|  |
| --- |
| **Course:** Middle School |
| **Unit:** Flight Level 2 | **exercise:** Straw Rockets | **Time Frame:** 2 - 3 Hours |
|  | Preparation: *Summary of “to do’s” that the teacher should understand and prepare before bringing this lesson to the classroom.* |
| Teachers will need to ensure that the proper supplies are available for students to build their solutions. **Materials*** Straws 7-3/4" pk/200
* Index cards 3x5 pln pk100
* Clay permoplast 1lb asst
* Paper graph econ 8.5x11
* Tape scotch trans .5" wide
* Tape magic tran .5"x800"
* Glue stic cool shot pk15

**Tools*** Ruler safe-t flex 12"/30cm
* Scissors safety point 7"
* Glue gun surebnd cool shot

\*\*Material distribution can affect how the problem is designed and solved. For example, a box of materials can be put out for all to use; a paper bag process where you only get to use what’s in the bag; a shopping trip theory where the designer has a set amount of “money” and they are forced to buy materials and when you run out of money there is no more; do you give more materials for failure solutions or ideas? Etc.\*\***Teacher Methodologies:**1. Define the four major components of a rocket: body-holds everything together, nose-cone – cuts through drag, fins – steer, propellant – provides thrust. A fifth component could be mentioned: a recovery system of some kind (difficult to design in this problem). How does this relate to real rockets?
2. What is compressed air and how does it provide thrust?
3. Decide how the distance will be measured and how many times will the rocket be launched. 3-5 launches provide an averaging aspect to the final calculations. Linear distance versus altitude provides a different problem set.
4. What are the factors that affect the problem? Help students understand how to identify the factors.
5. There is a value to comparing design versus successful flights.
6. Require proper geometric construction of cylinders and cones
7. Air leaking between the nose cone and the body is a big factor in harnessing the compression for thrust.
8. How much time to solve the problem
9. Have student develop the rules and laws
 |
|  | Safety: *Summary of safety strategies in the lesson.* |
| Students will be working with tools as well as sharp objects such as scissors. Never launch straw rockets at people. attack sharp objects to the end of a straw rocket. Projectiles are used in this activity. Clear the launch area before loading pressure into the reservoir and pulling the launch cord. Before launching, clear everybody from the path your straw rocket will probably take. 35-40 PSI is the maximum load for the reservoir. Risk of seal rupture on the pump if any more is applied. Clay nose cones will be blown off and rocket will not fly at pressure approaching 35-40PSI. Do NOT use a compressor plugged into the wall or shop air.Please use this space to describe safety procedures or highlights for this lesson.  |
|  | Desired Results:  |
| Established Goals: |  | Transfer: |
| *Problem Solving Techniques and Applications Standards:*Teachers should use the STEM Academy Standards Correlation System available in the STEM Connections area of a unit to extract specific standards and insert these standards here.  | *Students will be able to independently use their learning to…** Problem solve and construct a rocket.
 |
| Meaning: |
| Understandings*Students will understand that...** Much of engineering design depends on good documentation of the design process
* For an experiment to be valid, it must be designed so that only the independent variable can cause the change in the dependent variable.
* To find the optimum straw rocket, all variables except one independent variable must be controlled, or kept the same during each test.
* In any experiment, students should perform multiple tests on each variable.
* Variables do not have to be numbers
 | Essential Questions*Students will keep considering...** When do we have independent variables? Dependent variables? Controlled variables?
* What engineering careers may involve working with independent and dependent variables?
* How can a rocket be built to exceed in length of flight?
* Which principles of rocket construction contribute most to the flight?
 |
| Acquisition OF KNOWLEDGE AND SKILL: |
| *Students will know...** Aerodynamics and rocketry
* Principles of rocket construction
* Isolating variables
* Methodical approaches to problem solving
* Recording Data
* Engineering design process
* Principles of a variable
 | *Students will be skilled at...** Defining the origin of a problem
* Breaking down a problem, analyzing it, and determining the elements, specific issues within it
* Determining where problems come from
* Analyzing what is needed to solve a problem
* Investigating resources needed to solve a problem
* Working on a team
* Balancing testing with planning and research
* Repurposing old technology
 |
|  | Evidence:  |
| Evaluative Criteria: |  | Assessment Evidence: |
| * Used time wisely
* Completion
* Grading rubric
* 2-5 fins
* Rocket’s body 5-25 cm
* Clay nosecone max diameter of 2cm when rolled into a ball
 | *Performance Task(s):* **Straw Rockets**We need to design and build a straw rocket that travels further than any of our classmate’s rockets. To do this, your team will need to look at the differences certain changes make. Namely, you’ll need to look at nose cone shape and weight, body length, launch angle, fin number, and fin shape. It is important to note the changes that are made and their effects to find the most advantageous design. |
| * Thoughtful, clear, thorough
* Graded on accuracy, multiple choice questions
* Completed on time
 | *Other Evidence:* * Online end of unit test
* Self-reflection
 |
|  | Learning Plan: *Summary of Key Learning Events and Instruction* |
| Pre-Assessment: Defining the Problem Pre Test1. **Introduce**
2. Have students listen as you introduce or review dependent, independent, and control variables. Terms should be used while testing straw rocket.
3. Divide class into groups or 2 or 3.
4. Have students read the problem in the design brief.
5. Have students listen and read along as you review the constraints and write down any additional constraints or specific launching directions.
6. **Brainstorm**
7. Provide materials and have students read through the directions for step 4. They will follow the directions for building and documenting their process.
* Make two straw rockets that are exactly the same except for the nose cone’s weight. Document the design and results.
* Make two straw rockets that are exactly the same except for the body length. Document the design and results.
* Go through all of the possible independent variables, nose cone weight, body length, launch angle, fin number, and fin shape
1. Have students discuss their data with their group and design a rocket that will launch the farthest.
2. **Construct**
3. Students construct their ideal rocket.
4. **Test**
5. Students launch the rocket and record the results.
6. **Communicate Results**
7. Have students discuss the results to create and give a team presentation demonstrating their straw rocket and explaining the design they chose.
8. Set the students to work on the reflection question.

**Extension****Straw Rocket II**1. In your engineering journal or notebook, review the data from the previous activity. Create a design for a rocket to hit the target from a distance determined by your teacher. You will use the launch angle specified by your teacher. You will not be allowed to test your rocket before the official launch.
2. Build the rocket you designed
3. When it is your team’s turn, launch your rocket at the distance and angle specified. Did the rocket hit the target? If not, how far from the target did the rocket land? Record your rocket information in the Rocket Design and Results section under Target 1 on your data sheet.
4. Your teacher will change the distance of the target from the launcher. When it is your team’s turn, launch your rocket at the distance and angle specified. Did the rocket hit the target? If not, how far from the target did the rocket land? Record your rocket information in the Rocket Design and Results section under Target 2 on your data sheet.
5. Repeat this process as many times as your teacher changes the distance. Record your rocket information in the Rocket Design and Results section under Target 3 on your data sheet. If necessary, record the same data for additional launches on the back of your data sheet.
6. On the data sheet, complete the Analysis sections for all the launches.

**Progress Monitoring:**The teacher will need to monitor student progress. Teachers should move throughout the classroom checking to see that students are keeping up with the lesson. After lecturing, the teacher should use students to help move students forward during the activity by sharing their expertise. Teacher may choose to post exemplars of student work for students to use who may have missed the lesson, missed some steps in the process, or may be struggling to keep pace with the class. |
|  | Differentiation: *Summary of Key Differentiation Techniques* |
| Please use this space to insert your differentiation techniques. Depending on the needs of students, various techniques might be needed in a classroom, therefore use the information below and experts in the area needed to design your plan for differentiation.The ASCD Study Guide for Integrating Differentiated Instruction and Understating by Design: Connecting Content and Kids.by Carol Ann Tomlinson, Jay McTigheIntegrating Differentiated Instruction and Understating by Design: Connecting Content and Kids.by Carol Ann Tomlinson, Jay McTigheISBN-13: 978-1416602842 ISBN-10: 1416602844Differentiating Reading Instruction*by Laura Robb.*ISBN13: 9780545022989A Teacher's Guide to Differentiating InstructionThe Center for Comprehensive School Reform and Improvement |
|  | career Connections: *Summary of Career Opportunities Associated with this Lesson* |
| Please use this space to insert careers that might be connected to this lesson. This section will need continuous updating as new careers and emerging technologies change the opportunities available in the workforce.Good sources for career connections:Occupational Outlook Handbook<http://www.bls.gov/ooh>The National Career Clusters® Framework<http://www.careertech.org/career-clusters> |
|  | Keywords: *Please Insert Keywords from this Lesson with their Definitions* |
| Please use this space to insert keywords and their definitionsUse resources like [dictionary.com](http://dictionary.reference.com/) to find definitions to your keywords |