

PLTW GTT FS Science Frameworks

PLTW Course: GTT Flight and Space

Science Strand being addressed: The Nature of Science and Engineering

Science Sub-strand being addressed: Interactions Among Science, Technology, Engineering, Mathematics and Society

Overview:

Science Standard and Benchmarks: 8.1.3.3.3

Science Standard 8.1.3.3: Science and engineering operate in the context of society and both influence and are influenced by this context.

Benchmark 8.1.3.3.3: Provide examples of how advances in technology have impacted the ways in which people live, work and interact.

Correlation to AAAS Atlas:

MN 8.1.3.3 = AAAS 3A/M2

Essential Understandings/Big Ideas:

The study of aerospace engineering would not be complete without a basic understanding of the history of aerospace. The history of aerospace studies has influenced how people meet the challenges of traveling through the atmosphere or in space. Students are introduced to the history of flight through hands-on activities, research, and a presentation in the form of an infomercial.

Engineering designs in aerospace exploration evolve as they are developed. The aerospace industry uses engineers who specialize in many different types of engineering careers. By having the entire class experience the flight characteristics of various vehicles, explore the differences between aircraft and rockets, research their respective histories, and view each other's infomercial productions, each student will gain a greater understanding of the evolution of flight. Different types of vehicles studied and constructed by each class will result in each student getting a good cross section of information about flight and space.

What should students know and be able to do [at a mastery level] related to these benchmarks?

- Apply their knowledge of research techniques to investigate the history of an aerospace vehicle.
- Experience the flight characteristics of kites, whirly gigs, model airplanes, hot air balloons, and model rockets.
- Utilize language arts skills to write a script and create a storyboard for an infomercial promotion of an aerospace vehicle.

Misconceptions:

Student Misconceptions

Many students think that the space shuttle can go to the moon. Some even think people have been to Mars. These misconceptions are often the result of watching science fiction movies or television programs that look real to students.

Teacher Resources:

Flying Machines

- Experience the flight characteristics of kites, whirly gigs, model airplanes, hot air balloons, and model rockets.
 - Aeronautics is the science and art of flying through the air. It refers to all aspects of flight in the atmosphere, from design and manufacturing to operation and maintenance of aircraft and spacecraft. To design an air or spacecraft, engineers must understand the elements of aerodynamics, propulsion, materials and structures, and stability and control. In this unit your students will be exposed to all of these elements as they discover the science of flying, design and test propulsion systems, use simulations to create airfoils to test in a wind tunnel, and then use their knowledge to design, build, and test an airfoil
- The vehicles (i.e., kites, hot air balloons, rockets) may be purchased from commercial suppliers such as Pitsco or Kelvin.
- The safety rules associated with each vehicle must be covered with the entire class to ensure that all students understand the proper use.
- Parent helpers may be needed in order to conduct flight tests in a crowded area. Care should be taken to provide safe landing areas for model rockets. Students should not attempt to catch vehicles as they land. Safety glasses must be worn.

- Teachers may consider asking a local R/C Airplane club to demonstrate the flight of a helicopter instead of using the whirly gig simulation.
- Hot air balloons can be very flammable. Be certain to follow the directions that came with the kit and have a fire extinguisher available. Student must be closely supervised for all flight-testing.

Aerospace Infomercial

- Apply their knowledge of research techniques to investigate the history of an aerospace vehicle and utilize language arts skills to write a script and create a storyboard for an infomercial promotion of an aerospace vehicle
 - In this lesson students will be introduced to the history of flight through hands-on activities, research, and a presentation in the form of an infomercial. By having the entire class experience the flight characteristics of various vehicles, explore the differences between aircraft and rockets, research their respective histories, and view each other's infomercial productions, each student will gain a greater understanding of the evolution of flight.

Storyboards should be made for students to use to organize their thoughts before taping. If you are unfamiliar with storyboards, the website below will provide background information.

<http://accad.osu.edu/womenandtech/Storyboard%20Resource/>

Simple video editing software, such as Windows MovieMaker or iMovie, is easy to learn and provide an additional communications technology component to the commercial production. An excellent resource for learning MovieMaker is:
<http://cuip.net/~bbird/introkids.htm>

Students often confuse the words *tape* and *film*.

Technically, tape records information magnetically and film records an image photographically.

Students should know that they will *tape* a commercial, not *film* one.

Appropriate costumes might be used during the taping of the commercial.

The teacher should check for compliance with the school dress code.

(Optional) A simulated radio broadcast can be made instead of a video commercial. Students can use audio recording equipment to record a commercial or public service announcement (PSA).

Note: In either case, if students choose to add music to a video or audio recording, copyright restrictions should be followed.

A website for free music is:
<http://live.freeplaymusic.com/#downloads>

Make sure you read and follow their agreement:

<http://live.freeplaymusic.com/#licensing>

Additional Instructional Resources

- Flight and Space PowerPoint; Google Docs GTT Resources / Flight and Space
- Historical Developments PowerPoint; Google Docs GTT Resources / Flight and Space

Science of Flight

The DVD entitled *The Science of Flight: The Spirit of Innovation* may be purchased for \$59.95 from this website:

<http://store.discoveryeducation.com/product/search?Grade=&Brand=&terms=An+Era+of+Innovation>

What is it that students struggle with the most and how can the teacher most effectively help students learn the concepts?

Some students lack skills necessary to understand scientific inquiry. Having them work on real world problems, collect and examine data, and draw their own conclusion will help.

New Vocabulary

Aerodynamics	The study of forces and the resulting motion of objects through the air.
Aeronautics	The study or practice of travel through the air.
Aerospace	Branch of technology and industry concerned with aviation and space flight.
Aerospace Engineer	Design machines that fly.
Airplane	A powered heavier-than-air aircraft with fixed wings from which the aircraft derives most of its lift.
Airship	A power-driven aircraft kept buoyant by a body of gas (usually helium) which is lighter than air.
Astronautics	The art and science of designing, building, and operating manned or unmanned space objects.
Drones	Robotic aircraft, used extensively by the military.
Helicopter	A type of aircraft deriving both lift and propulsion from one or two sets of horizontally revolving rotors.
Hot Air Balloon	A large bag filled with hot air or gas to make it rise in the air, with a basket for passengers hanging from it.
Infomercial	An advertising film which promotes a product in an informative and supposedly objective style.
Jingle	A short, easily-remembered slogan, verse, or tune.
Launch	To set or thrust in motion.

Rocket	A vehicle, missile, or aircraft which obtains thrust by the reaction to the ejection of fast moving exhaust from within a rocket engine.
Sailplane	A glider designed for sustained flight.
Script	The written text of a play, film, or broadcast.
Seaplane	An aircraft with floats or skis instead of wheels, designed to land on and take off from water.
Slogan	A short, memorable phrase used in advertising or associated with a political party or group.
Space Shuttle	A rocket-launched spacecraft able to land like an unpowered aircraft, used for journeys between earth and craft orbiting the earth.
Storyboard	A sequence of drawings representing the shots planned for a film or television production.
Unmanned Aerospace Vehicle (UAV)	A powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload

Vignette:

Students in the GTT class are designing aerospace vehicles to be tested and used in their infomercial.

Teacher: Have you ever been in an airplane?

Student: Yes. I flew in one to Mexico last winter when we took our family vacation.

Teacher: Have you flown one?

Student: No, I'm not old enough to do that.

Teacher: Have you ever wondered what it would be like?

Student: It would be scary. Especially if the engines stopped working!

Teacher: The Wright Brothers spent a lot of time learning about flight and what it would take to make a plane fly. Now it's your turn to begin to understand what it feels like to be a pilot. Flying a simulated aerospace vehicle will be an exciting challenge. In this activity you will build a model of an aerospace vehicle that you will safely fly or launch.

Student: Can I make any type of vehicle I want?

Teacher: You can construct and flight-test an aerospace vehicle from the following:

- Kites
- Hot air balloons

- Helicopters (simulated)
- Hovercraft
- Model glider or rubber band powered airplane
- Compressed air rocket

Student: Can I use any materials?

Teacher: No. We need to remember that engineers must work within constraints and theirs are the materials below.

- Construction paper
- Tissue paper
- Balsawood
- Markers
- Glue
- Straws
- Tape
- String
- Recyclable materials
- Rubber bands

You may need additional supplies for specific vehicles. See your teacher.

Student: How will I use this for my infomercial?

Teacher: Your flight test will be recorded with our digital cameras.

Over the next weeks during GTT labs, students construct and test their aerospace vehicles.

Teacher: What challenges did the pioneers of aerospace face when designing and building a vehicle similar to yours?

Student: They did not have materials like ours.

Teacher: If given more time, what could have been changed on your vehicle to improve its performance?

Student: I would have made the wing span of my glider bigger so it would have flown farther.

Teacher: Were the materials used in your vehicle available when it was first invented years ago?

Student: I don't think glue I used on my rocket was around then. Perhaps they used rope to hold things together instead of glue.

Teacher: Most of the advancements in aerospace history have taken place in the past 100 years. How do you think this activity might be different 100 years from now?

Student: We could build aerospace vehicles that we could actually fly in 100 years from now!

Assessment:

Assessment Methods

Elements	Weight	5 Points	4 Points	3 Points	2 Points	1-0 Points	Total
Background Research		Answers to all seven questions and other important facts.	Five or more of the important questions are answered.	Three or more of the important questions are answered.	Only one of the important questions is answered.	None of the important questions are discussed in the infomercial.	
Aerospace History Flight Test		The aerospace vehicle is assembled accurately and safely. Flight-testing is conducted safely and videotaped.	The aerospace vehicle is assembled accurately and safely. Flight-testing is conducted safely but is not videotaped.	The aerospace vehicle is assembled and modified as necessary. Flight testing is conducted. Safety rules are not considered.	The aerospace vehicle is incompletely assembled. Flight-testing is conducted but is not successful.	The aerospace vehicle is unfinished. Flight-testing is not conducted.	
Content		The information included is accurate and completely addresses each component of the assigned topic.	The information included adequately addresses each component of the assigned topic.	The information included inadequately addresses the assigned topic. The information included is sometimes inaccurate.	The information included does not address the assigned topic.	There is no evidence of accurate content information.	
Aerospace Infomercial Storyboard		The storyboard accurately depicts the completed script, characters, time between frames, and camera location.	The storyboard contains 90% of the required information.	The storyboard contains 70% of the required information.	The storyboard is incomplete, lacking more than 50% of the required information.	The storyboard contains little to none of the required information.	

Aerospace Infomercial Production		The infomercial video is engaging and follows the organization outlined in the storyboard. The total length falls within the appropriate range of 2 to 3 minutes.	The infomercial video is complete and follows the organization outlined in the storyboard. The total length extends beyond the 3-minute limit.	The infomercial video is complete and generally follows the organization outlined in the storyboard. The total length does not meet the minimum 2-minute requirement.	The infomercial video is missing necessary components and does not follow the organization outlined in the storyboard. The total length does not fall within the appropriate range of 2 to 3 minutes.	The infomercial contains little to none of the necessary components.	
Aerospace Vehicle Historical to Futuristic Comparison		Infomercial clearly compares student's view of historical and futuristic uses and design of aerospace vehicle.	Infomercial somewhat compares student's view of historical and futuristic uses and design of aerospace vehicle.	Infomercial starts to compare student's view of historical and futuristic uses and design of aerospace vehicle.	Infomercial does not clearly compare student's view of historical and futuristic uses and design of aerospace vehicle.	Infomercial does not compare student's view of historical and futuristic uses and design of aerospace vehicle.	
Slogan		The slogan is easy to identify and memorable. The slogan is included in the infomercial 2 to 3 times.	The slogan is easy to identify and memorable, but it is not repeated in the infomercial.	A slogan is included in the infomercial, but the wording appears to change. More than one slogan appears to be present in the infomercial.	A slogan is included in the infomercial, but it does not convey the intended message.	The slogan is not included in the infomercial.	
Jingle		The jingle is easy to identify and memorable. The jingle shares an important fact about the product.	The jingle is easy to identify and memorable. The jingle shares a marginally important fact about the	A jingle is included in the infomercial, but it does not share an important fact about the product.	A jingle is included in the infomercial, but it is difficult to understand.	The jingle is not included in the infomercial.	

			product.				
Quality of Work		The work performed is of the highest quality, demonstrating exceptional content knowledge and outstanding effort.	The work performed is adequate, demonstrating a competent level of content knowledge and a strong effort.	The work performed is in need of improvement, as content knowledge appears weak while effort is adequate.	The work performed is in need of improvement, as content knowledge appears weak and effort is lacking.	There is little to no evidence that work was conducted or that content knowledge was enhanced.	
Grammar		Punctuation, grammar, usage, and spelling are effectively used throughout the report.	Minor errors in punctuation, grammar, usage, and spelling are evident, but they do not interfere with the readability of the report.	Occasional errors in punctuation, grammar, usage, and spelling are evident and interfere with the readability of the report.	Major errors in punctuation, grammar, usage, and/or spelling interfere with the readability of the report.	The report contains significant errors in punctuation, grammar, usage, and spelling.	
Informational Slides		The infomercial slides possess the necessary information, are well designed, and appear long enough to be viewed and read.	The infomercial slides possess the necessary information but may be difficult to read due to design and/or timing issues.	The infomercial slides do not possess all of the necessary information. They may be difficult to read due to design and/or timing issues.	The infomercial slides possess less than 50% of the necessary information. They are difficult to read due to design and/or timing issues.	The infomercial contains little to no evidence of informational slides.	
Transitions and Effects		Transitions and effects are appropriate and well timed. They are not distracting to the overall composition of the infomercial.	90% of transitions and effects are appropriate and well timed. They are not distracting to the overall composition of the infomercial.	Some transitions and effects are appropriate and well timed, but others are distracting to the overall composition of the infomercial.	Transitions and effects are not appropriately placed in the infomercial. Their use is distracting to the overall composition of the infomercial.	The infomercial contains little to no evidence of appropriate transitions and effects.	

Differentiation:

Gifted and Talented

- These students can increase the complexity of their video project or model design.

Special Education

- Students on an IEP and those who struggle could have extra handouts and related materials (computer simulations, videos and Internet links) made available to them.

English Language Learners

- Much of the vocabulary used in this area can be difficult for the ELL student. Using pictures that are shown in build sheets could help. Completed examples of the design process would be of assistance to the ELL students.
- This information would have to be reinforced through the help of the ELL teacher

Parents and Administration:

Administrative/Peer Classroom Observation

Students Are:	Teachers Are:
Developing a production	Questioning students
Documenting problems	Monitoring progress
Adjusting and making changes	Reinforcing success
Testing and Evaluating	Redirecting problems

Professional Learning Communities:

Reflection – Critical Questions regarding the teaching and learning of these benchmarks:

- In what areas did students perform best and what weaknesses are evident?
- How can this content be connected to other benchmarks in learning?
- Do students see the connection between flight and their production?
- Are students interpreting information correctly?
- What areas did students perform best and what weaknesses?

Materials – suggested articles and books for book study with PLC's:

Four forces of flight

Parent Resources:

- <http://www.cartoonstudio.co.uk/Pages/EngineeringAndTechnologyMap.html>
- <http://wright.nasa.gov/airplane/tunnlint.html>
- <http://www.grc.nasa.gov/WWW/K-12/airplane/foil2.html>

References:

- Project Lead the Way, Gateway To Technology, Flight and Space course curriculum
- Minnesota Academic Standards - Science K - 12 2009 version
- [AAAS Benchmarks](#)
- <http://www.project2061.org/publications/bsl/online/index.php?home=true>
- [NASA](#)
- <https://www.nasa.gov/>