AlbertaSat

Forces & Payloads

Topic	Forces, Kinetic Energy, Gravity, Thrust, Mass
Subject	Science, Physics
Grade Level	10-12
Time	70 minutes
Curriculum Alignment	Science 20-B2.4K students will explain how an unbalanced force causes change in motion and apply Newton's first law of motion to explain an object's state of rest or uniform motion ● See also: Physics 20-B1.1k explain that a nonzero net force causes a change in velocity Physics 20-B1.3k apply Newton's second law of motion to explain, qualitatively, the relationships among net force, mass and acceleration ● See also: Physics 20-B1.7k apply Newton's laws of motion to solve, algebraically, linear motion problems in horizontal, vertical and inclined planes near the surface of Earth, ignoring air resistance. Physics 30-A1.2s students will conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information ● perform an experiment to demonstrate the conservation of linear momentum

Hook:	**Notes:**
Show Ex-Alta 1 3D Model Video	https://m.youtube.com/watch?v=Ew2N9OqL-F4

Introduction:	**Notes:**
What is AlbertaSat? ● AlbertaSat is a student group at the University of Alberta that builds CubeSats ● CubeSats are small (like a loaf of bread) satellites made up of standardized cubes. These cubes (known as units) are 10cm x 10cm 10cm	Ex-Alta 1 Deployment: https://www.youtube.com/watch?v=l2sMkNNGVCM

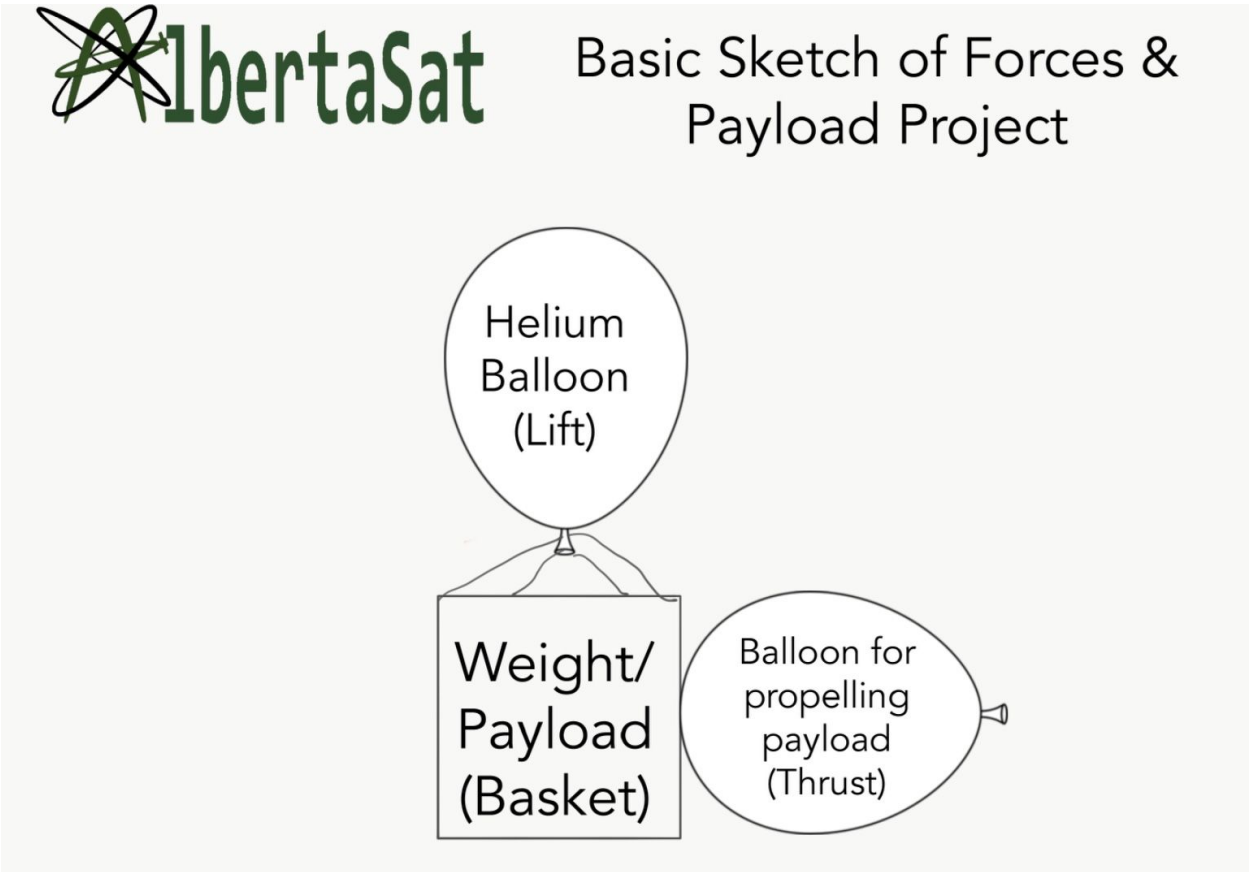
• Ex-Alta 1 (Experimental Albertan 1) is a 3U (3 unit/3 cube) CubeSat. It was the first satellite built by AlbertaSat. • Ex-Alta 1 was built as part of an international project, QB50. This project was lead by the European Space Agency (ESA) to study space weather. • Ex-Alta 1 was launched to the International Space Station (ISS) in April of 2017 and into orbit in May of 2017. • Show Map of QB50 Satellites • Ex-Alta 1 includes the following payloads: MNLP (Langmuir Probes), Dosimeter (studies radiation), Athena On-board Computer, Magnetometer	

Introduction:	**Notes:**
<u>Background Information:</u> • Explain overall activity to students. Students will work in groups of 4-5 lift and propel (move horizontally) a weight (payload) usually balloons. Students must consider the gravitational force, thrust, and the mass of their payload achieve a goal. In this case students must aim to move the payload the furthest horizontally.	

Explanation of Activity	**Notes:**
1. Once they are in groups, hand out the bags of materials for each group. 2. If available, go over the pre-built demo step-by-step with students. 3. First, they will have to create a platform/basket to hold the payload out of styrofoam/foam/aluminium foil/cardstock/or other materials. This will be lifted by the helium balloon. The helium balloon will be handed out to	1. Assume a closed system. 2. The helium balloon will be handed out to students by the presenter. 3. If a force gauge is not available, students can guess and check. 4. When all students are done, have students race in “heats”(4-5 groups at a time). 5. Extension Activity/Potential Assessment: Have students complete a

students by the presenter. 4. Students must then determine the weight of the payload and the basket using a scale. Students will then the weight of their basket/payload they by $9.81 m/s^2$ (acceleration of gravity to get F=mg units N (newtons)). 5. Students must then determine the amount of force needed to lift their payload/basket. Students will use a force gauge to determine how much lift is required. 6. Students must obtain a check before continuing. Students should also decide how far they want their balloon to go (estimation). 7. Attach the propelling system (regular balloon, elastic or glue). This will be used to move the balloon forward. 8. Students can attach their helium balloon to their projects. 9. When called upon, students will race their balloons by filling the propelling system up with air. Remind the students that the size of their balloon will contribute to the overall weight and drag. They need to find a balance between "fuel" and "tank size".	lab report for this project or a write-up explaining their design choices.

Report/Discussion	**Notes:**
1. Students will discuss with their groups how they could have improved, what went well, their results, their predictions vs. How far it went, etc. 2. Student will then complete a self evaluation for the group. 3. We will discuss results as a class.	**Self Evaluation** 1. How far did the balloon travel? How close was your prediction? 2. On a scale on 1-10, how well did your balloon perform? Explain. 3. What would you have done differently?



Materials Required
• Scissors • Popsicle sticks • Straws • Balloons • Cardstock/Foam/Styrofoam/Aluminium Foil for basket • Helium tank • String • Tape • Glue • A weight (a small stone, etc.) • Force gauge and scales