Week One: Introduction

*This week you will watch two videos; Crash Course in Aerospace Engineering series and an introduction to kites.*

*As you watch the first video, complete the blanks in the following questions. Green speaks very quickly throughout the video and covers a lot of information in a very short amount of time, so make sure you pay close attention so you don’t miss the information to answer the questions. If you have blank spaces by the end of the video, don’t worry! You can go back and rewatch it as many times as needed until completion.*

*[****To The Moon & Mars - Aerospace Engineering: Crash Course Engineering #34*** *; link to video:* [*https://www.youtube.com/watch?v=UvtYn2j78gw*](https://www.youtube.com/watch?v=UvtYn2j78gw)*]*

1. Astronauts visited the Moon in (more/less) time than it takes to cross the Atlantic by boat.
2. We’ve been able to do these things because of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the field dedicated to designing and building machines that fly.
3. Broken down into two main parts:
4. Aeronautical engineering is focused on making aircrafts such as:
5. While astronautical engineering builds spacecraft like:
6. Competition drives \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
7. What is the most basic form of lift? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
8. What is the Pressure Gradient Force?
9. What is lighter? Circle one.
	1. Hot air / Cold air
10. When in equilibrium, the forces should be equal to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
11. A Propulsion System is something that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
12. A Propulsion System usually consists of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_, and a \_\_\_\_\_\_\_\_\_\_\_.
13. Three main Propulsion Systems:
14. The goal is to provide enough \_\_\_\_\_\_\_\_\_\_ to overcome the \_\_\_\_\_\_\_\_\_\_ of the aircraft.
15. The jet engine has five core elements:
16. You need to make sure that you have a sturdy inlet that can operate efficiently -- meaning that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ -- for your aircraft’s entire flight.
17. You also need to design your engine with materials that can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. One thing we don’t have yet is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. What does Centrifugal Force mimc? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. On Mars, you’ll find an atmosphere about \_\_\_\_% as dense as Earth’s.
4. Satellites have three main elements:
5. There’s one last, special kind of spacecraft you might need to design, a \_\_\_\_\_\_\_\_\_\_\_\_\_.
6. A spacesuit’s tough exterior provides protection from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
7. The Z-2 uses advanced composites to achieve a \_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ suit that could withstand long duration missions in harsh environments (like the one found in Mars).

*Now that you have learned about aerospace engineering, let’s learn how it is applied to this month’s activity: building kites. Watch the second video and answer the following questions accordingly:*

 *[****The Science of Kites by Learn Something New*** *; link to video:* [*https://www.youtube.com/watch?v=NEv1HMX73N0*](https://www.youtube.com/watch?v=NEv1HMX73N0)*]*

1. What are the four forces of flight?
2. How does lift work? What do you have to do if there is not enough wind?
3. How does weight affect kites?
4. What is the role of thrust?
5. What is drag? What is the opposite of drag?
6. In order to get your kite into the air, the force of the \_\_\_\_\_\_\_\_ must overcome the force of \_\_\_\_\_\_\_\_\_\_\_\_.
7. To keep it in the air, the force of \_\_\_\_\_\_\_\_\_ must be equal to the force of \_\_\_\_\_\_\_\_\_\_\_\_.

*Answer these questions in 2-3 complete sentences.*

1. What is one thing described in these videos that you already knew?
2. What is one thing that you DIDN’T already know?
3. Name one thing that particularly surprised you from either video, and why:
4. Where do we see similarities between the topics discussed in the videos and society today?

*Do you remember the engineering process? Let’s review! Write 1-2 sentences of what each step means to us this month:*

1. **Ask**
	1. What are our needs?
	2. What are our constraints?
2. **Research**
	1. What is our topic? How have we researched this week?
3. **Imagine & Plan**
	1. Draw a quick sketch of how you think your kite will look next week!
4. **Create**
	1. What are we going to create this month?
5. **Test & Improve**
	1. What are we going to test with our kites? What is our goal this month?

Week Two: First Kite Design

 *This week we will be building our first kite! These are the materials you will need for this week:*

* Roll of tape
* 2 100 cm dowels (alternative: straws)
* 2 90 cm dowels (alternative: straws)
* 2 Sheets of wax paper
* Roll of String
* Scissors

*Before you start building, let’s review some of the concepts from last week. Write down the definitions and how they affect a kite’s flight.*

1. Lift
2. Thrust
3. Drag
4. Weight

 *Looks like you’re ready to start building! Use the following instructions to build your own kite and if you need a visual demonstration, the link below will help you:*

 *[****Let's Make a Kite! | Science Project for Kids by SciShow Kids*** [*https://www.youtube.com/watch?v=mc3AUuuj9\_I*](https://www.youtube.com/watch?v=mc3AUuuj9_I) *]*

***Note:*** *It is highly recommended to do the activity with adult supervision, plan accordingly!*

**Activity/Steps**

1. Cut two dowels 100cm and 90cm if you have not done so before.
	1. ALTERNATIVE: Take one straw and pinch one end. Insert that pinched end into a second straw so that they overlap 1 ½ inches. Do the same with the other two straws so they, too, overlap 1 ½ inches.
2. Make a cross with the two dowels, with the shorter stick (90 cm) placed horizontally across the longer stick (100cm). Make sure that both sides of the cross piece are equal in width.
	1. ALTERNATIVE: Make a cross with the two “jointed” straws. Make sure that both sides of the cross piece are equal in width.
3. Tie the two dowels together with the string at right angles to each other.
4. Cut notches at both ends of each dowel deep enough for the string to fit into. Cut a piece of string long enough to stretch all around the kite frame. Make a loop in the top notch and fasten it by wrapping the string around the stick. Secure with tape. Stretch the string through the notch on the right cross-piece, and make another loop. Stretch the string through the notch at the bottom and make another loop. Stretch the string through the notch left cross-piece and make another loop. Wrap the string a few times around the top of the stick and cut off what you don't need. Secure the string on the notch with string. This string frame must be tight, but not bend the sticks.
5. Lay the wax paper on the table and place the dowel frame face down on top. Cut the wax paper around the frame leaving a margin width of 3cm.
6. Fold these edges over the string frame and tape down so that the wax sheet is tight.
7. Cut a piece of string about 125 cm long, and tie the string to the loops at the top and bottom with about 20 cm hanging off of the bottom.
8. Tie another small loop in the string just above the intersection of the two cross pieces.
9. Cut a piece of string about 100 cm long, and tie the string to the loops on the left and the right through the small loop in the string just above the intersection of the two cross pieces. This will be the kite's bridle, the string to which the flying line is attached.
10. Tie a small ribbon to the tail piece hanging from the bottom.
11. Hold the string by the small loop in the center. The kite should be balanced from left to right. You may need to add tape to counterbalance the weight.
12. Attach the flying line.
13. Conduct as many flight tests as needed until the kite stays up in the air for at least 10 seconds.

**Data Tracking**

 *Track your flight attempts below as you test your new kite:*

| Attempt Number | Did your kite fly?(Yes/No) | How long did it fly? | Did it fly higher than the previous attempt? |
| --- | --- | --- | --- |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| 5 |  |  |  |
| 6 |  |  |  |
| 7 |  |  |  |
| 8 |  |  |  |
| 9 |  |  |  |
| 10 |  |  |  |

**Observations**

1. How did your kite fly?
2. How long do you think it took your kite to get into the air?
3. How long do you estimate your kite stayed in the air?
4. How high did your kite fly?
5. If you could build your kite differently, what would you do? Explain your answer.

(**Note**: This is important for next week’s homework!)

Week Three: Redesigning Time

 *We have reached the final step in the Engineering Process: improving our designs! Do you remember your prototype from last week?*

1. In a few sentences describe in what aspects of the model was it successful? Unsuccessful? What about outside factors (Wind, speed, etc).

 *This week you will improve your design using the information we researched the first week by watching Youtube videos. You have two options:*

1. With your remaining **unused** materials, you will build a new prototype with different dimensions. You may use last week’s instructions as a reference but your second design must aim to be more efficient than the first design.
2. Use remaining materials to upgrade your prototype! You can add or remove any elements in a way that you consider will be helpful for the kite to fly higher and for longer time.

 *Now that you have decided which route to take this week, briefly answer the following questions:*

1. Which option above do you consider best? Why?
2. What is your plan? What will you change about last week’s kite design? Write at least 4 sentences and sketch your new/upgraded prototype.
3. Why do you think your new design will be successful? Any doubts?

 *You can now begin your redesigning process. When building/fixing your new kite keep in mind how it will change the lift, thrust, drag, and weight and remember how each of these concepts are relevant to aerodynamics.*

**Data Tracking**

 *Track your flight attempts below as you test your new kite:*

| Attempt Number | Did your kite fly?(Yes/No) | How long did it fly? | Did it fly higher than the previous attempt? |
| --- | --- | --- | --- |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| 5 |  |  |  |
| 6 |  |  |  |
| 7 |  |  |  |
| 8 |  |  |  |
| 9 |  |  |  |
| 10 |  |  |  |

**Observation & Discussion**

 *Answer the following questions in complete sentences about your new design.*

1. How did you feel about ultimately building your own design?
2. Did you have to modify anything as you kept testing your prototype?
3. How did outside factors affect your kite’s flight?
4. Did your kite overall fly higher than last week? Did it stay up in the air longer this week?

Week Four: Redesigning Time

 *Last review quiz! Answer the following questions:*

1. What is aerodynamics?
	1. The study of birds
	2. The study of how air moves around a solid object
	3. How airplanes take off
	4. The force that slows race cards down
2. The force that slows down objects is called \_\_\_\_\_\_\_\_\_\_\_\_.
	1. Drag
	2. Weight
	3. Lift
	4. Thrust
3. Which object would have the least amount of drag?
	1. A wide, rough object
	2. A round, rough object
	3. A smooth, wide object
	4. A narrow, smooth object

**Reflection Questions**

 *Answer the following questions with at least four sentences each.*

1. What did you learn this month? Consider this package and the in-person classes.
2. Overall, what are your thoughts about aerodynamics? What about the kite project?
3. Would you consider becoming an aerospace engineer? Why or why not?
4. What was your favorite concept of aerospace engineering? Explain.
5. Why do you think it is important to learn about aerospace?