

**Physical Science: Flight**

**An At-Home Learning Unit for Grade 6 Science**

**By**

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**Unit Overview:**

**Introduction:**

During these uncertain times, Nova Scotia has delayed the re-opening of our public schools. This unit plan is designed so that you, the parents/guardians, have resources for at-home learning with your children. The activities and learning experiences I provide in this plan are centered around the unit of "flight", a unit mandated by the Nova Scotia grade 6 science curriculum. These activities are fun, engaging, and easily doable at home using everyday household items. If you have other children, younger or older, get them involved as well! These learning experiences can be enjoyed by the whole family.

The activities provided throughout this unit are designed to be hands-on and minds-on. The students will be active in their learning by making observations, asking questions, seeking answers, conducting experiments, and reflecting on their learning. The students should be encouraged to explore their natural curiosity and build upon their knowledge, as this is the way they learn best! In other words, don’t worry if you are uncomfortable teaching this material, the kids are in charge! Your role in these learning experiences is to start the discussions, ask thought-provoking questions, and help direct students to solutions without giving out the answer. Remember, we want them to learn through investigation, inquiry, and discovery. What better place for this than the comfort of their own home!

**Unit Focus (What will they learn?):**

From the Nova Scotia Science Curriculum Document: “Learners will explore the science and technology involved in flight as they investigate how things fly and develop and test a variety of prototype devices. A comparison of the characteristics of flight for living and non-living things will provide a foundation for the investigation of forces involved in flight. Learners will test flying devices for design, lift, movement and control.”

As mentioned above, the focus of this unit is investigation and problem-solving. Students will be engaged in rich learning experiences to help them understand aerodynamics and the forces of flight (drag, lift, weight, thrust). The curriculum guide defines these forces as follows: Drag is the force that slows down a flying device. Gravity is the force that pulls it towards Earth. Thrust is the force that propels flying devices. Lift is the force that keeps it up in the air. These forces interact together and require balance between them to sustain flight. Students will be designing, constructing, testing, and reflecting on different models and their flight properties using creativity, imagination, and research to do so. This is an excellent opportunity for families to work together and learn something new.

Throughout the unit, there are some main questions (guiding questions) your child will investigate during the 9 learning experiences (lessons) I have provided below. These questions are:

▪ How do flying living things compare with flying non-living things?

▪ How can the principles of flight be demonstrated/seen?

▪ How are forces balanced in a flying object?

▪ How is floating different from flying?

▪ How can I test a flying device?

▪ How can I improve the performance of a flying device?

▪ How have adaptations from living things led to flight designs?

▪How does the invention of aircrafts and spacecrafts influence our lives?

The students will be investigating these questions in a multitude of ways, most of which are hands-on. Therefore, if your child has limited fine motor skills or is uncomfortable building models, please feel free to help. It isn’t cheating! This science unit is integrated with multiple subject areas such as Language Arts, Math, and Art. Doing this allows students to make connections and accommodates the learning styles of all. I have provided activities I think will engage a diversity of learners, ensuring they have opportunities to learn in the way they do best. However, you know these learners best, so feel free to make modifications to the activities if it benefits their learning.

Note: To keep the students engaged and motivated in this unit, the learning experiences (lessons) should take no more than an hour and be done every day until completed. With an exception of the weekends, of course! In some cases, the learning experiences are broken into two days (two, one-hour periods) to ensure there is enough time to complete all activities without feeling rushed.

**Assessment (How will I know they have learned?):**

The purpose of this unit is not to drill students with information and then test them on the knowledge they acquired. We want students to engage with the activities and build upon and extend their prior knowledge through discovery. Therefore, I have not included any quizzes or tests in this unit plan. You will know the students have learned if they are engaging with the activities, asking relevant questions, thinking critically, and if they seek answers and respond to thought-provoking questions. I will provide ways you can assess the student’s learning during each learning experience.

One of the assessment strategies I have provided is an ongoing science journal. The students will be asked to write, draw, or record their learnings from each day. Make sure to look at it at the end of each day as it will give you information on the student’s knowledge and understanding. It will also let you know if the student is struggling with a concept, has misconceptions, or would like clarification on something. Having this information will allow you to re-address a concept before moving on to the next if need be. Perhaps the student is struggling with understanding a concept and needs to look at it in a different way.

There will also be a “unit project” to be completed at the end of the unit. Students will be given a variety of tasks and the option to choose one for their final assignment. This project will let you know if the student understands the key concepts related to the curriculum outcomes. Some of the options are easily done in a one-hour period. Others may take more time, or an additional day to complete. With this unit project comes a self-assessment form. Having students assess themselves is integral in helping them become independent learners Remember, every student is different, and we don’t expect them all to learn the same way. Don’t focus too much on if they are learning everything there is to learn. Focus more on *how* they are learning and if they are gaining valuable experiences that deepen their understanding

**Curriculum Outcomes (Where does this unit fit in the Nova Scotia Curriculum?):**

This is an integrated unit that fits into the N.S Curriculum in the following areas:

Science:

Learning Outcome: Learners will evaluate factors that influence flight.

Indicators (How will they do it?):

* Compare the characteristics of flight for living and non-living things. (COM, CT, TF)
* Investigate forces involved in flight. (COM, CT, TF)
* Test flying devices. (COM, CI, CT, TF)

Visual Arts**:**

Learning Outcome: Students will explore the creative process, individually and collaboratively, using a range of materials and technologies, to create with respect and sensitivity a variety of artworks that express feelings, ideas, and understandings.

Indicators:

* Explain the reasons why a particular subject matter and/or material have been selected when creating personal artworks. (CZ, COM, CI, CT, PCD, TF)
* Share and discuss personal artwork and the artwork of others, using the language of art while posing questions of increasing complexity. (CZ, COM, CI, CT, PCD, TF)
* Demonstrate respectful behavior for the creative process of self and others. (CZ, COM, CI, CT, PCD, TF)

English Language Arts:

Learning Outcome: Learners will select, interpret, and combine information in multicultural contexts.

Indicators:

* Use text features in print and digital media to access information Independently
* Use keywords effectively in a search engine to access relevant Information
* Select relevant, dependable sources of information, with growing Independence
* Interpret relevant information from selected sources, with growing independence
* Combine information to enhance understanding, with growing Independence
* Give credit to sources of information with guidance, with growing independence

Learning Outcome: Learners will use writing and other representations to explore, clarify and reflect upon thoughts and experiences.

Indicators:

* Develop the purpose(s) of specific pieces of writing
* Choose the audience(s) for specific pieces of writing
* Experiment by using descriptive language and word choice to enhance meaning, with increasing independence
* Refine ways to record, organize, and reflect on thinking and learning through writing and representing with increasing Independence

Mathematics:

Outcome Patterns and Relations 02: Students will be expected to represent and describe patterns and relationships, using graphs and tables. [C, CN, PS, R]

Indicators:

* PR02.01 - translate a pattern to a table of values, and graph the table of values (limited to linear graphs with discrete elements)
* PR02.03 - describe, using everyday language, orally or in writing, the relationship shown on a graph.

**Learning Experience (Lesson) Summaries:**

|  |  |  |
| --- | --- | --- |
| Day/Learning experience | Activities | Assessment |
| Day 1 – How Can We Build a Flying Object? | * Introduction – Purpose of the learning experience, background information you should know, how to prepare for the lesson. * Time to Teach - What do we know about flight? What kinds of things fly? What about gliding and floating? * Time to Discover – How can we build a flying object?   + Flight terminology – Start of an on-going word bank   Time to Reflect – Start of science journal | * Discussion and observation * Science journal (student response) |
| Day 2 & 3 – Weighed Down | * Introduction: Purpose of the learning experience, background information you should know, how to prepare for the lesson. * Time to Teach: Introduce the concept of gravity through a demonstration. * Time to Discover – Day 1:   + Experimenting with weight/gravity   + Adding weight to paper gliders * Time to Discover – Day 2:   + Buoyancy and balloons * Time to Reflect: Share/reflect on learning and add to science journal. | * Discussion and observation * Science journal (student response) |
| Day 4 & 5 –Up, Up, and Away! | * Introduction: Purpose of the learning experience, background information you should know, how to prepare for the lesson. * Time to Teach: Introduce the concept of lift and Bernoulli’s principle through a demonstration. * Time to Discover - Day 1:   + Wing Shape – Bernoulli’s principle WebQuest * Time to Discover - Day 2:   + Demonstrate Bernoulli’s principle * Time to Reflect: Share/reflect on learning and add to science journal. | * Discussion and observation * Science journal (student response) |
| Day 6 & 7 – What a Drag! | * Introduction: Purpose of the learning experience, background information you should know, how to prepare for the lesson. * Time to Teach: Introduce the concept of drag through a demonstration. * Time to Discover – Day 1:   + Experimenting with Drag   + Parachute activity * Time to Discover – Day 2:   + Aerodynamics * Time to Reflect: Share/reflect on learning and add to science journal. | * Discussion and observation * Science journal (student response) |
| Day 8 & 9 – Shoot for the Stars | * Introduction: Purpose of the learning experience, background information you should know, how to prepare for the lesson. * Time to Teach: Introduce the concept of thrust through a demonstration. * Time to Discover – Day 1: Experimenting with thrust   + Marshmallow launcher * Time to Discover – Day 2:   + Planes vs. Rockets   + Drag vs. Thrust * Time to Reflect: Share/reflect on learning and add to science journal. | * Discussion and observation * Science journal (student response) |
| Day 10 – The Force is in the Artwork | * Introduction: Purpose of the learning experience, background information you should know, how to prepare for the lesson. * Time to Teach: Review all four forces of flight * Time to Discover: Art project demonstrating the four forces   + Written/oral “Artist Statement” * Time to Reflect: Present your artwork and artist statement to a family member. | * Discussion and observation * Artist statement |
| Day 11 & 12 -From the Beginning | * Introduction: Purpose of the learning experience, background information you should know, how to prepare for the lesson. * Time to Teach: Introduction of important purposes and history of flight with a story. * Time to Discover: Day 1 - Research historical context and important purposes of flight. * Time to Discover – Day 2:   + Write a fiction Story on life without flight * Time to Reflect: Share your research and fiction story, add to science journal. | * Discussion and observation * Fiction story * Science Journal (student response) |
| Day 13 – Going the Distance (Math) | * Introduction: Purpose of the learning experience, background information you should know, how to prepare for the lesson. * Time to Teach: Review and introduction to activity. * Time to Discover: Going the Distance math activity   + Testing, measuring, and graphing distance of paper gliders/planes * Time to Reflect: Forces of flight game – build an airplane and master the forces of flight. | * Discussion and observation * Graph and questions activity |
| Day 14+ - Unit Project | * Introduction: Purpose of the learning experience, background information you should know, how to prepare for the lesson. * Time to teach: Review and introduce unit project. * Time to Discover: Choose a “Flight Task” to complete as a unit assessment and complete. * Time to Reflect: Self-assessment and share your project with family members! | * Final project assessment * Self-assessment |

**Learning Experience 1: How Can We Build a Flying Object?**

60 mins

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| **Introduction:** | | |
| This is an introductory learning experience designed to get the students thinking about flight, things that fly, and the forces that affect flight. By the end of this learning experience, students will have accessed their prior flight-related knowledge and observed some of the forces that will be introduced later in the unit. They will do this by brainstorming and creating a test flyer.  Guiding Questions addressed in this learning experience:   * How can I test a flying device? * How can I improve the performance of a flying device?   Background information you should know: That “force” is an interaction of some kind that affects the motion of an object. In flight, those forces are upward (lift), downward (weight), forward (thrust), and backward (drag). Each of these forces, where they come from, and how they affect flight will be explored throughout the unit.  Preparation for this lesson: Have all materials ready before the lesson. The student will need a “science journal” for this unit. This can be made using a notebook, paper stapled together into a booklet, a word document, or video/audio software. This should be ready for the student before starting the lesson. | | |
| **Curriculum Outcomes:** | | |
| Learning Outcome: Learners will evaluate factors that influence flight.  Indicators:   * Investigate forces involved in flight. (COM, CT, TF) * Test flying devices. (COM, CI, CT, TF) | | |
| **Materials Needed** | | |
| - Paper (multiple types if possible, ex: loose-leaf, white paper, construction paper, tissue paper, etc.)  -Scissors  - Website: <https://paperairplaneshq.com/> | | |
| **Part of the lesson** | **Learning Activity** | **Assessment** |
| Time to Teach!  10 mins | Before getting into the forces of flight, we first want to see what the student already knows about flight.   * In the science journal, write “Things I know about Flight” at the top. Talk about and ask the student (or you can help) to write down everything they know about flight and things that fly. They may know things that fly but they may also know things associated with flight such as wings, engines, etc. * You can ask prompting questions such as “what type of objects fly?”, “Do only planes fly?” We want them to think about other objects like hot air balloons, kites, rockets, helicopters, etc. Try not to give away the answers! * “What about animals that fly?” * “Are there any other living things that fly?” Think insects. * “What about gliding and floating? Is that the same as flying?” | Pre-assessment: We want the students to think about what they already know about flight, so they are prepared for the learning to come. |
| Time to Discover!  45 mins | Now that the student has thought a bit about flight, we want to get them thinking about *how* things fly, or how things stay in the air.  Activity: Building a Flying Object   * The student will design and construct a paper glider. They can look through the website <https://paperairplaneshq.com/> for inspiration, but they should come up with their own design. It can be any shape or size and made on any type of paper. * It would be helpful if family members could also build paper gliders (with different designs/sizes/paper types), as the student will be asked to compare them. If this is not possible, have the student come up with another design to compare. * Fly the gliders and determine which one traveled the farthest. * Have the student discuss how they think the design of the gliders affected their performance. * Have the student suggest design changes that might help their glider fly further. Re-design and test it out! * Be sure to keep these gliders as they will be used throughout the unit. * Ask the students to describe what they think makes the gliders stay in the air, and eventually come down. If they say “The wings keep them up” ask them how they think that works. If they say “the air keeps them up, and gravity brings them down” they are on the right track! * Lead them into a discussion that there are forces that act on an object/animal in flight. The forces work in four directions: upward, downward, forward, and backward. These are the forces we will be learning about throughout this unit.   Activity: Flight Vocabulary   * Have the students start a vocabulary list that they will add to throughout the unit. It can be on paper or a word document. They can use pictures as well! * Add “Force” to the list. They can research online for a definition. | Is the student actively participating? Are they engaged? Are they offering suggestions and answering questions? Are they asking their own questions? |
| Time to Reflect! (closure)  5 mins | This may seem like such a small part of the learning experience, but it is incredibly valuable! Students need an opportunity to share and reflect on their learning.   * Ask the students to tell one family member about the paper glider they made. They should mention how the different designs had different results and why they think that happened. * In the science notebook: “Write one thing you learned today about flight and one thing you would like to learn more about.” | Peer and self-reflection are important aspects of learning. |

**Learning Experience 2: Weighed Down**

120 mins (over two days)

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| **Introduction:** | | |
| This learning experience is designed to get students thinking about and experimenting with weight/gravity. By the end of this learning experience, students will understand the effects of weight/gravity on flying objects by adding weights to their paper gliders. They will also understand how some flying objects counteract the effects of gravity through buoyancy.  Guiding questions addressed in this learning experience:  ▪ How can the principles of flight be demonstrated/seen?  ▪ How is floating different from flying?  Background information you should know: Gravity is the downward force that pulls an object toward the ground. Weight is the force exerted on objects *by* gravity. Weight must be overcome by an upward force to achieve flight. Those two upward forces are buoyancy (like in hot air balloons), and lift (like in planes). In this lesson we will describe how hot air balloons fly by overcoming weight with buoyancy. Buoyancy is the upward force that is produced by a liquid or gas (like air) surrounding an object.  Preparation for this lesson: This lesson will be split into two, one-hour periods over two days. You will need the paper gliders made in the previous lesson. There is an activity in this lesson that requires a hair dryer. If you do not have one at home, please show this video instead when indicated: <https://www.youtube.com/watch?v=4m3t4zbXL6w>  This activity also requires measuring the distance paper gliders fly. Since some of them will go quite far, a ruler isn’t practical for measuring distance. A tape measure would be better. If you don’t have a tape measure at home, find something around the house that can be used as a measurement tool. For example, a broom handle makes an excellent measurement tool. “This glider flew the length of 1.5 broom handles”. It is not ideal or exact, but it can work for this activity. | | |
| **Curriculum Outcomes:** | | |
| Learning Outcome: Learners will evaluate factors that influence flight.  Indicators:   * Investigate forces involved in flight. (COM, CT, TF) * Test flying devices. (COM, CI, CT, TF) | | |
| **Materials Needed** | | |
| -Paper gliders from previous lesson  -Items from around the house that can act as weights (coins, paper clips, modelling clay, etc.)  -Tape  -Small plastic bag  -Large garbage bag  -Hairdryer  -Paper  - A heavy object that can be dropped to the ground (like a tennis ball)  -Tape measure or something that can be used as a measurement tool (like a broom handle) | | |
| **Part of the lesson** | **Learning Activity** | **Assessment** |
| Time to Teach!  10mins | To get students engaged in the lesson to come, we want to start with a review of what they know and a demonstration that “hooks” them in.   * Review the last lesson by asking the student what they remember about the four forces that act on flying objects. Right now, they know them as upward, downward, forward, and backward. * Crumple up a piece of paper and hold it in one hand. Take a heavier object (like a tennis ball) in the other hand. Ask, “Which one do you think will hit the ground first and why?” The student will likely think that the heavy object will hit first because it weighs more. * Drop the items to the ground. They will both hit the ground at the same time. Ask, “What made them hit the ground at the same time?” If they are unsure, explain that gravity on earth acts on everything equally. It doesn’t matter how heavy or light objects are, the force of gravity is always the same. | Pre-assessment: We are determining what the student already knows about weight and gravity. |
| Time to Discover!  50 mins (Day 1)  Time to Discover!  50 mins (Day 2) | Activity: Adding weight to paper gliders  From the demonstration above, students may believe that adding weight to planes won’t have any affect, because gravity acts on all objects equally. This is true, but things are a little different in terms of flight. To stay in the air, the weight of a plane must be overcome by lift. When weight is added to a plane, there must be more lift, or it will not stay up. The same thing applies to birds. The bigger the bird, the more lift they must create to fly. Lift will be explored in depth later.   * Take a paper glider from the previous lesson and give it a throw. Place a marker (like a coin) where the glider landed. Ask “Do you think adding weight to the glider will affect its flight? Explain your thinking.” At this point they will probably think no. * Have the student add some weight, like a paper clip or coin, to the glider and give it a toss from the same starting position as before. Did the glider go as far? Ask, “Did gravity act on the glider differently?” * Pose the question, “What does adding weight to the paper glider do to its flight?”. Let them test this out by adding various weights to the glider and testing it. How does the weight affect the flying distance? * In the science journal, have them record the different weights and distance measurements in a table. An example of the table they should make is in Appendix A. * Discuss with the student how the weights affected the distance flown. What patterns did they see? Ask them what they think would help the planes stay up longer. Maybe ask what the difference is between the wingspan of a small bird, and the wingspan of a large bird. What about the wings of a small plane vs a massive jet? How do they compare? Try and lead them into the conclusion that the shape and size of wings play a huge role in keeping all flying objects in the air. This is what we will be discovering in the next lesson.   **Day 2**  Activity: Hot Air Balloons  We will now move into how objects can overcome weight and achieve climb. We will start with buoyancy and discuss lift in the next learning experience.   * Pose these questions: “Have you ever tried to swim to the bottom of a swimming pool?”, “Did you have a hard time reaching the bottom because you felt like you were getting pushed back up?” * Explain that this force is called buoyancy. When you enter the water at the pool, you displace the water, meaning you push the water aside to make room for your body. The water exerts the same upward force on you that it did on the water you displaced, which is why you feel pushed up. If the force of buoyancy is stronger than the force of gravity, you will rise to the surface, like floating! Some flying objects, like hot air balloons, work the same way! * Ask the student “What happens to air when it is heated?” They should know that warm air rises. If they don’t, this experiment will help them understand. * If you do not have a hairdryer, show the video mentioned in the introduction now. If you do have one, continue to experiment. * Tape the opening of a small plastic bag so it is the same size as the end of the hair dryer (watch video from link above if this is not possible for you). Don’t tape the bag directly to the hairdryer as it will be hard to get off. Let the bag fill up with hot air (wait a bit after it is filled up completely to make sure the air is nice and hot). Release the bag and watch it float up! * Ask, “What made the balloon float up?” Explain that when the air is heated, the air particles inside the bag start colliding faster and the air expands, taking up more room. It displaces the air that was there before. Since the bag is lighter that the air it displaced, the pressure of the air causes it to rise. This is how hot air balloons work. * Try this with a large garbage bag. Ask, “What do you think the difference will be with the larger bag? Will it rise more? Why or why not?” Have them write their predictions in their science notebook and then let them test it! * Add weight, gravity, and buoyancy to your vocabulary list. | Does the student understand that adding weight to a glider affects the distance it will fly?  Does the student understand how buoyancy helps some flying objects lift into the air? |
| Time to Reflect!  10mins | In your science notebook:  -Was the prediction you made about the garbage bag hot air balloon correct?  -How does a hot air balloon float?  -Is floating the same as flying? Explain your thinking.  Discuss it with a family member! | Does the student understand why gravity keeps flying objects down and how they can overcome it? Do they need more practice? |

**Learning Experience 3: Up, Up, and Away!**

120 mins (over two days)

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| **Introduction:** | | |
| This learning experience is designed to get students thinking about and experimenting with lift. By the end of this learning experience, students will understand lift as the upward force on man-made flying objects and living things that helps them become and remain airborne. They will do this by experimenting further with their gliders, discovering Bernoulli’s principle, and investigating wing shape of living and non-living things.  Guiding questions addressed in this learning experience:  ▪ How do flying living things compare with flying non-living things?  ▪ How can the principles of flight be demonstrated/seen?  ▪ How are forces balanced in a flying object?  Background information you should know: In flying objects that don’t rely on buoyancy, weight must be overcome by lift to achieve flight. The only way a plane can climb is if the force of lift is greater than the plane’s weight. When weight and lift is balanced, the plain will fly straight. The heavier the plane, the more lift it requires to achieve and sustain flight.  **Bernoulli’s Principle:** Because wings are curved, air that passes over the top of the wing moves faster than the air under the wing. Faster moving air has less pressure than slower moving air, meaning there is more pressure on the bottom of the wing than the top. The higher-pressure air pushes upward on the bottom of the wing, causing it to lift.  Preparation for this learning activity: This lesson will be split into two, one-hour periods over two days. This lesson contains many videos, it would be helpful to watch them before doing the lesson with the student. | | |
| **Curriculum Outcomes:** | | |
| Learning Outcome: Learners will evaluate factors that influence flight.  Indicators:   * Investigate forces involved in flight. (COM, CT, TF) * Compare the characteristics of flight for living and non-living things. (COM, CT, TF) | | |
| **Materials Needed:** | | |
| - materials for Bernoulli demonstration, depends on student’s demonstration. This will likely require various items from around the home.  -paper | | |
| **Part of the lesson** | **Learning Activity** | **Assessment** |
| Time to Teach!  15 mins | As an introduction and “hook” for this lesson, start with a brief demonstration on lift.   * Ask the student what birds, flying insects, and airplanes all have in common. The answer? Wings! * Ask the student if they know what wings have to do with flying. They may conclude that the air around the wings helps them fly, but they likely don’t know how it works. * Have the student take a piece of paper and hold the end right above their top lip. Ask them what they think will happen to the paper when they blow air underneath it. They will say the paper will lift because they are blowing air underneath it (pretty obvious, right?). Try and see. * Now have them hold the end of the paper right below their bottom lift. Ask them what will happen when they blow. They will probably think nothing will happen because they are blowing air right over the top of the paper. Try it and see. The paper still lifts up! * Video of this demonstration found at <https://www.youtube.com/watch?v=MYXiL2wGDAw> * Next, have them fold a piece of paper in half so that it forms a tent. Set the tent up on the table and ask the student what will happen if they blow through the center of the tent. They might think that it will blow away. Try it and see. The paper flattens out! * Video of this demonstration found at <https://www.youtube.com/watch?v=eqemk4Sa_m8>     Discussion: Ask the student what made the paper lift and the tent flatten. Explain that this is called Bernoulli’s principle, and it has to do with the pressure of the air! This same principle is how birds, insects, and planes fly.   * Show this video explaining air pressure on plane wings. <https://www.youtube.com/watch?v=bv3m57u6ViE> | Pre-assessment: We are determining what the student already knows about lift. |
| Time to Discover!  45 mins (day 1)  Time to Discover!  50 mins (day 2) | Activity: Wings and Bernoulli’s Principle WebQuest   * Have the student research wing shape and Bernoulli’s principle. They must research how 1 animal/bird, 1 insect, and a helicopter uses Bernoulli’s principle to obtain lift. * Have them write in their science journals what they learned about each.   Extension (for those who want a challenge): What is “angle of attack” and what does it have to do with lift? Research to find out!  **Day 2**  Activity: Demonstrate Bernoulli’s Principle   * Pretend you are Daniel Bernoulli and are explaining to other scientists how to demonstrate your principle. * Create a writing piece, voice, or video recording explaining how your activity demonstrates Bernoulli’s principle. * Gather materials and complete your demonstration. Parents/guardians/family members can help as well, it’s not cheating! * Practice your demonstration to make sure it appropriately demonstrates Bernoulli’s principle, making modifications if necessary. * This doesn’t need to be an extravagant demonstration, something simple like the two demonstrations with paper is enough. | Does the student understand the concept of Bernoulli’s principle? |
| Time to Reflect!  10 mins | Present your findings from how animals, insects, and helicopters use Bernoulli’s principle to achieve lift to a family member. Also, present to them your demonstration of Bernoulli’s principle.  In your science notebook: How do you think lift and weight/gravity are connected when it comes to obtaining flight? Please explain your thinking. | Does the student understand the connection between lift and weight? |

**Learning Experience 4: What a Drag!**

120 mins (over 2 days)

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| --- | --- | --- |
| **Introduction:** | | |
| This learning experience is designed to get students thinking about and experimenting with drag. By the end of this learning experience, students will understand drag as the backward force acting on a flying object, causing it to slow down. They will do this through an investigation on parachutes and how to reduce the effects of drag on their paper gliders.  Guiding questions addressed in this learning experience:  ▪ How can the principles of flight be demonstrated/seen?  ▪ How can I test a flying device?  ▪ How can I improve the performance of a flying device?  Background information you should know: Drag is the force that acts backward on a flying object, causing it to slow down. It is also referred to as air resistance. Flying objects need to have the least drag as possible to stay in the air. This is where aerodynamics comes into play. The design of the flying object plays a crucial role in reducing drag.  Preparation for this learning activity: This lesson will be split into two, one-hour periods over two days. Have all materials ready before the lesson. If you do not have the materials at home to create various parachutes, please show this video <https://www.youtube.com/watch?v=UpWU2Hg1sBs> when indicated. | | |
| **Curriculum Outcomes:** | | |
| Learning Outcome: Learners will evaluate factors that influence flight.  Indicators:   * Investigate forces involved in flight. (COM, CT, TF) * Test flying devices. (COM, CI, CT, TF) | | |
| **Materials Needed:** | | |
| - Parachute: paper, plastic bags, cloth, etc.  -strings: dental floss, twine, ribbon, string, etc.  -weight: marble, Dinkie car, ball, washer, toy figurine, etc.  -optional: yogurt cup basket for holding weights  -stopwatch (can find one on most cell phones) | | |
| **Part of the lesson** | **Learning Activity** | **Assessment** |
| Time to Teach!  10 mins | Take a moment at the beginning of this lesson to address the question posed at the end of the last lesson, “How do you think lift and weight/gravity are connected when it comes to obtaining flight?” If they haven’t figured it out on their own, explain that for flying objects to stay up, the force of lift must overcome (be greater) than the force of gravity/weight.  Students will be familiar with the force of drag, they just haven’t heard the word for it! As a “hook” for this lesson, we will have the students do a demonstration with lift.   * Get the student to hold a piece of paper above their head (as if they were holding a sign at a concert), the larger the better (preferably Bristol board), and run with it. Did they feel any resistance on the paper? Ask them to explain what they think was happening. They will probably say that the air is hitting the paper and slowing them down. * Explain that this is correct, and that backward force is called drag. It is responsible for slowing things down. You also feel drag when you put your hand out of a moving car’s window. When you put your hand out, the moving air hits your hand and tries to push it back. * Add “Drag” to your vocabulary list | Pre-assessment: We are determining what the student already knows about drag. |
| Time to Discover!  50 mins (Day 1)  Time to Discover!  50 mins (Day 2) | Activity: Testing Parachute Designs  To get students thinking about how design helps increase and decrease drag, they create and test various parachute designs.   * If you don’t have the supplies needed to make the parachutes, show this video now: <https://www.youtube.com/watch?v=UpWU2Hg1sBs> * Ask the student what factors might increase and decrease the amount of drag on a parachute and record it in their science journal. * Using three different pieces of paper of the same size, have students create a different shape parachute canopy with each piece of paper. They could also try plastic or cloth! * Attach strings to the canopy and tie all strings to a weighted object. * Next, students should make a prediction of how each parachute will act in a free fall and why they think that. * Have the student drop their parachutes from a decent height (a deck would work perfectly!) It can be inside or out providing the parachute is dropped from the same height each time. * Students will record how long each parachute takes to fall to the ground. Test each parachute at least 2 more times to ensure a fair test! Record all times and take the average (mean) of all trials for each parachute. * How can they modify a parachute to either slow it down or make it drop faster? Have students determine whether they want to have an efficient parachute that has more drag or one with less drag. What is the goal? Do they want the parachute to fall quickly or slowly? Why is it important that it falls quickly or slowly? * Have them make a new design and test it (3 times) and record the time. Were they successful in speeding up or slowing down the new parachute?   **Day 2**  Activity: Aerodynamics  Start this activity with a discussion on when having less drag is important, and when having more drag is important. For example, when people go skydiving, would we want their parachutes to have a lot or little drag? We would want them to have a lot of drag to make sure they land slowly and safely. Would we want airplanes to have a lot or little drag? This part of the learning experience is to get students thinking about why we want to reduce drag in flying objects and how we can do it.   * Attach one of the parachutes from the previous lesson to the back of a paper glider and fly it. What happened? The parachute added more drag to the glider, causing it to slow down and fall faster. * Explain that flying objects, including animals, will not fly as fast/far if they are experiencing too much drag. * Ask the student to think about race cars and fighter jets. Ask, “What kind of shape do they have?”, “What do you think the shape has to do with these fast-moving vehicles?”, and “What reason would the makers of these vehicles have for making them this shape?” * Help the student conclude that the more streamlined an object is, the faster it can go. Explain that the streamlined shape allows air to easily pass over the racecar/jet, reducing the force of drag. The way air passes over objects is called “aerodynamics”. The smoother and more streamlined an object is, the more “aerodynamic” it is. * To give the student a visual demonstration of drag in flying objects, first ask, “How do you think we can reduce drag in our paper gliders so they go as far as possible?” If they get stuck, refer them back to the shape of fighter jets and the idea of “streamlined”. * Have the student design more paper gliders to try and reduce drag as much as possible. Ask, “How do we know if we are reducing drag?” Explain that you can test the forces of drag by comparing paper gliders made of the same type/size of paper but with different designs. If we always start from the same throwing position and use the same amount of throwing force, the glider that travels the farthest will have the least amount of drag. This way, the only variable changing is the design (weight, size, position, etc. will not be a factor) * Which glider design traveled the farthest? Is it more streamlined than the others? * In the science journal, write about (and maybe draw a picture of) the glider that traveled the farthest. How was it different than the other designs? What made it travel the farthest? Explain your thinking. * Keep the gliders for the next lesson! * Add aerodynamics to the vocabulary list. | Does the student understand how we increase/decrease drag on a flying object?  Does the student understand when it is important to reduce drag, and when to increase drag?  Does the student understand why we want aircrafts to have the least amount of drag (air resistance) as possible?  Does the student understand how “aerodynamics” affects drag?  Does the student understand that they can reduce drag in a glider by making it more streamlined or “aerodynamic”? |
| Time to Reflect!  10 mins | Let the student share their discovery on which parachute design reduces/increases drag the best with a family member. Be sure to explain why it is better! They can also share their learnings on aerodynamics and how the shape of flying objects helps them fly.  In your science journal, what are three important things you want people to know about drag? | Has the student developed an understanding of drag? Do they need more practice? |

**Learning Experience 5: Shoot for the Stars!**

60 mins

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| **Introduction:** | | |
| This learning experience is designed to get students thinking about and experimenting with thrust. By the end of this learning experience, students will understand thrust as the force acting forward on flying objects by investigating propellers and jet engines.  Guiding questions addressed in this learning experience:  ▪ How can the principles of flight be demonstrated/seen?  ▪ How are forces balanced in a flying object?  ▪ How can I test a flying device?  ▪ How can I improve the performance of a flying device?  Background information you should know: Thrust is the force acting forward on flying objects, causing it to move through the air. Without thrust, flying objects wouldn’t be able to take off or stay in the air. Thrust is needed to overcome the drag of a flying object. It must be equal to or greater than the force of drag for sustained flight.  **Helicopters:** The propellers draw air in at one end and push it out at the other. This gives the machine the thrust it needs to become airborne.  **Jet airplanes**: Jet engines pull in the air and mix it with the fuel. The burning gas goes out through the back of the plane and this provides the thrust. The trail following a plane in the sky on a clear day is this combination of air and fuel.  **Rockets:** Rocket engines use a combustion reaction for propulsion upward. This is why you usually see a big explosion when rockets launch.  **Birds:**Birds have very strong breast muscles used to flap their wings. The flapping is what generates thrust. If a bird stops flapping its wings, it will only be able to glide for so long before coming down.  Preparation for this learning experience: This lesson will be split into two, one-hour periods over two days. Please have all materials ready before the lesson. | | |
| **Curriculum Outcomes:** | | |
| Learning Outcome: Learners will evaluate factors that influence flight.  Indicators:   * Compare the characteristics of flight for living and non-living things. (COM, CT, TF) * Investigate forces involved in flight. (COM, CT, TF) * Test flying devices. (COM, CI, CT, TF) | | |
| **Materials Needed:** | | |
| - paper towel tube  -toilet paper tube  -marshmallows or other small, light objects for launching (cotton balls, paper balls, etc.) | | |
| **Part of the lesson** | **Learning Activity** | **Assessment** |
| Time to Teach!  10 mins | As an introduction and “hook” for this lesson, start with a brief demonstration of thrust.   * Get the student to take one of their paper gliders and ask them to see if it will fly by just dropping it. Ask, “What made it fall and not fly?” They will likely say, “because I didn’t throw it!” * Ask, “How does throwing it help it to fly?” They might say “because it needs power” or “it needs a start, first”. * Explain that this is correct, and this forward force is called “thrust”. * Add “Thrust” to the vocabulary list. | Pre-assessment: We are determining what the student already knows about thrust. |
| Time to Discover!  50 mins (Day 1)  Time to Discover! 50 mins (Day 2) | Activity: Shoot for the Stars!  The students will be experimenting with cardboard tubes of different lengths to see how far they can propel a marshmallow (or another item, like cotton balls) using only their breath.   * Place the marshmallow at the end of the short tube, hold it horizontally, put your mouth to the end with the marshmallow, and blow! How far did it go? * Try placing the marshmallow in the middle and beginning of the tube and blowing. Does it make a difference? * Place the marshmallow in the longer tube and repeat the steps above. Did the marshmallow go farther? Did you need to blow harder? Ask them what they think is happening. * Note: when investigating distance, make sure you are conducting fair tests by always starting from the same position! * Explain that blowing into the tube increases the air pressure in the tube. As soon as it leaves the tube, the blowing no longer affects it. The faster the marshmallow is going when it leaves the tube, the farther it will go. In the longer tube, the marshmallow has more time for your blowing to speed up the marshmallow before it leaves the tube. That’s why it launches farther! However, you will need to blow harder and longer to propel it all the way out of the longer tube! This is also why the marshmallow doesn’t launch as far when placed in the middle or beginning of the tube. Let them experiment a few more times so they can see for themselves.   Extension (for those who want a challenge): Build a model that demonstrates thrust (bottle rocket, elastic band launcher, mini catapult, etc.)  **Day 2**  Activity: Aircraft vs. Spacecraft  Ask the student where they think the following objects get thrust and have them write it in their journals:   * Planes (Jet engines) * Helicopters (propellers) – explain this * Rockets (Rocket engines) * Birds (Wings and muscles) – explain this   Let them take a little time to research online if they need more understanding. Make sure they are writing in their journals what they are learning!  Ask the students what they think the difference is between jet engines and rocket engines. They will probably say that rockets go straight up and have an explosive burst.   * Let the students investigate online how jet engines and rocket engines operate and write it in the science journal. * There is a great video at <https://www.grc.nasa.gov/WWW/K-12/UEET/StudentSite/engines.html> on how jet engines work.   How are drag and thrust connected?   * Remember when we attached a parachute to a paper glider? Try it again, throwing it as hard as you can! Did it go farther than before? * What if an older sibling/parent throws it as hard as they can? People who are bigger and stronger can throw the glider farther because they can generate more power (thrust)! * We know that if there is too much drag, the glider won’t go very far. Explain that for it to go farther, there needs to be more thrust. The only way flying objects can stay in the air is if the thrust is equal to or greater than drag. This is why aerodynamics is so important! | Does the student understand why thrust is needed to help objects fly?  Does the student understand that different flying objects obtain thrust in different ways?  Does the student understand how engines create thrust?  Does the student understand how thrust and drag are connected? |
| Time to Reflect!  10 mins | Let the student report on their rocket vs jet investigation to a family member.  In the science journal: What are 3 things you learned about thrust, 2 things you have questions about, and 1 thing you would like to learn more about. | Does the student understand the concept of thrust? Do they need more practice? |

**Learning Experience 6: The Force is in the Artwork**

60 mins

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| **Introduction:** | | |
| This learning experience is designed to integrate the science of flight with art. Not all students learn the same way, and art highly resonates with some. By the end of this learning experience, students will better understand the forces of flight by viewing them through an artistic lens.  Guiding questions addressed in this learning experience:   * How can the principles of flight be demonstrated/seen?   Background information you should know: Artist statement – A written statement by an artist describing their work to give the viewer understanding.  Preparation for this learning activity: The activity requires the use of paint, but don’t worry if you don’t have any! You can make paint by mixing ½ cup of flour, ½ cup of salt, and ½ cup of water. Add food coloring to make colorful paint, but it’s ok to stay white if you have colored paper. Prepare the materials and have them ready prior to the lesson. View the video <https://www.youtube.com/watch?v=lNeLafoY8Ic> to get an idea of what the different elements of the art activity look like. | | |
| **Curriculum Outcomes:** | | |
| **Science:**  Learning Outcome: Learners will evaluate factors that influence flight.  Indicators:   * Investigate forces involved in flight. (COM, CT, TF)   **Visual Arts:**  Learning Outcome: Students will explore the creative process, individually and collaboratively, using a range of materials and technologies, to create with respect and sensitivity a variety of artworks that express feelings, ideas, and understandings.  Indicators:   * Explain the reasons why a particular subject matter and/or materials have been selected when creating personal artworks. (CZ, COM, CI, CT, PCD, TF) * Share and discuss personal artwork and the artwork of others, using the language of art while posing questions of increasing complexity. (CZ, COM, CI, CT, PCD, TF) * Demonstrate respectful behavior for the creative process of self and others. (CZ, COM, CI, CT, PCD, TF) | | |
| **Materials Needed:** | | |
| - paint (bought or homemade!)  - straws (preferable but not totally necessary)  - sticks  -paper  -marble or another round object that rolls (like a ball) | | |
| **Part of the lesson** | **Learning Activity** | **Assessment** |
| Time to Teach!  5 mins | Before beginning the art, ask the student to remind you what the four forces acting on flight are – gravity/weight, lift, drag, and thrust. These concepts will be important to keep in mind throughout this art activity. | Pre-assessment: We are determining what they have learned about flight so far. |
| Time to Discover!  50 mins | Activity: The Force is in the Artwork   * Put a big drop of paint on a piece of paper put it in motion by tilting the paper. Use a straw to blow the paint in a perpendicular direction that it’s flowing. If you don’t have a straw, you can simply blow on it but not too hard! Use as many colors as you’d like and blow the paint into multiple directions, creating a unique design. This represents lift as lift is the force acting perpendicular to a fluid (paint) around the surface of an object (paper). Lift doesn’t always have to be straight up! * Next, hold the paint up high and let it drip or splatter it on to the paper. Use these motions to add to your design. This represents gravity. * Next, take a stick and pull/drag some paint around the paper. This represents drag. * Lastly, put a marble or other round object onto your artwork and roll it around on the page. When you push it forward, you are representing thrust. When you pull it backward, you are representing drag. * Your artwork can be completely abstract, or you can use these methods to try and create an image.   Activity: Artist Statement  It’s possible the student is not familiar with artist statements yet, so they should be modelled before asking the student to complete one. If this is the case, save the artist statement for the next day. I have provided some examples of artist statements in Appendix B. Please read them with the student so they have an idea of what is expected. It would also help if you and the student create a brief artist statement together before sending them off to create their own. If they are familiar with artist statements, please continue.   * Create an artist statement in either written, audio, or video format. Refer to the sheet “How to write an artist statement” provided in Appendix C. * The statement should start with a description of the artwork, then how the art was created, what was the big idea (how does the artwork reflect the forces that affect flight? What are the connections?), your favorite part of the lesson, and what you learned from your artwork. * Be sure to include an engaging lead, a descriptive middle, and a satisfying conclusion. | Does the student know which force is being demonstrated with each action? Every time a new action is introduced, ask the student what force the action represents.  This artist statement is a good way for students to show their understanding. Do they understand how the painting techniques represent the four forces that affect flight? |
| Time to Reflect!  5 mins | Act like an artist!   * Display your artwork and present it and your artist statement to a family member. | Does the student understand how the forces work on objects other than flying devices? |

**Learning Experience 7: From the Beginning**

60 mins

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| **Introduction:** | | |
| This learning experience is designed for students to investigate the history and development of flying devices, as well as the effects they have on our lives today. By the end of the lesson, students will understand the inspiration for flying devices, problems that were faced, and how the invention of flying devices have changed the way we work, live, and interact with our environment. They will do this through research and a written/oral piece on how different the world would be if we didn’t have flying devices such as planes, helicopters, rockets, etc.  Guiding questions addressed in this learning experience:  ▪ How have adaptations from living things led to flight designs?  ▪ How does the invention of aircrafts and spacecrafts influence our lives?  Background knowledge you should know: That people got their inspiration for flying machines from birds and the desire to fly like them.  Preparation for this learning experience: This lesson is split into two, one-hour periods over two days. There is a reading at the beginning of this lesson, which is found at <https://greece.mrdonn.org/greekgods/icarus.html>. Please read this aloud to the student. | | |
| **Curriculum Outcomes:** | | |
| **Science**:  Learning Outcome: Learners will evaluate factors that influence flight.  Indicators:   * Compare the characteristics of flight for living and non-living things. (COM, CT, TF) * Investigate forces involved in flight. (COM, CT, TF)   **English Language Arts:**  Learning Outcome: Learners will select, interpret, and combine information in multicultural contexts.  Indicators:   * Use text features in print and digital media to access information Independently * Use keywords effectively in a search engine to access relevant Information * Select relevant, dependable sources of information, with growing Independence * Interpret relevant information from selected sources, with growing independence * Combine information to enhance understanding, with growing Independence   Learning Outcome: Learners will use writing and other representations to explore, clarify and reflect upon thoughts and experiences.  Indicators:   * Develop the purpose(s) of specific pieces of writing * Choose the audience(s) for specific pieces of writing * Experiment by using descriptive language and word choice to enhance meaning, with increasing independence * Refine ways to record, organize, and reflect on thinking and learning through writing and representing with increasing Independence | | |
| **Materials Needed:** | | |
| - “Icarus and Daedalus” Greek myth found at <https://greece.mrdonn.org/greekgods/icarus.html>  -Paper and pencil or other software for creating a story | | |
| **Part of the lesson** | **Learning Activity** | **Assessment** |
| Time to Teach!  10 mins | As an introduction and “hook” for this lesson, read aloud the Greek myth of Icarus and Daedalus to the student. You can find this story at <https://greece.mrdonn.org/greekgods/icarus.html>   * Explain that even as far back as ancient times, people looked at birds in the sky and wondered how they could fly, wishing to do the same. * Ask, “what are some ways you think inventors tried to create flying devices?” “What problems do you think they ran into?” | Pre-assessment: We are determining what student already knows about how flight was invented. |
| Time to Discover!  50 mins (Day 1)  Time to Discover! 50 mins (Day 2) | Activity: History Research   * Have the student research about the history of flight on the NASA website: <https://www.grc.nasa.gov/www/k-12/UEET/StudentSite/historyofflight.html> * Have them choose two “inventors” to explore further, writing/voice recording about the contributions they made to the advancement of flight and the problems they ran into.   Activity: How does flight influence our lives?   * With the student, compile a list of how the invention of aircrafts and spacecrafts changed the way people work, live, and interact with the environment. Ex: mail/cargo transportation, travel, space exploration, global trade, war, etc. * Let the student research some more way the invention of flight has impacted the world around us – good and bad. Ex: How has the invention of flight impacted our environment? (fossil fuels being burned). How has the invention of flight impact our accessibility to medical resources? (medical helicopters, fast transport of resources) This global pandemic we are in is a great way to explore the impacts of flight on our lives. How has flight sped up the global transmission of COVID-19? How is flight helping us now? (Quick delivery of medical supplies)   **Day 2**  Activity: Fiction Story   * Have the student write a fiction story on what the world would look like if flight was never invented. They can use the guiding questions above as inspiration for their stories. If writing is a learning barrier for the student, they can use speech-to-text technology or create an audio/video version of their story. * Be sure to include an engaging lead, a descriptive middle, and a satisfying conclusion. * To make this story the best it can be, it would be beneficial to spend some time editing, revising, and proofreading. If they run out of time, this could be done during language arts at-home learning (if allowed by the student’s classroom teacher). | Does the student understand where humans got the idea of flight from?  Does the student understand how the wings of birds influenced the early designs for flying machines?  Pre assessment: What does the student already know about how flight has changed the world?  Does the student understand how flight has impacted our lives, both good and bad? |
| Time to Reflect!  10 mins | * Share your research on the history of flight and your fiction story to a family member. * In your science journal: Describe 2 things in our lives that are impacted by flight and one scientific discovery that helped in the advancement of flight. | Does the student have an understanding on the history of flight and its importance to us? Do they need more practice? |

**Learning Experience 8: Going the Distance (Math)**

60 mins

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| **Introduction:** | | |
| This learning experience is designed to bring the students’ understanding of how all four forces of flight work together to create a paper glider that “goes the distance.” Students will use what they know about the forces to create, test, and improve a paper glider. Incorporating math allows students to view these concepts from a different perspective. Graphing gives students pictorial evidence of how glider design affects traveling distance. By the end of this lesson, students will understand how adjusting a paper glider affects its ability to travel farther by investigating, testing, measuring, and graphing flight distances.  Guiding questions addressed in this learning experience:  ▪ How can the principles of flight be demonstrated/seen?  ▪ How are forces balanced in a flying object?  ▪ How can I test a flying device?  ▪ How can I improve the performance of a flying device?  Background knowledge you should know: How to create a bar graph. The graph should include a title, axis labels, and scale. I have provided a copy of the graph expectations and how to interpret a bar graph for you. It is found in Appendix E.  Preparation for this learning experience: This activity requires measuring the distance paper gliders fly. Since some of them will go quite far, a ruler isn’t practical for measuring distance. A tape measure would be better. If you don’t have a tape measure at home, find something around the house that can be used as a measurement tool. For example, a broom handle makes an excellent measurement tool. “This glider flew the length of 1.5 broom handles”. It is not ideal or exact, but it can work for the purposes of this activity. There is also an online game at the end of this lesson that requires an updated version of adobe flash player. Please download or make sure yours is up to date before starting. | | |
| **Curriculum Outcomes:** | | |
| **Science:**  Learning Outcome: Learners will evaluate factors that influence flight.  Indicators:   * Investigate forces involved in flight. (COM, CT, TF) * Test flying devices. (COM, CI, CT, TF)   **Mathematics:**  Outcome Patterns and Relations 02: Students will be expected to represent and describe patterns and relationships, using graphs and tables. [C, CN, PS, R]  Indicators:   * PR02.01 - translate a pattern to a table of values, and graph the table of values (limited to linear graphs with discrete elements) * PR02.03 - describe, using everyday language, orally or in writing, the relationship shown on a graph. | | |
| **Materials Needed:** | | |
| - Tape measure or something that can be used as a measurement tool.  -paper for gliders  -Graphing Activity Sheet – Appendix D | | |
| **Part of the lesson** | **Learning Activity** | **Assessment** |
| Time to Teach!  5 mins | By now, the students have explored each force independently. They have even had a bit of experience on how lift and weight oppose each other, and how drag and thrust oppose each other. To fully understand flight, they need to explore how they all work together for, level, and extended flight. When do we want the forces to be balanced (cruising) and unbalanced (ascending, descending, speeding up, slowing down)?  As a review of what the students have learned about the forces of flight, and as a “hook” for this lesson, play the song and video found at <https://www.youtube.com/watch?v=_iV65AjEoCM>.   * Ask the students to remind you what the four forces are and how they act on flying objects. | Pre-assessment: We are getting the students thinking about what they know and have learned about the forces of flight. |
| Time to Discover!  45 mins | Activity: Going the distance   * Using what you know about the forces of flight, create a paper glider you think will travel as far as possible. It doesn’t need to be an airplane shape! * You’re going to test the glider, but remember, a fair test includes multiple trials for each test. Test the glider from the same starting point 3 times. Measure and record the distance traveled in your journal for each trial. * How do you think you could make the glider go farther? First, think about weight and lift. How can we adjust these two forces to make the glider travel farther? (remember weight and lift must be equal for sustained flight) Design it, test it 3 times, and write the distance traveled in your journal for each trial. * Think: If we increased the size of the wing to provide more lift, it increases the drag, slowing it down again (How?). Now what do we do? Answer: add more thrust! * Thinking about drag and thrust, how can we adjust these two forces to make the glider travel farther? (remember thrust must be equal to or greater than drag for sustained flight) Design it, test it 3 times, and write the distance traveled in your journal for each trial. * Were you able to find the right proportions of all four forces to create a glider that traveled as far as possible? What other modifications could you make to increase flight distance? Record in your journal. * Find the average distance traveled for all glider designs and record them. Use the graphing sheet provided in appendix D to graph the average distance of each trial/test. Label the graph and axes. Answer the questions provided. If you don’t have access to a printer, please copy the graph into the science notebook. | Does the student understand the connection between weight and lift? Can they demonstrate it on their gliders?  Does the student understand the connection between thrust and drag? Can they demonstrate it on their gliders?  Does the student understand that the proportions of all four forces play a role in successful flight?  Does the student understand how to represent information in a graph?  Can the student describe the relationships shown on the graph? |
| Time to Reflect!  10 mins | Take 10 or 15 minutes to play the Forces of Flight game found at <http://howthingsfly.si.edu/activities/forces-flight>. You will need to think about the proportions of all four forces to create a plane that flies faster, and one that flies higher. What will you need to do if you increase the size of the plane? (bigger engine and wings). Adjust the forces and see what happens. Reflect on what you know about the forces to beat the challenge! | Does the student understand how changing design affects the forces of flight? Do they need more practice? |

**Learning Experience 9: Unit project**

60 mins (or more)

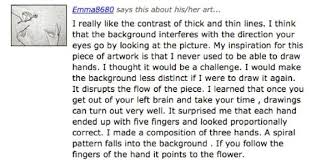
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| **Introduction:** | | |
| This closing learning experience is a choice project designed for students to demonstrate their understanding of the unit. Students are given opportunity to explore at their own pace and demonstrate their understanding in a way that is accessible and meaningful to them. By the end of this lesson, students will demonstrate their understanding of the forces that influence flight through creativity. | | |
| **Curriculum Outcomes:** | | |
| Learning Outcome: Learners will evaluate factors that influence flight.  Indicators:   * Compare the characteristics of flight for living and non-living things. (COM, CT, TF) * Investigate forces involved in flight. (COM, CT, TF) * Test flying devices. (COM, CI, CT, TF) | | |
| **Materials Needed:** | | |
| -Paper -“Flight Choice Board” Handout  -Pencil - Project Self-Assessment Form  -Scissors -Markers/paint/crayons  -glue/tape | | |
| **Part of the lesson** | **Learning Activity** | **Assessment** |
| Time to Teach! | By now, the students should understand the four forces involved in flight and how they influence it. If there is anything the student would like to know more about, now is the time to explore it. There are plenty of online resources available that could help fill any gaps if necessary. If you believe the student it ready, move on to the unit project. |  |
| Time to Discover!  50 mins | Activity: Unit project   * Provide the student with the unit project choice board (Appendix F) and let them pick one project to complete. They may choose something that is not on the choice board if it is informational. * If the student would like a challenge, they could complete more than one task. * Give them time to complete their project. If it takes more than 60 mins, let them finish the next day. You may help but try not to do the work for them. | Is the student engaged and participating in the task? |
| Time to Reflect!  10 mins | Now is time for the final assessment – self-assessment!   * Have the student fill out the self-assessment form in Appendix G. * Now they can share their project with a family member! They are an expert now! Have them walk through the forces of flight that act upon living and non-living things and how they work. | Has the student gained an understanding of essential learnings mandated by the Nova Scotia Curriculum?  Self-assessment: Does the student feel the project they completed was valuable to their learning? |

Appendix A - Example of table to be made in science journal

|  |  |
| --- | --- |
| Weight Added | Distance Flown |
| Ex: One coin |  |
| Ex: Two paper clips |  |
|  |  |
|  |  |
|  |  |
|  |  |

Appendix B – Examples of Artist Statements







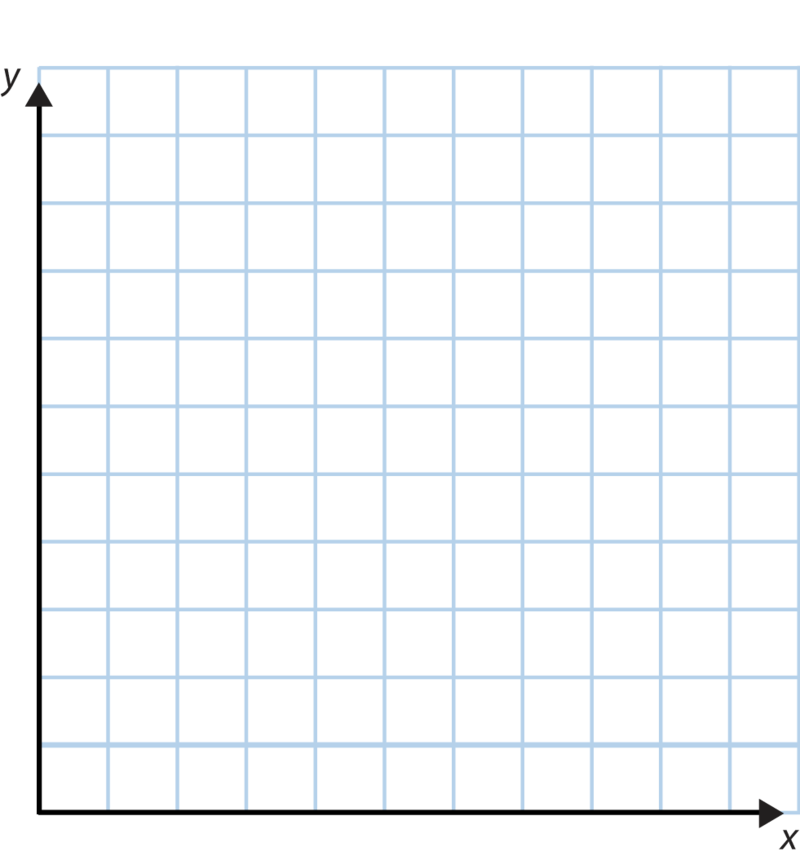
Appendix C – Artist Statement

How to write an Artist Statement

1. I would like to title this piece of art \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. How did you make your art? What tools, materials and techniques did you use? I created this art by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Some things I learned while creating my art were \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
4. My favorite part about this lesson was \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
5. My art was inspired based on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Appendix D- Graphing activity

Use the data from the glider testing activity to create a bar graph for distance traveled by each trial. Be sure to title the graph, title the axes, and include all values and labels.



Questions:

1. Which glider design traveled the farthest?
2. What properties of flight made that glider travel the farthest? What connections between the four forces did you see?
3. How could you improve your glider design further?

Appendix E- Graphing Activity Parent/Guardian Resource

A close up of text on a white background

Description automatically generated

A close up of text on a white background

Description automatically generated

Appendix F – Choice board

Flight Project Choice Board

Directions: Choose at least one task to show me what you learned about Flight. Look through your science journal and vocabulary list to help you think of some ideas! If you choose one of the more complex projects, be sure to take some extra time to complete it.

|  |  |  |
| --- | --- | --- |
| Brochure  Fold a piece of paper into a brochure. Write and draw important information you learned about flight and the four forces that act upon it. | Flash Cards  Make informational flash cards demonstrating the different concepts you learned about flight. You may also include drawings. | Voice Recording/Podcast  Explain flight as if you were teaching it through a podcast. Make sure you are using your own understanding, not something read off a piece of paper. |
| Fiction Story  Write a story with characters and a creative plot. Maybe the characters are the four forces of flight! You may use a graphic organizer to get started. Make sure that your understanding of flight is evident in the plot. | Cartoon/Comic Strip  Draw a cartoon or comic that includes important information about flight. Maybe there is a superhero with flying powers! How does he fly? | Song/Rap  Write a song or rap that demonstrates your understanding of flight. Sometimes it’s fun to make songs and raps rhyme! |
| Concept Web  Think about what you know about flight. Write the key idea (flight) in the middle with at least 4 key points coming off it (the four forces). Include an explanation underneath each one. If you don’t remember how to make a concept web, there are blank ones online! | Informational Poster  Create a poster that you may see on the walls of the school. What do you think people should know about flight? Use your creativity and be specific! | Play  Write and perform a play. You may need to gather some family members for this one! The setting and characters of the play are up to you, but make sure it involves flight and the forces that act upon it. Maybe the characters can be the four forces of flight! |

Note: If you would like to do something other than what is on this choice board, that’s ok too! As long as you create something informational, there is no reason why you can’t do it.

Appendix G – Project Self-Evaluation Form



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