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School/Program: Catholic Charities North - Alternative High School Diploma Program - Hi-SET (formerly GED)

Lesson: Basic Aviation: Balance & Distance Lesson

Science or Education Topics: Science of Mass-Balance in Aeronautics/Work Place Skills and Career Exploration

Engineering Technology Industry Related Field/Activity: A challenge based on an industry specific focus (inquiry, exploration, measurement, teamwork, collaboration, solution)

When taught: March 2016

Abstract: The objective for this introductory lesson is for Hi-SET students to understand how balance is a function of both mass and distance from the center of rotation. The launch for this lesson will be a video taken from "[Learning to Fly: The Wright Brothers Adventure](#)" <http://spacelink.nasa.gov/products>. A Power point lesson providing background information on the Wright Brothers will be presented. Handouts will be distributed.

Learning to Fly: The Wright Brothers' Adventure: This booklet provides students with a fun and challenging adventure in which students are exposed to a lesson in aeronautics. This one lesson touches upon a number of standards in Work Place Skills - Math/Science.

Problem: This problem was faced by the Wright Brothers in 1903. A major concept understood by the Wright Brothers early in their careers is that the first step in any program is research. Research activity was fundamental in solving problems for the Wright Brothers. Thus, before the students undertook the activity "research" on the issue facing the Wright Brothers in 1903 as they moved from glider craft to motorized air craft. Students will use the internet via laptops. By the time we complete the activity, students will be able to understand how the Wright Brothers used balance and distance from the center of rotation to insure a successful controlled flight. With an engine adding to the weight of the aircraft, the Wright Brothers needed to stay near the center of the plane in order to control it, instead of moving further out on the wing to balance the engine, the Wright Brothers made the wing on the engine side 4 inches longer than the pilot's side. The added four inches caused extra lift on that side to counteract the extra weight of the engine and as a result, it kept the wings level even for the 38 seconds of flight.

The educational community along with the Massachusetts Workforce Investment Board has challenged teachers to engage their students in a new way of learning that focuses on solving real world problems through hands on, inquiry based teaching methods. We at CCN accepted the challenge and teamed up with GE Aviation Lynn to expand our students' horizons in approaching problems in math and science more holistically using critical thinking and

collaboration. The Science (S), Technology(T), Engineering (E) and Math (M) - STEM program challenges our students to investigate real-world questions that cover several disciplines by incorporating both math and science technology. Using the powerful tools of inquiry, application, analysis and evaluation skills students will discover these powerful tools really can assist in solving difficult problems.

General Electric – Aviation is the world’s leading producer of large and small jet engines for commercial and military aircraft. GE’s history of powering the world’s aircraft features more than 90 years of innovation. GE – Aviation is globally located. Today, GE Aviation is found on four continents and is in 19 countries. GE Aviation has over 2,000 customers worldwide. GE – Aviation, Lynn, Massachusetts produces jet engines for commercial and military use.

In the beginning, basic inquiry brought our class back 90+ years to examine an aircraft engine used by the Wright Brothers. The Wright Brothers, Wilbur and Orville wanted to be the first to design and build a flying craft that could be controlled while in the air. It was also main found out that there is connection between the Wright Brothers and GE-Aviation. Because GE-Aviation plays a major role in the economic vitality on the North Shore and are interested in aircraft, we wanted to examine a problem that the Wright Brothers dealt with in 1903.

Objectives

Students will break into small groups and be given materials to recreate and explore a particular problem the Wright Brothers encountered when they tried mounting an engine onto the glider craft in 1903. This type of collaborative effort will be used to parallel the type of teamwork that is a common practice in engineering groups. A visual representation of the Wright Brothers 1903 Flying machine will be handed to each small group.

Objectives:

By the end of this lesson the students will be able to:

- Identify use and apply the conversion of standard units to metric units and to understand the relationship of mass and distance in balancing a level surface
- Infer and comprehend the measure of mass (grams) and length (centimeters,, millimeters)
- Research, collect organize, collaborate and present findings to a small group of peers
- Students will explore career opportunities and prerequisites in engineering/technology by utilizing the internet to discover the educational requirements for specific STEM type degrees at colleges and universities that lead to job opportunities in the career of aviation such as at GE –Aviation, Lynn Massachusetts.
- Demonstrate student knowledge through small group discussion of exploration and findings.

Assessment:

- After viewing the video on the Wright Brothers the students will have a better understanding of the history of the Wright Brothers' adventure and will provide background information.
- The students will determine the solution based on a 12 inch ruler and be able to convert these measurements to the metric system.

2 paper clips set at two inches from the center = 5.08 cm or 50.8 mm

4 paper clips set at four inches from the center = 10.16cm or 101.6mm

Since one group of paper clips weighs twice as much as the other group, it should only be half as far from the center. To ensure proper balance, for any distance that 2 paper clips are set, the 4 paper clips must be set half as far from the center.

- The students will work in pairs to explore and understand the concept of distance/mass and balance. After introducing the concept did the students explore and apply math/science concepts.

Engineering/Technology Link

1. Engineering design challenge related to industry

2. Guided inquiry. The instructor provided the question. The students designed the procedure and determine the results.

Open inquiry: The students will investigate career opportunities in aviation, engineering or flight

Two paper clips together represent weight of the pilot and the four paperclips represents the weight of the engine. These paperclips are hooked together. When the ruler is level, the total weight of one set of paperclips times the distance from the center is equal to the total weight of the other set of paperclips times the distance from the center. Since one group weighs twice as much as the other group, it should be only half way. The students will discover that for any distance that two paperclips are set, the four paperclips must be set half as far from the center. When the ruler is level, the total weight of one set of paper clips times the distance from the center is equal to the total weight of the other set of paper clips times their distance from the center. Students will record the standard measure from each group of clips. In addition, they will convert into the standard measure into the metric measurement. Students will break up into small groups and be given the materials to recreate and this problem the Wright Brothers encountered trying to mount an engine onto the glider craft in 1903. This type

of collaborative effort will mirror the type of teamwork that is a common practice in engineering groups.

Standard(s)/Unit Goal(s) to be addressed in this lesson: The students will use the standards of Mathematical Practice – 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Time:

Mass/distance activity: 20-25 minutes

Research career options, educational prerequisites: 30-45 minutes

Company Name & Brief Description: GE – Aviation, Lynn, Riverworks

Overview of the Lesson: After a brief history of the 1903 flight of the Wright Brothers, the students will engage in a new way of learning that focuses on solving real world problems through hands on, inquiry based teaching methods. Increased emphasis will be placed on training students to approach problems in math and science using critical thinking and collaboration. Career opportunities and educational prerequisites will be explored.

Standards: Strand: Geometry & Measurement

– G4 Use simple instruments graduated in familiar units 4.4 Know appropriate scale for familiar measures - 4.4.1

Convert unit of measures in different system 4.1

No common equivalences of measurement units 1.1

Measure with a ruler 4.4

ELA Literacy SL9-10.4 Present information, findings and support evidence clearly and concisely

ELA Literacy WHST.11-12.7 Conduct a project to answer a question or solve a problem demonstrating understanding of the subject under investigation

WHST 9-10 2A Introduce a topic and introduce ideas, concepts, and information to make important connections and distinctions

WHST 9-10 2D Use precise language and domain specific vocabulary

WHST 9-10.6 Use technology to link information.

OC1.1E Express thoughts or opinions about a topic or situation

OC1.2D Summarize orally events from an experience

HS ETS 1-2 Design a solution to a complex real world problem by breaking it down into smaller more manageable problems that can be solved through engineering

Motion and stability forces an interaction PS 2-1 Plan and conduct an investigation to provide evidence of the effects of balance and unbalance forces on the motion of an object

ETS 1-2 Generate and compare multiple possible solution to a problem.

MS-ETS 1-7 Students will develop an understanding of the influence of technology on history

Essential Question: How did the Wright Brothers use balance and distance from the center of rotation to insure a successful controlled flight?

Objectives:

1. Students will understand how balance is a function of mass and distance from the center of rotation.
2. Student will explore career options and their educational prerequisites

Link to Industry:

Through the use of: science, technology, engineering and math. Solutions to problems can be found. (See G.E Aviation Imagination at work handout)

What students should know and be able to do before starting this lesson:

Know how to access the internet web, know how to use a tape measure, know how to convert measurements from standard to metric units, apply balance and math strategies, have the ability to synthesize information and collaborate in small groups

Instructional Materials:

Ball of string, 12 inch rulers, metric measuring rulers (millimeters, centimeter), inches to metric conversion chart, paperclips, Wright Brothers 1903 visual flyer, various visual handouts for small group exploration the metric conversion tables which may be accessed via Google.

Lesson delivery:

Lesson Opening: Power point presentation on the history of flight in 1903. Deciding how balance and mass affect distance. Students will collaborate in small groups to recreate and explore a problem the Wright Brothers encountered. They will break up into small groups and be given materials to recreate and explore a problem the Wright Brothers encountered trying to mount an engine onto the glider craft in 1903. This type of collaborative effort will be used to parallel the type of teamwork that is a common practice in engineering groups. A visual representation of the Wright Brothers 1903

Flying machine will be handed to each small group. This activity will have students understand how balance is a function of both mass and distance from the center of rotation.

During the lesson (activities/labs/challenges):

The students will be given a ruler and string. They will need to decide how to balance paperclips along the ruler using standard measurement and then converting it into metric measurement. The students will take a piece of string and tie it around a 12 inch ruler in the center. They will then hook two paper clips together to represent the pilot and 4 paper clips together to represent the engine. One of the end paper clips on each group will be opened so they can be hung on the ruler. Hook the groups on either side of the center and then slide the paper clips along the ruler until the ruler hangs level. When the ruler is level, the total weight of one set of paper clips times the distance from the center is equal to the total weight of the other set of paper clips times their distance from the center. The students will record the inch reading for each group of clips and convert it to metric measurement using a chart provided on the internet.

Lesson closing:

Since one group weighs twice as much as the other group, it should only be half as far from the center. Check the inch marks to see if this is true. The Wright Brothers needed to stay near the center of the plane in order to control it, so rather than move farther out on the wing to balance the engine, they made the wings of the engine side of the plane 4 inches longer than on the pilot's side. This caused extra lift force on that side to counteract the extra weight of the engine and keep the wings level.

Student Assessment:

Students will determine that 2 paper clips set at two inches from the center=5.08 cm or 50.8 mm or 4 paper clips set at four inches from the center=10.16cm or 101.6mm

Delivery Assessment:

Did the students work cooperatively in small groups?

Did they determine the proper distance and mass?

Were they able to convert standard measurement to metric measurement?

Were they able to access additional resources to help them solve the problem?

Were they able to persevere by using trial and error to come to a solution?

Were they able to explore career opportunities at GE? Elsewhere?

Additional Resources /Attachments

Learning to Fly: The Wright Brothers' Adventure; online NASA link

<http://spacelink.nasa.gov/products>; Wright Brothers 1903 visual flyer, Mass and distance visual center of gravity chart, GE Aviation imagination at work