

What A Drag!

| Teach 1 | Names of student(s) teaching: |
|---------------------------------------------|----------------------------------------------------------------------------|
| Teach date: Teach time: Teach length: | Title of lesson: What A Drag! (Airplanes) Source (Kit, Lesson, Page #): |

| Concept statement/Main idea: |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Through this activity, students learn how drag affects falling objects. Guided by a worksheet, student teams make a variety of paper shapes (cones, boxes) and experiment to see how size, shape and weight affect the speed with which their paper shapes fall. They collect free-fall timing data and examine the collective class data to draw conclusions about which shapes had less drag as well as the relationship between mass and time. |

| Standards for the lesson: |
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| Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. |
| Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. |

| Objectives | Evaluation |
|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Write objectives in SWBAT form | Write at least one question to match the objective you listed or describe what you will look at to be sure that students can do this. |
| SWBAT: Explain geometric shape and size affect the amount of form drag on an object through measurement and analysis. | How did the shape of the "airplane" affect how fast the "airplane" flew? |
| SWBAT: Predict the relative form drag on any given object based on their observations of the object's size and shape. | Explain how well you think the "airplane" will fly given its parachute. |

Engagement

Estimated time: 5 minutes

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July 2021

Description of activity: Students will watch a video over the factors that affect the flight of an airplane as well as answer questions about the video.

| What the teacher does | What the student does | Possible questions to ask students — think like a student and consider possible student responses |
|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The teacher will show the students the video and will ask them questions about the video. | The students will watch the video and answer questions based off of the video. | <p>What force pulls down on the plane itself?</p> <p>Does lift have to be greater than gravity to fly?</p> <p>Why are the wings at an angle?</p> <p>Do air molecules play a factor in how the airplane flies?</p> |

Resources needed:

Powerpoint

[Video link](#)

Safety considerations:

Exploration 1: Design

Estimated time: 15 minutes

Description of activity: Students will re-use their assembled shapes from the previous lesson and will add a parachute to it to determine how it will play a role in how fast their shape falls.

| What the teacher does | What the student does | Possible questions to ask students — think like a student and consider possible student responses |
|----------------------------------------------------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| The teacher will distribute materials and have the students assemble their | The students will assemble their shapes and will add weight to the bottom to | How do you think the weight will affect how long it takes for your shape to fall? |

| | | |
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| <p>respective shapes in their groups. Each group will have a different shape that they assemble and will test out.</p> <p>Once the shapes are assembled the teacher will monitor the students as they time how long it takes for their shapes to fall 2 meters.</p> | <p>determine how it affects how long it takes to fall.</p> <p>After testing the first set of weights, the students will record their data and will test out the second set of weights.</p> | <p>Do you think using something else as a weight such as a washer will affect how fast the shape falls?</p> |
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Resources needed:

- Assembled shapes
- Play-dough for weight
- Timer
- Meter sticks

Safety considerations:

Be careful when dropping the shapes from tall heights.
Make sure not to drop the shapes on someone!

[Explore 1 WS](#)
[Shapes \(pdf\)](#)

Exploration 2: Redesign

Estimated time: 15 minutes

Description of activity: Students will re-use their assembled shapes from the previous lesson and will add a parachute to it to determine how it will play a role in how fast their shape falls.

| What the teacher does | What the student does | Possible questions to ask students — think like a student and consider possible student responses |
|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The teacher will have students add a parachute to their shapes to determine how the parachute will affect how fast the shape will fall.</p> | <p>The student will add a parachute to their shapes and will drop it from a height of 2 meters and will measure how long it takes for the shape to fall.</p> | <p>How do you think the parachute will affect how fast the shape falls?</p> <p>Do you think the material chosen for the parachute will</p> |

| | | |
|--------------------------------------------------------------------------------------------|--|-------------------------------------|
| The teacher will monitor the students as they drop their shapes from a height of 2 meters. | | play a factor in how fast it falls? |
|--------------------------------------------------------------------------------------------|--|-------------------------------------|

Resources needed:

- Assembled shapes from last lesson
- Plastic bags
- Paper bags
- Paper clips
- Stapler
- Glue

Safety considerations:

Be careful when dropping the shapes from tall heights.
Make sure not to drop the shapes on someone!

[Explore 2 WS](#)

Explanation 1: Design

Estimated time: 10 minutes

Description of activity: Students will explain the results of their “airplane” flights.

| What the teacher does | What the student does | Possible questions to ask students — think like a student and consider possible student responses |
|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The teacher will have students explain their results as well as ask them questions based on their results. | The students will explain their data and will provide feedback and answer questions. | <p>How do you think the shape of your “airplane” played a factor in how well it flew?</p> <p>What changes would you make to your “airplane”?</p> <p>Would you want to make your “airplane” larger or smaller? Why?</p> |

| | | |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | <p>Would you want to keep your “airplane” the same size? Why or why not?</p> <p>Do you think using a different type of paper would affect how well your “airplane flew”?</p> |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Resources needed:

- Assembled shapes
- Data results

Safety considerations:

Explanation 2: Redesign

Estimated time: 10 minutes

Description of activity: Students will explain the results of their redesign of their “airplane” with the new parachute attached.

| What the teacher does | What the student does | Possible questions to ask students — think like a student and consider possible student responses |
|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The teacher will have students explain their results with their parachutes as well as ask them questions based off of their results. | The students will explain their data and will provide feedback and answer questions. | <p>Did your “airplane” fly faster or slower with the parachute?</p> <p>How do you think the parachute played a factor in how well it flew?</p> <p>What changes would you make to your “airplane” with the parachute attached?</p> |

| | | |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | <p>Would you use a different type of material for your parachute?</p> <p>Do you think the material used for the parachute affects how your “airplane” flies?</p> |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Resources needed:

- Assembled shape with parachute
- New data collected

Safety considerations:

Elaboration

Estimated time: 10 minutes

Description of activity: Students will connect their airplane shapes to real world examples.

| What the teacher does | What the student does | Possible questions to ask students — think like a student and consider possible student responses |
|-----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The teacher will ask questions and have the students discuss the connection between their “airplane” and real-life planes.</p> | <p>The student will answer questions and discuss the importance of a parachute and the shape of a plane.</p> | <p>Why do you think shapes are important when building a plane?</p> <p>Why do you think airplanes have a weight limit on when flying to different destinations?</p> <p>Why do you think some aircrafts have parachutes and others don’t?</p> <p>Does gravity have the same effect on all the aircrafts that fly?</p> |

Resources needed:

Powerpoint

Safety considerations:**Evaluation**

Estimated time: 5 minutes

Description of activity: Students will complete the evaluation quiz on their own.

| What the teacher does | What the student does | Possible questions to ask students — think like a student and consider possible student responses |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <p>The teacher will distribute the evaluation quizzes and have students turn it in when it is completed.</p> <p>*Evaluation quiz answers will vary depending on what shape students had in their group; there is no key for this portion.</p> | <p>The student will complete the evaluation quiz on their own.</p> | |

Resources needed:[Evaluation Quiz](#)**Safety considerations:**

Name: _____ Date: _____

What a Drag! Activity Worksheet (Design)

Activity Instructions

1. Cut out the four shapes: small cube, large cube, small cone and large cone.
2. Add clay to the bottom of each shape so that they are all the same mass.
3. Select one person to stand on a chair and drop the objects from a height of 2 meters. Record how long it takes each shape to fall the same distance. Each time, be sure to drop the cones with the pointy side facing down! Do three trials for each shape. The first trial will be with the shape with NO weight followed by two trials with the weight inside the shape.

| Object | Mass | Attempt | Time to Fall | Average Time |
|--------|------|---------|--------------|--------------|
| | | 1 | | |
| | | 2 | | |
| | | 3 | | |

4. What is drag (in your own words)?

Name: _____ Date: _____

What a Drag! Activity Worksheet (Redesign)

Activity Instructions

1. Select one person to stand on a chair and drop the objects from a height of 2 meters. Record how long it takes each shape to fall the same distance. Each time, be sure to drop the cones with the pointy side facing down! Do three trials for each shape. The first trial will be with the shape with NO weight followed by two trials with the weight inside the shape.
2. Note any, if applicable, differences in time the shape falls with the parachute.

| Object | Mass | Attempt | Time to Fall | Average Time |
|--------|------|---------|--------------|--------------|
| | | 1 | | |
| | | 2 | | |
| | | 3 | | |

4. Did the "airplane" fall faster or slower with the parachute? Why do you think that is?

What a Drag Activity – Drag Shapes Handout





