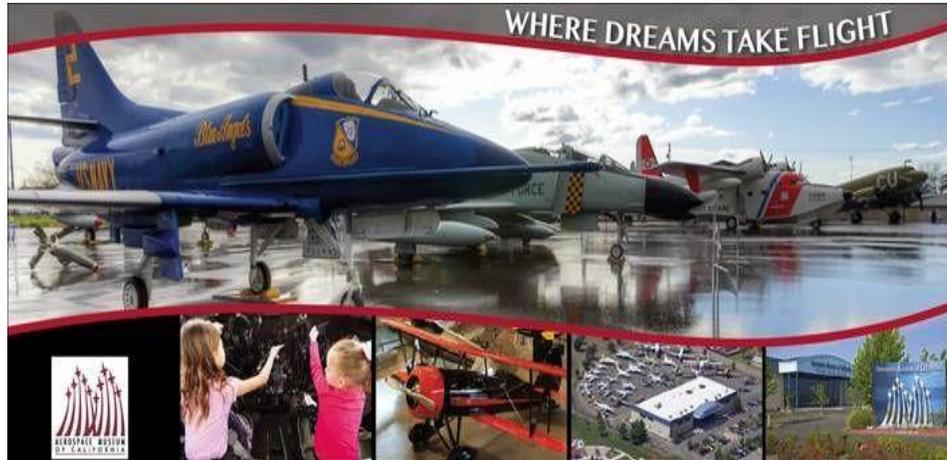


AEROSPACE MUSEUM



Arts Integrated Pilot Lessons

2017-18

Dr. Nancy Andrzejczak

Created in collaboration

With

Student Engagement and Arts and Career Education



GRADE 5

Aerospace Museum-Taking Flight:

Twin Rivers Unified School District

THEME: Engineering design involves the application of scientific knowledge coupled with creativity to solve problems.

BIG IDEAS:

- Flight was made possible through the application of the scientific understanding of aerodynamics.
- Aerospace designers used scientific knowledge and their imagination to create designs of new planes and rockets.
- Writers use their imagination along with their knowledge of the real world to tell stories about places they have never been.

ESSENTIAL QUESTIONS:

- How do planes fly? What principles of aerodynamics do designers need to know?
- How does the design of a plane affect its ability to fly?
- How can a design use the principles of design effectively?
- What would it be like to fly and look down at the world like a bird?

CULTURAL / LINGUISTIC RESPONSIVE STRATEGY:

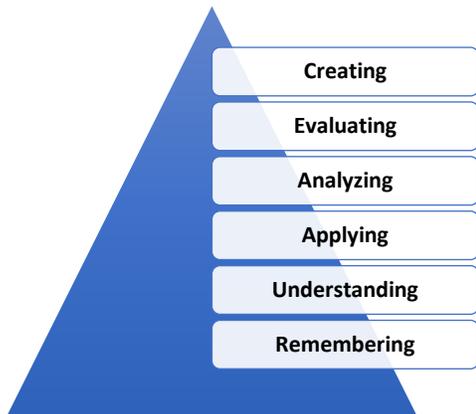
Respect: Students will use respectful listening and collaborative skills as they work together in groups to design and problem-solve their airplane designs

Responsibility: Students will be responsible for their contributions to the group process in researching and designing airplane designs.

Bloom's Taxonomy Chart

The learning activities with this lesson provide multiple opportunities for all levels of Bloom's

taxonomy. There is a particular emphasis on the top three levels.



DEPTH OF KNOWLEDGE (DOK)

The DOK levels are indicated for each lesson in this unit in the student learning goal chart.

SUMMARY:

This series of lessons is designed to provide some foundational knowledge for the field trip to the aerospace museum and then offer some post visit possible extensions for the students. In the **pre-lesson** the students will learn about the basics of flight and how a plane can fly. In the **post lesson**, the students can create their own paper airplanes and experiment with design modifications to test how flight is affected. The students will use data collection and mathematics to record the flights. The classroom can hold a paper airplane Olympics. Another activity is to imagine the paper airplane flying over Sacramento or one of the states. Students will create a work of art and then write a letter home about what they have seen. They can also write a poem about flight.

STANDARDS ADDRESSED:

| Content | Standards |
|---|--|
| <p>Next Generation Science Standards</p> | <p>3-5 ETS Engineering Design</p> <p>2. Generate and compare multiple solution to a problem based on how well each is likely to meet the criteria and constraints of the problem.</p> <p>3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</p> |

| | |
|---|---|
| | <p>5-PS2-1 Motion and Stability: Forces and Interactions Support an argument that gravitational force exerted by Earth on objects is directed down.</p> |
| <p>Common Core-English Language Arts</p> | <p>Language Standards Writing Standards <i>Text Types and Purposes</i> 2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly. d. Use precise language and domain-specific vocabulary to inform about or explain the topic. 3. Write narratives to develop real or imagined experiences or events using effective technique, descriptive details and clear event sequences. d. Use concrete words and phrases and sensory details to convey experiences and events precisely. Speaking and Listening Standards a. Engage effectively in a range of collaborative discussions.</p> |
| <p>History/SS</p> | <p>5.9 Students know the location of the current 50 states and the names of their capitals.</p> |
| <p>National Core Arts Standards</p> | <p>Anchor Standards:</p> |
| <p>Visual Art</p> | <p>1: Generate and conceptualize artistic ideas and work. 2. Organize and develop artistic ideas and work. a. Explore and invent multiple art-making techniques and approaches through practice. b. When making works of art, utilize and care for materials, tools, and equipment in a manner that presents a danger to oneself and others. 3. Interpret intent and meaning in artistic work.</p> |

LESSON OBJECTIVES:

STUDENT LEARNING GOALS with DOK Levels:

| Subject Focus | Informational Knowledge | Skills & Processes Knowledge |
|----------------|---|---|
| Science | <ul style="list-style-type: none"> • Understand and apply the physics principles involved in flight. (Levels 1& 2) | <ul style="list-style-type: none"> • Generate creative solutions to problems (Levels 3 & 4) • Design and redesign modifying based on data collection (Level 4) • Use data to make judgment and form conclusions (Level 4) |
| ELA | <ul style="list-style-type: none"> • Learn domain specific vocabulary. (Level 1) • Understand how to write step by step directions. (Level 2) | <ul style="list-style-type: none"> • Be able to articulate the steps needed to create their paper airplane using precise language. (Levels 2 & 3) • Justify with supportive evidence their design choice using domain vocabulary. (Level 4) • Create and write a narrative using descriptive language and details. (Level 4) |
| VAPA | <ul style="list-style-type: none"> • Overlapping, placement on page and relative size can create the illusion of space. (Level 1 & 2) • The correct application of media. (Level 1) | <ul style="list-style-type: none"> • Design and redesign (Level 4) • Create artwork using mixed media (Level 4) |

PRIOR KNOWLEDGE:

How to care for art materials and use tempera properly.

What do students know about the force of air?

CHECK FOR UNDERSTANDING STRATEGY

- K-W-L
- White Boards – Brainstorm Ideas

PRE-ASSESSMENT: Teacher observation

Find out how many students have ever been in an airplane.

Assess their understanding of how birds and airplanes fly. What holds the plane up in the sky?

LESSON MATERIALS:

Paper (5 sheets per student minimum)

Pencil

Paperclips (10 per student)

For the Plane Course:

Hula Hoop or wire hanger

Blue painters tape

Stop watch

Tape measure.

Mixed Media paper for artwork

Bristle brushes, mixed size

Paper plates (for paint)

Cups for water

Paper towels

Good quality tempera preferably (Crayola Premium) (Magenta, Red, Yellow, White, Turquoise, Blue and Black is all you need)

Newspaper or butcher paper to protect desk from paint

LESSON VOCABULARY:

Drag: Drag is the force pushing against an object; for example, the wind pushes against the airplane.

Lift: Lift is the force the pushes the airplane up in the air.

Gravity: Gravity is the pull of the earth.

Thrust: Thrust is the force that moves an airplane through the air.

Background: Objects or things in that appear to be further back in the artwork; for example, the mountains in a landscape.

Space: Space is a 2D work of art such as a painting is the illusion of depth in the work. In a sculpture or 3D work, it is the areas around parts of the work.

Foreground: The objects or things that appear to be nearest the viewer of a work of art.

Mixed Media: Mixed Media is a work of art that that is made from multiple media.

Design: Design is the arrangement of the elements in a work of art. In engineering, it is the development of concept into actual object or process using science and mathematics.

Hypothesis: A hypothesis is a proposed explanation made on the basis of limited evidence that can be tested.

Conclusion: Conclusion is summary that is based on evidence that either supports or rejects the hypothesis.

LESSON SEQUENCE:

Session 1:

INTRODUCTION: This can be done before your trip to the museum. This way your class will have some pre-knowledge and look brilliant to the docents.

1. Talk about how do planes fly? Why don't they fall down from the sky?
 - a. See resources for various hand-outs on principles of aerodynamics.
 - b. Review the 4 principles and the vocabulary. The principles are shown in the PowerPoint.
 - c. You can show one of these videos:
2. <https://youtu.be/AGzOOM0Pz98> A science film by the British, but very fun and shows different types. Nice references to the physics principles. Recommended.
3. <https://youtu.be/Gg0TXNXgz-w>
4. <https://youtu.be/EabBvyr4qw4> This film is made by a kid for kids, but does hit the science.
5. <https://youtu.be/j3ISnUYW9FA> This film features a teacher and a STEM lesson. He uses the vocabulary and talks about how changes in design affect flight.

6. After talking about flight and seeing other people make paper airplanes, your class should be begging to start. (or making them at home)

Session 2:

Design planes and experiment

1. Assign students in design teams. Challenge the teams to test out different plane designs and find the design that can fly a long distance and another that stays in the air a long time.
2. While developing their team planes, they can experiment with changing the variables of flight—drag, gravity (weight with clips), lift (wing design), and thrust.
3. Collect and record data on the attached data collection sheet.
4. Discuss results in design groups. Each group reports out the planes that flew longest and flew furthest and why they think that design worked well using the physics vocabulary.

Session 3: (optional)

Plane Course or Olympics

1. Create a course that teams have to follow and fly their planes. The course could include a target zone for accurate flying—a taped series of squares within squares with point values. Another target can be a hanging hula hoop or wire hanger stretched to be a diamond. Student's plane has to fly through the target for points. Another station can be place where they send their planes for distance flying. A final station can be a timed flight station for longest flight time.
2. Teams take their planes through the course recording their scores.
3. You can have prizes if you wish or certificate.

Session 4

Writing the steps

If you are working on writing about the sequence of events, you can have the students either write or orally present the steps that are needed to complete one of their airplanes.

Session 5

My Plane's Trip

Please see the PowerPoint for illustrations on how to make this project.

Artwork

To create the illusion of space in an artwork, there are some techniques to use.

1. Relative Size—things in the background are smaller than objects in foreground.
2. Placement on page—things higher up on the paper appear to be further away. For example, the things closest to you are by your feet, further away higher up in your view. (except that fly in your face.)
3. Overlapping—things that are closer can overlap objects further away.

Students will create a mixed media artwork using an image from internet depicting the flight of their airplane.

1. Provide for your students selected images that you or they can print out of monuments or national landmarks.
2. Students can plan how their plane would fly to that landmark by researching its location on the internet. Then as part of their written assignment they can include a map with their “flight plan”.
3. While a variety of media could work for this project, good quality tempera seemed to work well. You could add another layer of interest with oil pastels, but the results with tempera are fine. The difference between different brands of tempera is huge. Good quality tempera like Crayola Premium will be more opaque and easier to handle. Cheap tempera is very thin and doesn't mix well. (You can order Crayola Tempera through Dick Blick, Sax or NASCO and your district should have a discount.) Another tip, use bristle (stiff) brushes not the soft watercolor kind. The watercolor brushes are designed to load

liquid, but with tempera they get too heavy and hard to handle. The brushes designed for tempera will work better and your students will get better results.

4. Steps for the artwork: (See PowerPoint for illustrations and additional tips)
 - a. Cut out the image of the landmark.
 - b. Plan where you are going to put it, but DO NOT glue at this point.
 - c. Paint the background—sky and/or mountains or whatever. Let dry.
 - d. Glue on the object. Then paint the foreground and middle ground filling around and on the object to make it part of the picture.
 - e. When dry, glue on a small folded paper plane onto the picture.

Writing

(include map of US to show flight plan from <http://www.waterproofpaper.com/printable-maps/united-states-maps/printable-map-of-the-united-states-labeled.pdf>)

1. Doing the artwork first is critical. The art is a vital part of the pre-writing experience. You want the students to talk about their paintings and what they think the plane is “seeing”. Bring up front a few students to share about their paintings. Have students describe what they see in the work. Jot down on a word wall or sticky notes for the student the words and phrases that were suggested. Then, you can have kids pair share with each other about their paintings. This will give every child an opportunity for oral rehearsal before they write.
2. If you normally have students use a graphic organizer as part of pre-writing, you can do that as well after the oral rehearsal. Encourage the students to imagine they are the plane, what do they see, hear, smell, etc. as they glide through the sky. Having their artwork in front of them will give them an entry point to this creative activity.
3. Writing assignments can vary based on your classroom needs. The students can write a letter from their plane to them describing what the plane saw. They can write a descriptive narrative. Lastly, they could write a Haiku related to their artwork and the flight.

Extensions or Modifications

Could send plane to someone who photos it. (like the book Flat Stanley)

ASSESSMENT:

Teacher observation

See student rubric and tools in Appendix

ASSESSMENT TOOLS

Individual RUBRIC

RESOURCES: (websites, videos, books, etc)

Resources

Paper Rockets

<http://www.beyondthechalkboard.com/activity/paper-rockets-flying-farther/>

https://www.nasa.gov/pdf/153413main_Rockets_3_2_1_Puff.pdf

<https://www.sciencebuddies.org/blog/2015/11/paper-rocket-aerodynamics.php>

https://er.isc.nasa.gov/seh/Paper_Rockets.pdf

http://www.primaryscience.ie/media/pdfs/col/dpsm_paper_rocket.pdf

Paper Airplanes

<https://www.sciencebuddies.org/science-activities/paper-airplanes-aerodynamics?from=Blog>

<https://www.origamiway.com/paper-airplanes.shtml>

<http://www.paperairplanes.co.uk/index.php>

<http://paperairplaneshq.com/>

<https://www.grc.nasa.gov/www/k-12/aerosim/LessonHS97/paperairplaneac.html>

<https://www.grc.nasa.gov/www/k-12/airplane/foil3.html>

<https://www.grc.nasa.gov/www/k-12/airplane/foilsime.html> computer program to let students experiment with wing design. This one is for elementary students.

<http://www.paperplane.org/education.html>

<https://www.grc.nasa.gov/www/k-12/aerosim/LessonHS97/HomePage.html>

Nasa site with several resources for paper airplanes and flight.

<https://www.grc.nasa.gov/www/k->

[12/Summer_Training/Elementary97/Lesson9_ForceAirPlane.HTML](https://www.grc.nasa.gov/www/k-12/Summer_Training/Elementary97/Lesson9_ForceAirPlane.HTML)

https://howthingsfly.si.edu/sites/all/themes/htf/pdf/paper_airplane/NASM_paper_plane_printout_b1p3i5.pdf

<http://www.ymca.net/sites/default/files/health-kids->

[day/2017%20HKD%20Principles%20of%20Flight%20Challenge.pdf](http://www.ymca.net/sites/default/files/health-kids-day/2017%20HKD%20Principles%20of%20Flight%20Challenge.pdf)

<http://www.funpaperairplanes.com/> This one has downloads for patterns

<http://www.brunswick.k12.me.us/smccormack/files/2012/08/wht-makes-a-paper-airplane-fly.pdf>

<https://paperplanemafia.com/how-do-paper-airplanes-fly/>

<https://paperplanemafia.com/history-of-paper-airplanes/>

<https://www.grc.nasa.gov/www/k-12/airplane/glidpaper.html>

Careers in Aerospace Technology

<https://www.nasa.gov/centers/langley/news/factsheets/FS-2001-09-68-LaRC.html>

[https://www.aiaa.org/uploadedFiles/Education and Careers/STEM K-12 Outreach/Careers in Aerospace/Careers-in-Aerospace-2010.pdf](https://www.aiaa.org/uploadedFiles/Education%20and%20Careers/STEM%20K-12%20Outreach/Careers%20in%20Aerospace/Careers-in-Aerospace-2010.pdf)

Appendix: Worksheets, graphic organizers, etc.

Name: _____

Student Check List for Letter from My Plane Project

| | |
|---|--|
| | |
| I feel my painting was successful. | |
| I created the illusion of space because I have a background and a foreground. | |
| I made things in the background smaller so they look farther away. I overlapped objects to give the illusion of space in my picture. | |
| I was able to make my landmark fit into the painting. | |
| I made my flight plan on the map of the United States showing a path from Sacramento to the landmark. | |
| I wrote my letter from the airplane. My letter included specific descriptive details. I included sensory details. I used at least two of the aerospace vocabulary words (drag, gravity, thrust, lift) in my story. | |
| My writing is strongly related to my artwork. | |

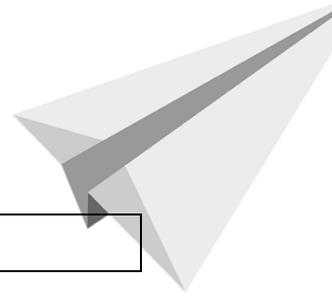
The best part of my artwork is and explain why:

I feel my writing is successful because? And why?

Rubric for Student Artwork and Writing Assignment

| | Below | Approaching | Proficient | Exemplary |
|---------|---|---|--|--|
| Artwork | The student did not use a landmark with the painting or showed no integration into the landscape. The student was not able to mix colors to make the landscape-only used the colors from the bottles. The student did not create an illusion of space in the artwork. The student did not include a small paper airplane. | The student used a landmark with the painting and attempted integrated it into the landscape. The student was able to mix some secondary colors to make the landscape. The student attempted to create an illusion of space in the artwork using one of the techniques. Student included a small paper airplane. | The student used a landmark with the painting and successfully integrated it into the landscape. The student was able to mix colors to make the landscape. Student created an illusion of space in the artwork using one or more of the techniques. Student included a small paper airplane. | The student used a landmark with the painting and showed innovation in how it was integrated it into the landscape. The student was able to mix numerous colors to make the landscape. Student created a strong illusion of space in the artwork using all of the techniques. Student included a small paper airplane. |
| Writing | The student doesn't use clear language and is unable to use domain-specific vocabulary correctly. The student struggles to create an imagined experiences or events. The student uses few or no descriptive details and event sequences. The student does not use concrete words and phrases and sensory details to convey experiences and events. | The student uses fairly clear language. The student uses domain-specific vocabulary with few errors in meaning. The student creates an imagined experiences or events using some descriptive details and limited event sequences. The student has limited use concrete words and phrases and uses only a few sensory details to convey experiences and events. | The student uses clear language and domain-specific vocabulary. The student creates an imagined experiences or events using descriptive details and event sequences. The student uses concrete words and phrases and sensory details to convey experiences and events. | The student uses clear language and domain-specific vocabulary demonstrating an in-depth understanding of words. The student creates an imagined experiences or events using multiple descriptive details and event sequences. The student uses concrete words and phrases and multiple sensory details to convey experiences and events. Student word choices are imaginative and create a mental image. |

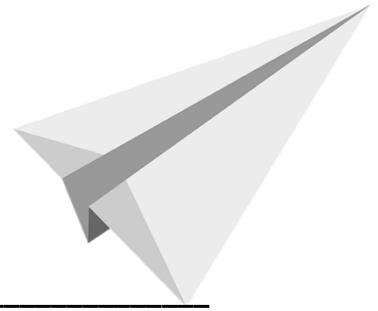
Name:



| |
|------------------------------|
| The Physics of Flight |
|------------------------------|

Illustrate the definition for the following terms

| | |
|---------------|-----------------------|
| Drag | Weight/gravity |
| Thrust | Lift |



Team Name: _____

Team
Members: _____

Airplane Design Trials: The goal is to pick the best plane design for the course. Teams will compete with other teams.

Data Collection: Do each activity twice. Record the distance or time in each box. The team will pick the best plane design for each activity for the team competition.

| Team Member | Going for the distance | | Hang time | | Bullseye- hit target | | Through the hoop | |
|-------------|------------------------|-----|-----------|-----|----------------------|-----|------------------|-----|
| | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| 1. | | | | | | | | |
| 2. | | | | | | | | |
| 3. | | | | | | | | |
| 4. | | | | | | | | |



Airplane Olympics

Record the names of the teams. Each team will enter one plane for each activity to represent their team.

Data Collection: Do each activity twice. Record the distance or time in each box. The team will pick the best plane design for each activity for the team competition.

| Team Name | Going for the distance | | Hang time | | Bullseye- hit target | | Through the hoop | |
|-----------|------------------------|-----|-----------|-----|----------------------|-----|------------------|-----|
| | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| 1. | | | | | | | | |
| 2. | | | | | | | | |
| 3. | | | | | | | | |
| 4. | | | | | | | | |

| Team Name | Going for the distance | | Hang time | | Bullseye- hit target | | Through the hoop | |
|-----------|------------------------|-----|-----------|-----|----------------------|-----|------------------|-----|
| | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| 5. | | | | | | | | |
| 6. | | | | | | | | |
| 7. | | | | | | | | |
| 8. | | | | | | | | |

Have a great day!!