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| **Course:** Middle School |
| **Unit:** Flight Level 3 | **exercise:** Hot-Air Balloon | **Time Frame:** 1 - 2 Hours |
|  | Preparation: *Summary of “to do’s” that the teacher should understand and prepare before bringing this lesson to the classroom.* |
| 1. Develop teacher checkpoints throughout the planning and construction phases of this activity.
2. Decide what to do with the product when it is finished. Who gets it?
3. This activity works best in conjunction with another activity, such as a celebration or the beginning of something exciting. Some people may criticize this activity as “fluff or butterfly lessons”. But it is an excellent team-building, direction-following, and success-versus-failure processing activity.
4. Choose a location to launch the balloons. You can launch outside in calm winds. If you launch inside (i.e., in a gym), watch out for ceiling fans
5. Rubber cement works better than glue sticks for this activity, because it has less mass.
6. Do not use heavy tapes, such as duct tape, masking tape.

Teachers will need to ensure that the proper supplies are available for students to build their solutions. From the kit you will need these items:**Materials:*** Copy paper
* Tissue paper
* Clear tape
* Glue sticks
* Paper clips

**Tools:*** Ruler
* Pencil
* Scissors
* Gore pattern
* Hot air popper with top removed (3 Phillips screws)
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|  | Safety: *Summary of safety strategies in the lesson.* |
| Scissors are used in this lab, use caution. The hot air popper can get hot in the center, no combustibles should touch it. |
|  | 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…** Design and construct a balloon that can hold as much payload as possible while still maintaining the capability to fly.
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| Meaning: |
| Understandings*Students will understand that...** Gas density affects the flight of balloons
* Hot air travels faster than cold air
* Hot air balloons need to be piloted
* Oxygen levels are decreased at higher altitudes
* Wind and weather play a role in piloting a hot-air balloon
 | Essential Questions*Students will keep considering...** What gases allow bags or canopies to float?
* How might wind and weather affect the flight of a hot air balloon?
* How is buoyancy created? Why do we need to know how the force works?
* What are factors that affect a hot-air balloon’s lift?
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| Acquisition OF KNOWLEDGE AND SKILL: |
| *Students will know...** The principle of buoyancy (Archimedes’ principle)
* Density and its properties
* How a lighter-than-air vehicle works
* Rigid airships and how they are built
* Blimps and how they are built
* The difference between dirigible and free floating
* The three essential parts to a hot air balloon and their purpose
* Air pressure + gravity=buoyancy
* Ideal gas law (PV=nRT)
 | *Students will be skilled at...** Manipulating mass and lift
* Transferring points to a template
* Working together with a partner
* Following directions
* Adhering to safety restrictions
* Communicating with evaluator
* Interpreting measuring directions

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|  | Evidence:  |
| Evaluative Criteria: |  | Assessment Evidence: |
| * Effort/Commitment
* Self-motivated
* Followed criterion
* Appearance
* Creativity
* Time management
* Template construction and transfer
* Team work
* Following directions
* Completion
 | *Performance Task(s):* **Hot Air Balloon**Students will work in pairs to design and construct a balloon that can hold as much payload as possible while still maintaining the capability to fly. At the end of the activity, students will write a formal report that self-reflects on their work and progress during the project. |
| * Thoughtful, clear, thorough
* Correct answers
 | *Other Evidence:* * Formal report/self-assessment
* End-of-unit quiz
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|  | Learning Plan: *Summary of Key Learning Events and Instruction* |
| **Pre-Assessment:** Lighter Than Air Vehicles Pre-test**Activity: Make a Hot Air Balloon**Refer to design brief for detailed instructions1. **Introduce**
2. Have students read the first page of the Design Brief.
3. Summarize the activity’s main points and explain how they will collect data.
4. Assign partners
5. Hand out the necessary materials: Copy paper, tissue paper, clear tape, glue sticks, paper clips, ruler, pencil, scissors, gore paper, hot air popper with top removed, 3 screws
6. Have groups read along and listen to the directions as you discuss each step to construct the balloon. Optional: If you have very independent learners, you can have their groups read the directions and discuss it with their partners and move ahead independently.
7. Students will construct the balloon and weigh the balloon. Students should write this mass on their design brief.
8. **Brainstorm**
9. Students will write down possible payloads on their design brief.
10. Have them listen to and write down rules and constraints.
11. Students should discuss with their partners and write down possible solutions on their design brief.
12. After they discuss and determine a payload for their balloon, they should sketch it. Check each group’s payload to make sure it is appropriate for the tasks.
13. **Construct**
14. Students will attach their payloads
15. **Test**
16. Take off the top of the hot air popcorn popper by removing three screws.
17. If weather permitting, launch balloons outside. Otherwise, use a gym or room with high ceilings and no ceiling fans.
18. Make sure every group understands how to launch their balloon. Each launch should use a different payload for each launch until they reach the maximum payload.
19. Students should record the data on their design brief.
20. **Communicate Results**
21. Students should read and write down answers to the reflection questions on the design brief.
22. They will use the answers to type up a formal report.

**Progress Monitoring:**Teacher should observe students and provide on-going feedback during the activity. While introducing the unit, the teacher will pause and ask for questions to make sure everyone understands.Students will complete self-assessment and brainstorm how they could improve their skills in the future. At the end of the unit, there will be a quiz to measure their overall understanding. |
|  | 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 |

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|  | 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 |