Center of Mass, Center of Pressure, and Paper Airplanes

Materials:
8.5 by 11 inch piece of paper (4,5g)
pennies (2.5g)
tape

Task #1:
Using only your sheet of paper, make a paper airplane.

Task #2:
Fly it.

Expectation #1:
What are the important structures of your airplane, how do the keep the plane in the air, how do they keep the plane going straight, how do they keep the plane moving forward?

Airplane inspection:
Determine the center of Mass of the airplane experimentally. Mark its location on the airplane and explain how you found it.

Propulsion Prediction A:
Additional weight can cause the plane to go faster or slower. How can you use a penny and tape to make the airplane fly faster?

Propulsion Experiment and Results A:
Attach the penny to the airplane in the way you predicted would make it fly faster. Fly the airplane. What happened?

If your prediction turned out to be wrong keep trying different configurations until you get the airplane to go faster with the penny than without and describe the arrangement that works.

Propulsion Prediction B:
Now that you have found how to make the airplane go faster, how can you use a penny and tape to make the airplane stop in mid flight?

Propulsion Experiment and Results B:
Attach the penny to the airplane in the way you predicted would make it stop in mid flight. Fly the airplane. What happened?

Applying physics ideas #1
How can you use the concepts of center of mass and center of pressure to understand what happened in your experiments on propulsion?

STOP FOR CLASS DISCUSSION

Steering Prediction:
What are the motions a car executes when a driver turns the car? What are the motions that an airplane executes when a pilot turns the airplane? How can you use the penny to cause your airplane to execute at least one of the motions a turning airplane? What would you do differently to help the plane turn to the left compared to the right?

Steering Experiment:
Use your prediction to attach the penny to the airplane in a way that will help the plane turn right. What happens? Can you make the airplane turn sharply to the right? What happens when you try to do so?

Applying Physics Ideas #2:
How can you use the concepts of center of mass and center of pressure to understand what happened in your experiments on steering?

STOP FOR CLASS DISCUSSION

These techniques for propulsion and steering have their limits, why aren't they used on airplanes today? What do airplanes today do to steer?

Modern Steering Prediction:
Can you rip and fold the appropriate surfaces to make your airplane turn to the left or right? Explain how you would do it,

Modern Steering Experiment:
Apply your prediction and test them. What did you find?