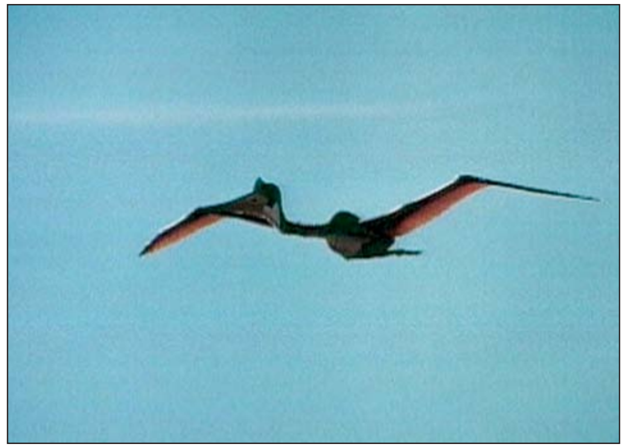
The Pterodactyl Flies Again

The Movie:

A young aeronautical designer creates a flying replica of a prehistoric dinosaur. Featured: David Busch of AeroVironment Inc. *(Movie length: 2:36)*



Background:

The largest flying animals that the Earth has known lived over 100 million years ago, in the time of the dinosaurs. With a wingspan of up to 40 feet, these huge flying reptiles (not, technically, dinosaurs themselves) seem to have thrived within their environment. Can modern science and technology learn anything from these ancient creatures? If nothing else, our study of them is an opportunity to test the limits of our knowledge of the physics of flight.

Curriculum Connections:

1 Ratios

One type of pterodactyl had a wingspan of around 40 feet, and weighed about 110 pounds. One of the largest of modern birds, the California Condor, has a wingspan of about 9 feet, and weighs around 25 pounds. Compare the ratios of wingspan to weight for each animal. What do you conclude?

2 Measurement (speed)

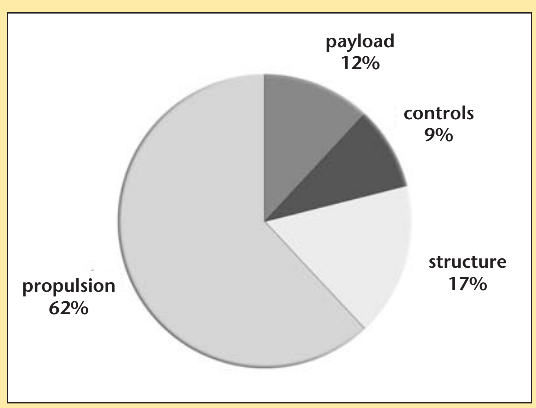
Small unmanned aerial vehicles (UAV's) are used by law enforcement agencies and the military in order to collect images of an area without risking human lives. If such a vehicle can stay aloft for 1.5 hours at an average speed of 50 miles per hour, what is its range of travel? (Remember, the vehicle must also have time to return to the point of departure.)

3 Percents

This pie graph describes the percent of contribution of the various systems of an aircraft to its total weight.

If the aircraft weighs 2,500 pounds, what is the weight of the propulsion system?

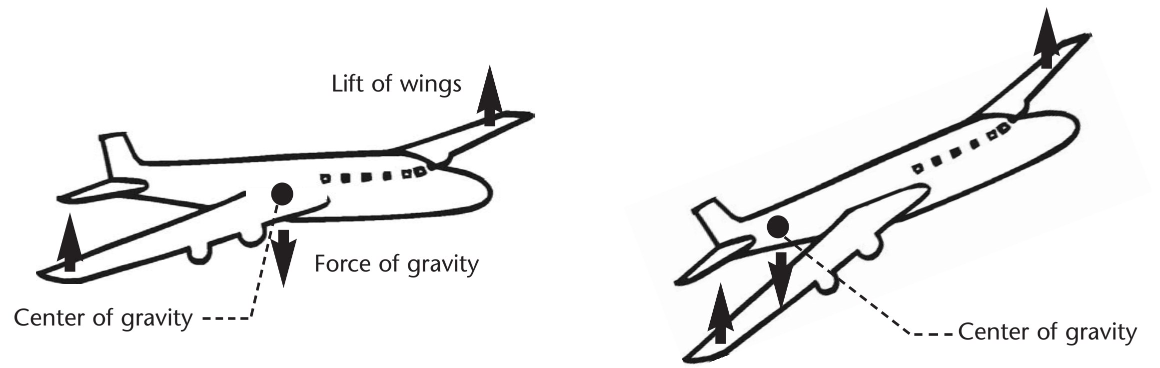
If the control system weighs 90 pounds, what is the weight of the aircraft?



Algebra (expressions)

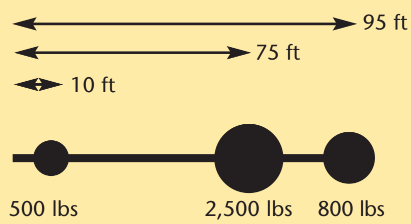
The center of gravity of an object is the place where you can lift it and not have it tilt forwards, backwards or sideways.

It is important that the center of gravity of an aircraft be in line with the wings, or the aircraft will not fly well.



Stable flight **Unstable flight**

The position of the center of gravity is found by a special kind of averaging of the positions of the weights of the parts of the airplane. The average is computed by multiplying the weight of each part by its location (as measured from a specific point, such as the back of the airplane), and then dividing by the sum of the weights. For example:



Position of center of gravity (as measured from back end of the airplane)

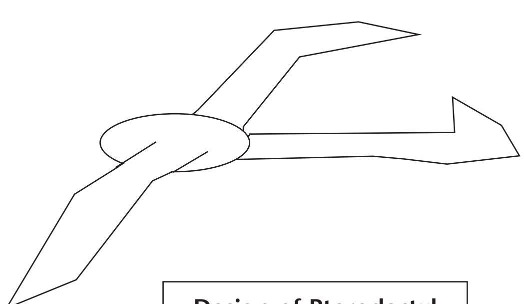
$$= \frac{w_1 \times h_2 + w_2 \times h_2 + w_3 \times h_3}{w_1 + w_2 + w_3}$$

$$= \frac{500 \times 10 + 2500 \times 75 + 800 \times 95}{500 + 2500 + 800}$$

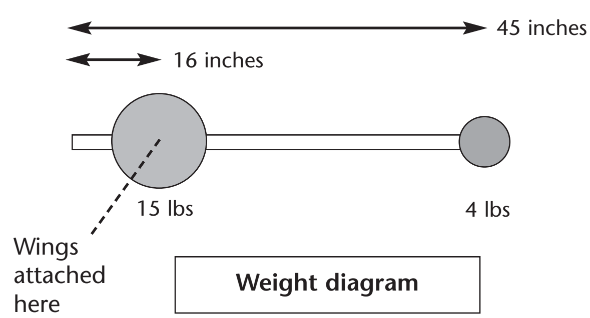
$$= \frac{500 + 187500 + 76000}{3800}$$

= 70.65 feet (answer in same units as the positions)

Determine the position of the center of gravity of this design for a flying pterodactyl. (Use the simplified weight diagram to do so.) Do you think it will fly stably?



Design of Pterodactyl



Weight diagram

WOW AIRPLANES

To: Engineer Team 8
From: President's Office

We've been having a big argument up here on the subject of correct wingspan in comparison to the length of the airplane. I need your help to get it settled.

Here's the project: Make a set of paper airplanes using the plan below, but start with different-sized sheets of paper, so that the ratio of wingspan to airplane length is different in each case.

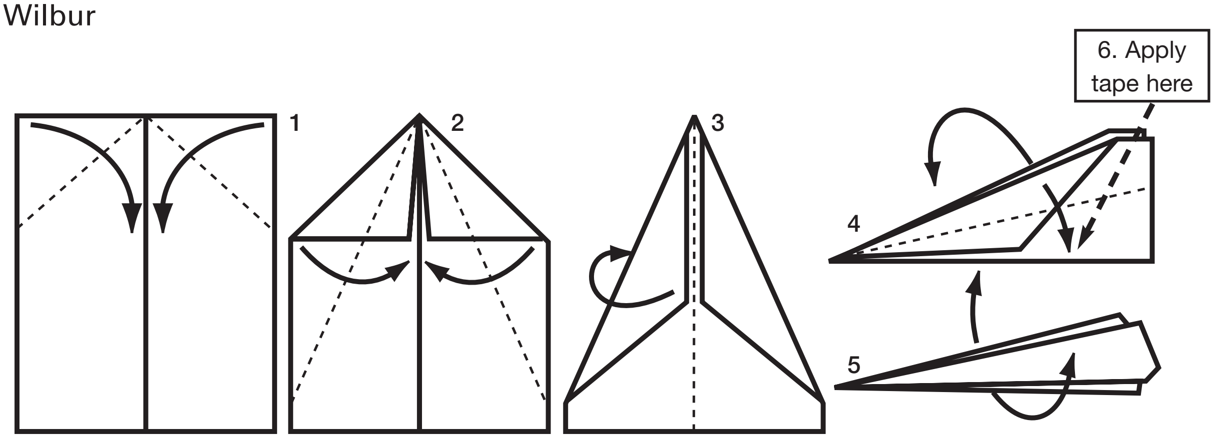
Then test the flight characteristics of each plane. We want to know which one will glide the farthest.

You're going to have to figure out how to make it a fair test. Obviously you should fly each plane several times, for one thing. Also, when the plane is thrown, the angle at which it is released makes a difference, and so does the speed with which it is released. And of course you will have to somehow minimize the effects of any atmospheric winds or air currents.

What I need from you is a clear presentation of your results and the exact procedure you used, and a discussion of sources of error.

Forget the X38 project for now. This is much more important. And please get it done as soon as possible.

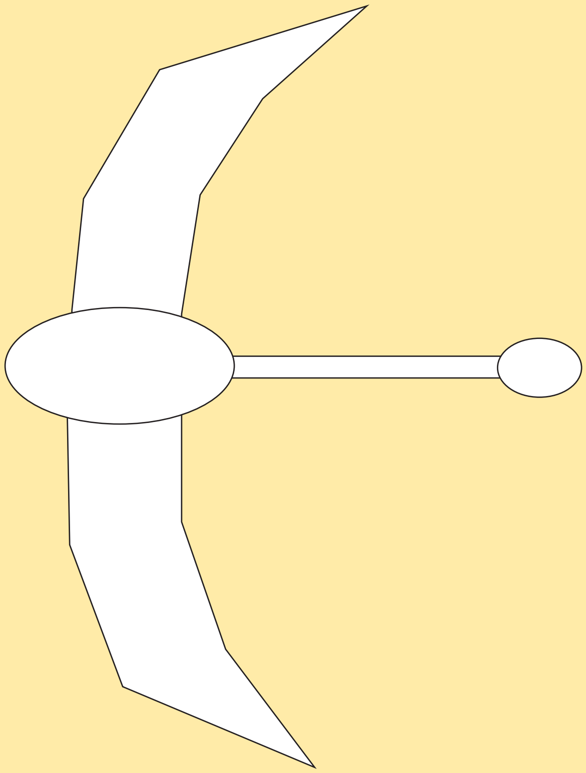
Wilbur



1. Fold paper in half and fold top corners in to center line.
2. Fold resulting corners in to center line again.
3–4. Fold wings down on outside so that edges of wings match bottom of "fuselage."
5. Spread wings.
6. Tape fuselage closed at top rear of wings.

Geometry (polygons), Ratios, Decimals

The skin of any aircraft must be both light and strong. Determine as accurately as you can the surface area of the wings of this pterodactyl. If the plastic used to cover the wings weighs 0.27 ounces per square foot, what will be the total weight of that plastic covering? (Hint: To find the area, divide the wing shape into triangles.)



Scale of drawing: 1 inch = 2 feet

If you enjoyed this Futures Channel Movie, you will probably also like these:

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Maglev Trains, #1004	Gliding on a wave of electromagnetic force, a maglev (magnetic levitation) train could travel at 300 miles per hour or faster. Designer-engineers Gordon Danby and James Powell describe the mechanics and future benefits of such superconductor trains.
Windsails, #1011	Windsail designer Trevor Baylis develops the shape of a sail on his computer, builds it in his shop, and tests it out on the waves.