

Fractions and Flight		Grade 5 and 6
<b>Lesson Plan</b>	<b>Coding Tool</b>	TinkerCAD, Scratch
	<b>Time Required</b>	3 periods
<b>Math Curriculum Connections</b>  <b>Algebra: Coding</b> C3. solve problems and create computational representations of mathematical situations using coding concepts and skill  <b>Specific Expectations</b> C3.1 solve problems and create computational representations of mathematical situations by writing and executing code C3.2 read and alter code and describe how changes to the code affect the outcomes  <b>Number: Number Sense</b> B1. Demonstrate an understanding of numbers and make connections to the way numbers are used in everyday life  <b>Specific Expectations</b> C1.3 represent equivalent fractions from halves to twelfths using appropriate tools C1.4 compare and order fractions from halves to twelves in various contexts	<b>Science Curriculum Connections</b>  <b>Flight</b> <ul style="list-style-type: none"> <li>Flight occurs when the characteristics of structures take advantage of certain properties of air</li> </ul> <b>Overall Expectations</b> <ul style="list-style-type: none"> <li>Investigate ways in which flying devices make use of properties of air</li> <li>Explain ways in which properties of air can be applied to the principals of flight and flying devices</li> </ul> <b>Specific Expectations</b> 2.4 use technological problem-solving skills to design, build and test a flying device 3.3 identify and describe the four forces of flight, lift, weight, drag, and thrust 3.4 describe, in qualitative terms, the relationships between the forces of lift, weight, thrust and drag that are required for flight 3.5 describe ways in which the four forces of flight can be altered	
<b>Description</b> Through this set of hands-on and coding activities, students will investigate fractions and forces of flight. In TinkerCAD, students will look at how code can be used to divide a piece into fractions. In Scratch, they will be challenged to code a flappy bird style game that describes movement using the forces of flight.		
<b>Success Criteria</b> <ul style="list-style-type: none"> <li>The Grade 5 and 6 students will be able to create shapes that use fractions using a 3D modelling program</li> <li>The grade 6 students will be able to represent the four forces of flight using code and Scratch</li> </ul>	<b>Materials and Media</b> <ul style="list-style-type: none"> <li>Paper, pencils</li> <li>Ruler</li> <li>Scissors</li> <li>Transparent tape</li> <li>Devices with web access</li> <li>Paper Instructions Handout</li> <li>Fractions Coding Guide</li> <li>Flight Coding Guide</li> </ul>	

## Computational Thinking Skills

This lesson introduces a variety of computational skills using two different platforms; TinkerCAD and Scratch. Both programs are useful computational tools that can be used to express different concepts using code. In the case of TinkerCAD, it will be used to look at fractions using 3D modeling, whereas Scratch will be used to create a game that uses the forces of flight. What these programs have in common is that they will help familiarize students with conditional statements and other control structures. To add efficiency to the code, both programs will also use variables and loops. Conditional statements, variables and loops are some of the key building blocks for coding, so learning these computational skills as part of the two activities will help build student's confidence with code.

There are two Coding Guides associated with this lesson, one for TinkerCAD and one for Scratch. Both of these will provide a more detailed step-by-step procedure of what to do than is described in the action of the lesson.

## Introduction

This lesson starts with an unplugged activity about flying discs to explore both fractions and flight. The preparation of the lesson requires students to organize their material with fractions, while the action of the activity looks at the four forces of flight. These four forces of flight are elements of the lesson that tie into the science curriculum. The four forces of flight are:

- Lift: the upward acting force
- Thrust: the forward acting force
- Drag: the backwards acting force (air resistance)
- Weight: the downward acting force (gravity)

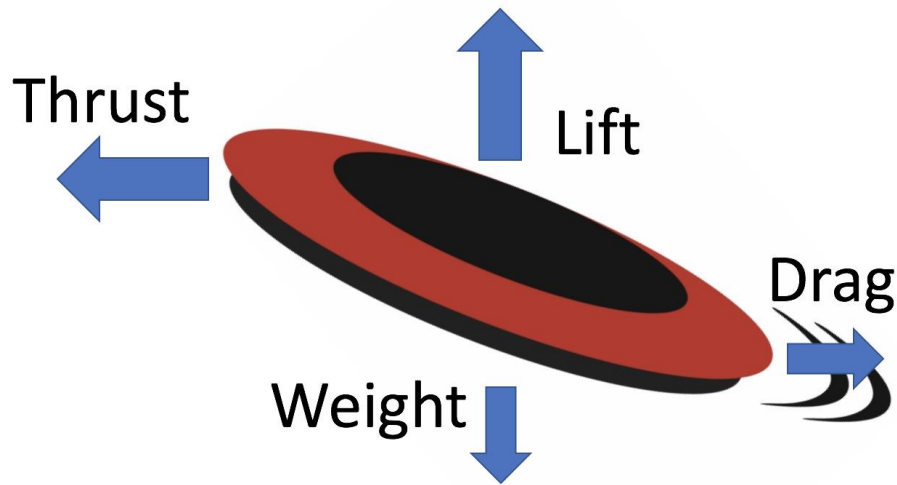
Following the unplugged activity, there are two coding activities, one that relates to fractions and one that relates to flight. In the first coding activity, students will have the opportunity to reinforce and expand on the manipulations of fractions. Students will equally gain a better understanding of transformations by moving shapes about an origin. The second coding activity has students building a playable game that will parallel the forces of flight using code.

## Action

### **Unplugged Activity: Build a flying disc**

This activity has students follow a set of instructions to measure, cut, fold and tape paper into a paper aircraft. The folding and paper cutting provide visual and tactile explorations of fractions. Eight identical squares will be used to fold into a disc. After constructing the disc, students will have the opportunity to toss it to explore and explain the 4 forces of flight. The building guide for this activity is provided in the **Paper Instruction Handout**.

There is the WEIGHT of the aircraft pulling downwards, so there needs to be LIFT to go in the opposite direction. There needs to be a forward force that is called THRUST and the force of the air against the forward motion is called DRAG.

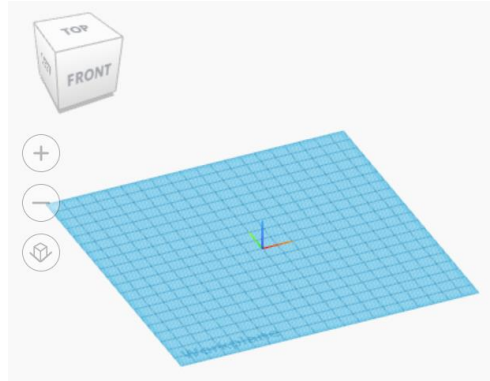


Students should consider these forces in the context of their disc and how they might make changes to compare different conditions. Building paper aircraft can be a great way to experiment with the forces of flight. It allows students to make quick modifications and retest often. Folding and adding layers can change the weight distribution. Throwing at a different angle can cause different lift and drag. There are many things for students to try and to change.

**Note:** Be careful when throwing the paper discs. It is recommended to do this activity in an open space with distance between the students.

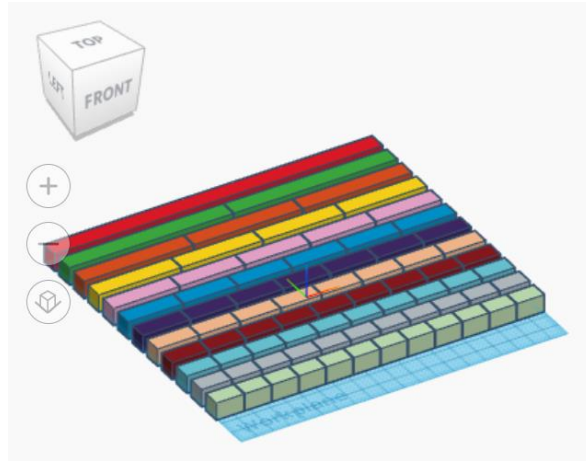
### **Fractions Coding Activity**

To complete the fractions coding activity, students will use the program TinkerCAD, a free online 3D modelling program. Using the 3D design space, students will use block code to create and place shapes in the workplane to represent fractions. An example of an empty workplane with the origin represented in the centre is shown below:



Students will create a shape that spans the length of the workplane. They will then create a set of shapes that still span the length of the plane but in a different number of fractions. Once

they begin to see a pattern emerge, it's possible to introduce variables and loops to make the code more efficient. Students will continue to use their code to divide the width of the workplane with fractions up to 12. An image of the end result, sowing the workplane divided into fractions is shown below. Additionally, a complete guide for coding this project using TinkerCAD is provided with the **Fractions Coding Guide**.



### **Flight Coding Activity**

In the flight coding activity, students will create a game, similar to what is seen in Flappy Bird, in which they will apply the forces of flight to move a bird between obstacles. Students will code the bird to move up and down, which represents lift and weight respectively. The key concept to consider is that if the lift is greater than the weight (gravity), an object will gain altitude, but if the weight is greater than the lift being generated, the object will fall. This equally applies to thrust and drag, with the greater force determining the direction of movement. These four forces are always in action, but it's the one that's strongest that determines the movement.

As part of the coding game, the forces of thrust and drag are assumed based on the movement of the bird relative to the pipes. As a challenge, students could also have their sprite say the prominent force of flight acting on the bird. For complete steps on how to code this game, refer to the **Flight Coding Guide**.

### **Closure and Assessment**

This lesson does not have any obvious assessment of learning pieces that could be used for summative assessment or to assign grades. That said, all three parts of the lesson can be used as a form of assessment for learning, to allow the teacher to monitor students' progress on coding, fractions and science concepts. Use this lesson as an opportunity to see what students know and to determine what next steps can be taken for students in those areas.

<p><b>Adaptations</b></p> <ul style="list-style-type: none"> <li>• This lesson has three very different and unique portions. Extend the length of each part as needed to ensure comprehension depending on the topic.</li> <li>• How the Scratch and TinkerCAD components are taught can be varied for learners. For beginners take a step-by-step approach where as more advanced coders can be challenged to try some of the code by themselves.</li> </ul>	<p><b>Extensions</b></p> <ul style="list-style-type: none"> <li>• As an extension for the fractions coding activity, challenge students to create a 3D model of something symmetrical (building, furniture, etc.). Use this as an opportunity to talk about proportionality and how fractions and size go into the design of many things.</li> <li>• As an extension for the flight coding activity, challenge students to add thrust and drag to their program. Get them to consider how this changes its gameplay.</li> </ul>
<p><b>Additional Resources</b></p> <p>Tinkercad.com (Free account required) The online account is free and only one account should be required (all students can login under same account); however, you may choose to create individual student accounts if desired.</p> <p>Scratch source code: <a href="https://scratch.mit.edu/projects/494730499/">https://scratch.mit.edu/projects/494730499/</a></p>	