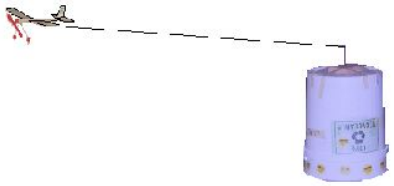
AEROLAB WEIGHT

Name _____ Class Period _____

Background: When you wind up the rubber motor of a model plane, you are storing potential energy. This energy is transformed into kinetic energy when you launch the plane. As thrust accelerates the plane forward, the wings of the plane generate lift. As a plane goes faster, lift increases.



According to Newton's 2nd Law, F=MA, if mass is added to a plane and thrust remains the same, the plane will accelerate more slowly, thereby delaying take off. Lift is equal to weight when a plane flies level and at constant speed. For example, a 15-gram plane generates 15 grams of lift. A *JETSTREAM* with added mass will have greater kinetic energy (but less potential energy) than a lighter *JETSTREAM*.

Directions: You will be adding pennies to the plane to study how added weight affects flight. Work with your partners and choose one *JETSTREAM* to study.

1) Finish this hypothesis: If weight increases, then…

2) List at least three variables you should keep the same every time you test your plane.

3) In addition to weight, what variable is also affected when you add pennies to your plane?

4) Calculate the distance your plane will fly around the pylon:

The radius from the pylon to the fuselage = _____ meters

One revolution = Circumference = $2\pi r$ = _____ meters

5) Fly your *JETSTREAM* without any added weight

- Adjust the wing to balance your plane. Then mark the wing position with a pen. Wind your motor 1000 times.
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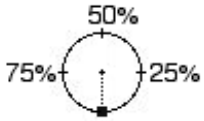
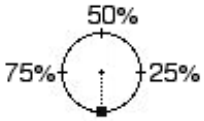
- Release your plane and note the exact point of takeoff. Record the takeoff point on each circle below. (The release point of the plane is represented by the dot at the bottom of the circle.) Meanwhile, have another person in your group time how many seconds the plane flies in the air around the pylon while a third person counts the laps in the air. Stop timing and counting laps the instant the wheels of the plane touch down. Wind the rubber motor of the plane the same number of times for each trial.

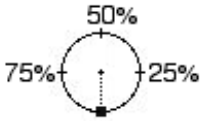
UNMODIFIED JETSTREAM			
Trial 1	**Trial 2**	**Trial 3**	**Averages**
Laps =	Laps =	Laps =	Average Laps =
Seconds =	Seconds =	Seconds =	Average Seconds =



Takeoff = ___ %



Takeoff = ___ %



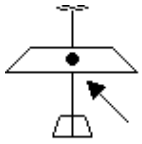
Takeoff = ___ %

6) Calculate the average speed of your *JETSTREAM*.

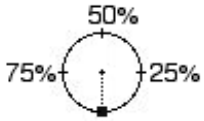
Average Speed = $\frac{\text{Distance}}{\text{Time}}$ = $\frac{(\text{Average Laps x Circumference})}{\text{Average Seconds}}$ = _____ m/sec

7) Fly your *JETSTREAM* with added weight

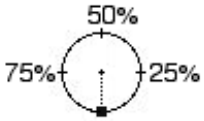
- Add 1 or 2 pennies to the exact center of gravity (about 1/4 of the way back from the front of the wing) and collect data. Adjust your wing so that it is back at the marked location. Collect data using the same procedure as before.



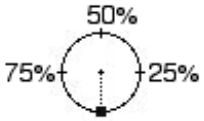
JETSTREAM WITH ADDED MASS			
Trial 1	**Trial 2**	**Trial 3**	**Averages**
Laps =	Laps =	Laps =	Average Laps =
Seconds =	Seconds =	Seconds =	Average Seconds =



Takeoff = ___ %



Takeoff = ___ %



Takeoff = ___ %

8) Calculate the average speed of your *JETSTREAM* with added weight.

Average Speed = $\frac{\text{Distance}}{\text{Time}}$ = $\frac{(\text{Average Laps x Circumference})}{\text{Average Seconds}}$ = _____ m/sec

9) How did the addition of weight affect the takeoff distance?

10) Why did the heavier plane fly the way it did? Discuss the relationship between its greater weight, kinetic energy and potential energy

11) How did the addition of weight affect the flight time?