. Remember to check in consistently with students to ensure they are on the right track.

STUDENT INQUIRY PROJECT

The purpose of student inquiry is to allow students to explore concepts of flight that interests them, to learn more, to solve problems, look at an issue from different perspectives, and develop solutions.

There are many ways this can be done. Students will explore different issues related to flight. Students should be encouraged to work beyond these topics for inquiry if they're ready and capable. Teachers should avoid placing limits on reasonable topics, providing narrow selection of topics, or discouraging student creativity. Instead, teachers are encouraged to support students to choose topics that are interesting, relevant, and timely for them.

The steps of inquiry that students can follow include:

- choose 2-3 stakeholders
- choose 1 issue
- ask questions
- research and grow background knowledge
- apply learning
- evaluate learning and draw conclusions
- share what was learned

An inquiry booklet has been included that that will help to scaffold student inquiry. As the teacher, it is important that you conference with students to ensure that they are moving through their inquiry journey appropriately. At times you may need to stop a group of students for a guided inquiry lesson on topics such as brainstorming, how to research, or how to synthesize information. Lessons during your other areas of instruction, such as during your language arts time, will help to support students in understanding how to do many of these things successfully. A cross-curricular approach is very helpful when conducting inquiry projects.

By the end of the student inquiry research, students will share what they have learned. Teachers should avoid restricting student creativity by planning how students will present this information.

INQUIRY PROJECT CHOICE BOARD

stakeholders

pilots	farmers	airline workers
doctors	home owners	tour operators
travelers	airlines	security guards
police	machinery developers	photographers
television production	fuel companies	flight attendants

INQUIRY PROJECT CHOICE BOARD

issues related to flight

Drones for crop dusting	Supersonic Plane from New York to Paris	Amazon Drone Delivery
Planes and no fly hours	Avro Aero	Drones and Privacy
D8 plane design for less fuel consumption	COVID on the aviation industry	Autopilot
Boeing 737 issues	Airplane Air Quality	Drone security and surveillance
Drones affecting jobs	Airplane Pollution	Airplanes Impacts on Animals

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MY INQUIRY PROJECT

NAME:

_____

My Topic

BRAINSTORMING

1

WHAT I WONDER ABOUT MY TOPIC

Record some questions you can ask about your topic. What questions will your research answer?

2

WHAT DO I KNOW ABOUT MY TOPIC

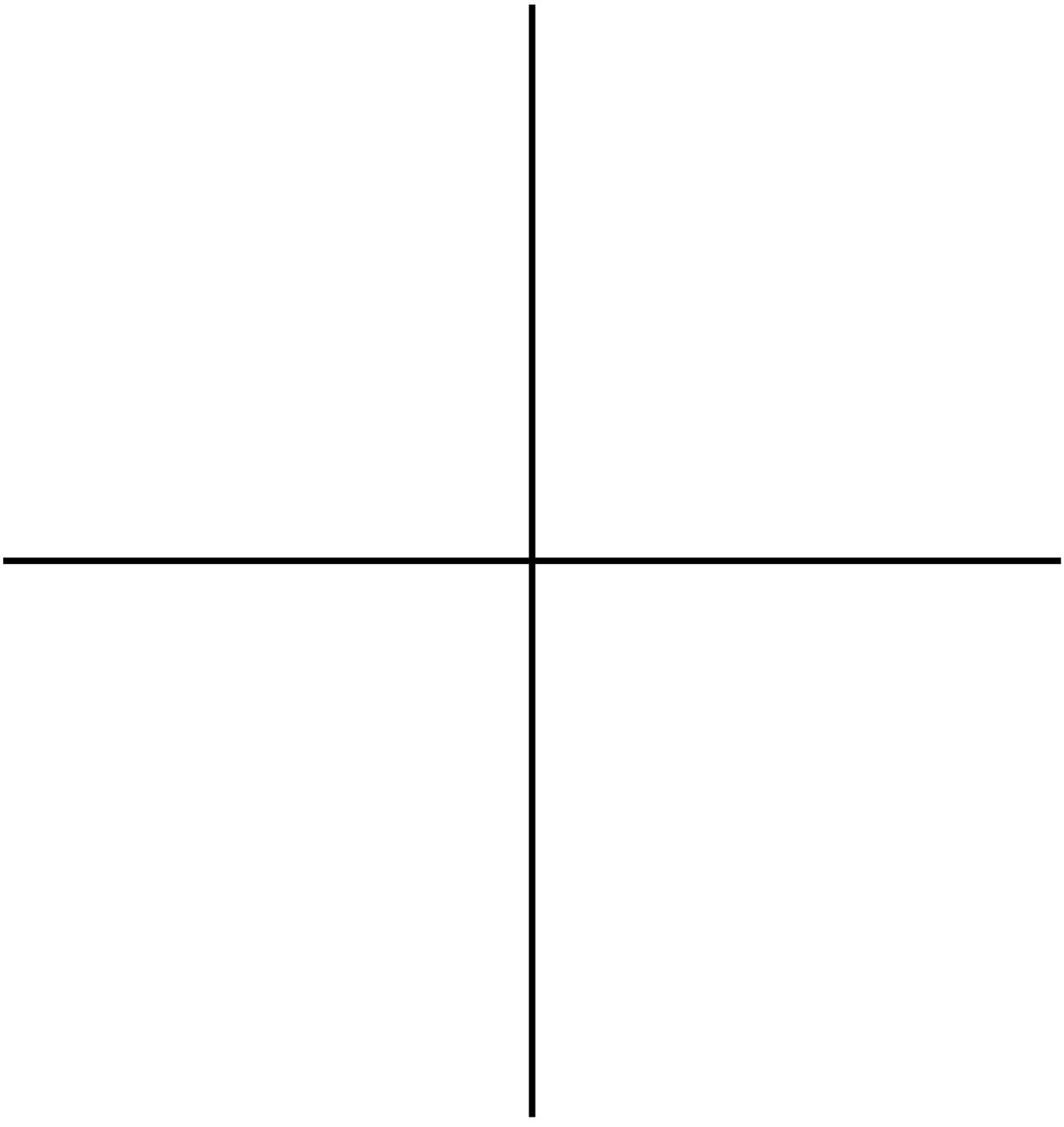
What background knowledge do you already know about your topic?

BRAINSTORMING

3

TIME TO RESEARCH

Using your questions to help guide your research, begin to learn more about your topic. Record your jot notes and organize what you find into separate categories.



BRAINSTORMING

3

TIME TO RESEARCH

Using your questions to help guide your research, begin to learn more about your topic. Record your jot notes and organize what you find into separate categories.

BRAINSTORMING

4

SUMMARIZE YOUR FINDINGS

Write a paragraph for each of your subtopics in your own words.

BRAINSTORMING

4

SUMMARIZE YOUR FINDINGS

Write a paragraph for each of your subtopics in your own words.

BRAINSTORMING

4

STAKEHOLDERS

Write a paragraph for each of your stakeholders in your own words.

BRAINSTORMING

5

MAKE A PLAN

How will you share what you learned with others in a creative way?

- ☐ poster
- ☐ video
- ☐ pamphlet
- ☐ museum exhibit
- ☐ podcast
- ☐ speech
- ☐ song
- ☐ model

6

SOURCES

RECORD THE SOURCES YOU USED FOR YOUR RESEARCH BELOW

ASSESSMENT PAGES

STUDENT INQUIRY PROJECT
assessment

CRITERIA	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
Knowledge and Understanding: • benefits and costs of aviation technology • social and economic perspectives into account	Student has a limited understanding of key concepts learned and with significant support.	Student has a basic understanding of key concepts learned and uses them appropriately some of the time.	Student has a solid understanding of key concepts learned and uses them appropriately most of the time.	Student has a deep understanding of key concepts learned and uses them appropriately all of the time.
Thinking: • research skills • analyze and synthesize information • make connections and inferences	Student requires a high degree of support to research and struggles to analyze and synthesize what they read to answer inquiry questions.	Student demonstrates basic research skills and with some support can analyze and then synthesize what they read to answer questions.	Student demonstrates good research skills by analyzing and synthesizing what they read to answer inquiry questions.	Student demonstrates excellent research skills by analyzing and synthesizing what they read to answer inquiry questions.
Communication: • appropriate terminology/vocabulary • communicate and collaborate with others	Student rarely uses subject specific vocabulary correctly. Student rarely communicates and collaborates with others to share ideas and insights.	Student uses a few subject specific vocabulary correctly. Student communicates and collaborates some of the time with others to share ideas and insights.	Student uses some subject specific vocabulary correctly. Student communicates and collaborate effectively with others to share ideas and insights.	Students uses most subject specific vocabulary correctly. Student communicates and collaborates effectively with others to share ideas and insights.
Application: • make connections between research and real life	Student struggles to use the information from their research to identify a problem and possible solutions.	Student partially uses the information from their research to identify a problem and possible solutions.	Student sufficiently uses the information from their research to identify a problem and possible solutions.	Student comprehensively uses the information from their research to identify a problem and possible solutions.

STUDENT INQUIRY PROJECT
assessment

CRITERIA	Notes
Knowledge and Understanding: • benefits and costs of aviation technology • social and economic perspectives into account	
Thinking: • research skills • analyze and synthesize information • make connections and inferences	
Communication: • appropriate terminology/ vocabulary • communicate and collaborate with others	
Application: • make connections between research and real life	
Overall Grade/ Comments:	