It's a Bird, It's a Plane, It's an Ornithopter Extravaganza!

Background:
Since the dawn of time man has been fascinated with flight. The earliest attempts at human flight centered on recreating the flight of the birds, with the creation of moving wing contraptions that, more often than not, resulted in fatally hard landings for their creators. These moving wing flying machines are called Ornithopters. They get both their lift and their propulsion from their flapping wings. The Ornithopter does, despite the difficulties it presents, remain an intriguing problem for hobby flying enthusiasts. To create an effective Ornithopter, one must balance wing size, shape, weight, and power.

Problem:
You will need to build an optimized Ornithopter to fly farther than anyone else's design in the class. If there is a tie, the time taken to cover the distance will determine the winner.

Procedure:
You will first construct a pre-designed model Ornithopter in groups which we will then fly. Then you must use what you have learned and research what is needed to design your own improved Ornithopter. Your finished design will be flown in the main concourse of the school during lunch time on a date to be announced. The winning design will travel the greatest distance without hitting any surface of the school.

Constraints:

- The Ornithopter must fit inside a 60 by 40 centimeter box.
- You may use one (1) elastic supplied by the instructor.
- You must not exceed the amount of balsa wood supplied in the kit.
- You must remain under the maximum weight (250 grams)
- You must only use materials supplied in the kit

Design Considerations

- Weight
- Wing material/shape
- Propulsion – elastic band – few strong strokes or many weak
- Hinges/pivot points – free pivoting or unidirectional, lubrication?
- Overall proportions, ex. small body large wings or large body large wings.
- Overall size
- Materials and sustainability/availability of materials

Safety: Read handouts before you start!!

Date Sequence (In 55 minute Days):

Day #	
1-5	Assemble sample Ornithopter in groups
6	Test fly to investigate flight properties

6 Research Ornithopter designs. Create a mind map of the elements of a successful design.
7-8 Create 12 thumbnail sketches and Refine 3 sketches into development drawings.
9-10 Produce one 3-D rendering of your final design and highlight innovations. Get your design checked and approved by the instructor.
11 Produce a diagram of each part of your design and a template for your wings then photocopy templates.
12-14 Use spray-adhesive and paste a copy of your diagram to the balsa blanks. Carefully cut out and join your balsa frame together.
15-16 Make your crankshaft then make your wings out of your material choice and adhere to frame.
17 Assemble Ornithopter and Fit elastic band then decorate as desired. Carefully test fly in open area (ask instructor first).

Sources of info:

- Google "Ornithopters". Look at both images and several recommended sites.
- Look at the wing shapes of birds.
- Look at gliders and examine wing shapes.

Related Studies:

- Biology
- Physics
- Engineering
- Materials Science

Management Issues:
The timeline is as follows:

Item	Due Date	Marks
Sample Ornithopter	October 30	40
12 Thumbnails and mind map	November 5	10
3 Development Sketches	November 10	10
3 D Rendering	November 14	10
Templates	November 18	10
Final Ornithopter	December 10	60
Distance Results	December 10	10

The total project is out of 150 marks.
The distance marks will be assigned based on percentage of the farthest flight. The farthest will receive 10 marks and the shortest 6 marks with the others arranged in between.

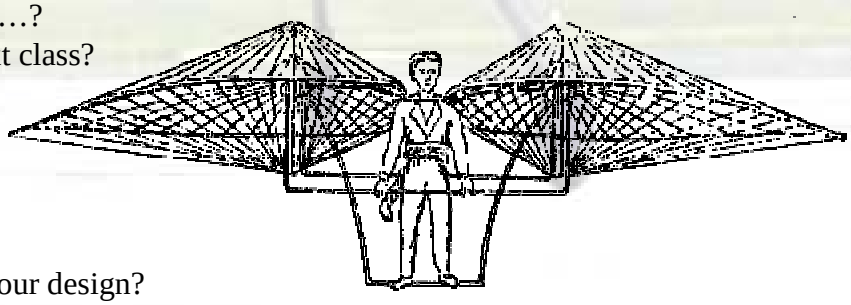
Assessment:

1. Sample Ornithopter
   a. Is it complete (10 marks)
   b. Is it well made (10 marks)
   c. Did you participate in the group (5 marks)

   d. Did it fly (5 marks)
   e. Customization of appearance (10 marks)
2. Thumbnails and mind map
   a. Are they complete (8 marks)
   b. Quality of communication (2 marks)
3. 3 development sketches
   a. Complete (5 marks)
   b. Labeled innovations (2 marks)
   c. Quality (3 marks)
4. 3D Rendering
   a. Complete (5 marks)
   b. Color (1 mark)
   c. Labeled Innovation (2 marks
   d. Quality (2 marks)
5. Templates
   a. Complete (4 marks)
   b. Accuracy (3 marks)
   c. Labeled as part name (3 marks)
6. Final Ornithopter
   a. Complete (20 marks)
   b. Quality (15 marks)
   c. Fits in size and weight limit (10 marks)
   d. Color/appearance customized (5 marks)
   e. Flies (10 marks)
7. Distance
   a. Furthest distance – 10 marks
   b. Shortest distance – 6 marks
   c. All others extrapolated in between 6 and 10 marks based on individual distance

Self Evaluation:

- What have I accomplished today?
- Are my designs workable according to my research?
- Is my Ornithopter too heavy?
- Do I need to ask for help?
- Have I submitted everything?
- What can I do to improve …?
- What are my goals for next class?



Group Discussion:

- What worked for me?
- What did not work?
- What was the best design?
- How could you improve your design?
- How did you decide on your design/materials choices?