

## 3RD QUARTER DYNAMICS PROJECT: HOW TO BUILD A LOU-VEE AIRCAR

### Materials (per car)

1. One sheet of legal-sized paper
2. Three standard paper clips
3. One butterfly paper clip
4. One plastic soda straw
5. Two large index cards
6. Narrow masking tape
7. Rubber band(s)
8. White glue (optional)

### Tools

1. Pencil
2. Drawing compass
3. Pliers with wire-snipping capability
4. Scissors

### Components

#### A) Body

1. Place your pencil along the long edge of the sheet of paper. Roll the paper around the pencil to form a tube. Tape the tube and remove the pencil. This tube is the body tube.

2. Next, pull apart the two loops on one of the standard paper clips until the loops are about 30 degrees apart. Slip one of the loops inside one end of the body tube. This paper clip is the front hook.

#### B) Propeller and motor mount

1. Fold one index card at the center to make two 12.7-by-10.2-cm rectangles. Open the fold and cut along the crease. Then cut one of the rectangles into two 12.7-by-5.1-cm rectangles. One of these is your propeller. (Save the other for future AirCars or use it as a bookmark.) Pierce a small hole in the center of your propeller and put it aside.

2. Fold the remaining 12.7-by-10.2-cm card so that the 12.7-cm edges meet. You should now have a double-thick 12.7-by-5.1-cm rectangle. Now fold the doubled card so that the 5.1-cm edges meet. When you open the fold, you should have two 6.4-by-5.1-cm rectangles, each of which is two layers thick. Crease each of the rectangles around 4 mm from the last crease you made. Then fold the card at the creases. Your card should now look like an "M." This is the motor mount. A soda straw should fit in the hollow, or shallow groove, of the "M." Finally, trim the edges of the mount as shown.

#### C) Wheels

1. Draw two large circles (radius = 4.5 cm) in the opposite corners of your remaining index card. These circles will be your rear wheels. Now draw two smaller circles ( $r = 2.1$  cm) in the blank area between the large circles. These circles will be your front wheels. Make a small hole in the center of each circle, and then cut the circles out very carefully.

## **D) Axles and propeller shaft**

1. To make your axles and propeller shaft, gently unfold all the remaining paper clips (as you would open a pocketknife). Use the pliers to straighten the clips out as much as possible. Be careful not to twist the clips, because they may weaken or break. The long wire is your rear axle; the other two are your front axle and propeller shaft.

2. Set the wires aside momentarily. Take your soda straw and cut it in half, and then cut one of these halves in half as well. These are your axle tubes and propeller tube.

3. Check to see that the straightened butterfly paper clip extends about 1.5 to 2.0 cm beyond the ends of the long tube, and that the straightened standard paper clips extend 1.5 to 2.0 cm past the ends of the short tubes. Snip the wires to the proper lengths.

4. Now bend the axles and propeller shaft or one end as shown, slip them through the tubes, and bend them on the other end.

Assembly

## **A) Axles**

1. Stick the ends of the front axle through the holes in the smaller wheels and tape the L-shaped sections of the axle to the outside of each wheel. Be sure to rub the tape hard, so that you attach the wire firmly to the wheels. Do the same with the large wheels and the rear axle.

2. Now tape the axle tubes to the body tube as shown. Make sure that they are at right angles to the body tube. Line them up squarely or your car will turn improperly or lean.

## **B) Motor**

1. The first step in assembling the motor is to attach the propeller to the propeller shaft. Stick the double-L end of the propeller shaft through the hole in the propeller. Tape the L-shaped section of the wire to the back of the propeller, making sure the tape sticks very tightly to the wire and the propeller.

2. Next, tape the propeller tube to the motor mount. Make sure the propeller tube extends about 1 cm beyond the rear edge of the motor mount.

3. Now tape the motor mount to the rear of the body tube.

## **C) Power supply**

1. Rubber bands provide the power for the AirCar. You can either use one very long rubber band or link several smaller ones together. When the car is assembled, the rubber band(s) should be long enough to hang about 2 cm below the line from the propeller tube to the front hook.

2. Hook the rubber band to the curved end of the propeller shaft and to the front hook.

## **Final Adjustments**

Add a twist to the ends of the propeller so that it will screw into the air and push the car forward. (See the Finished AirCar.) Wind the propeller about a hundred turns and place the car on the floor. Release the propeller a split second before you release the car.

## Troubleshooting

If your car won't go, don't despair. And don't approach your teacher for help right away-do that only as a last resort. First check your AirCar against the cars built by successful classmates-look yours over carefully to see whether you can discover the problem. A number of correctable things could be at fault. Here are some possible construction flaws and ways you can fix them:

*The propeller is not turning.*

It might be hitting something-adjust by bending or retaping it in a better position.

*The propeller is spinning, but the car isn't moving.*

1. See whether your car's propeller blades are bent properly. Try adjusting the twist in them.
2. Spin the wheels. If they are stiff, the axle may be bent and rubbing inside the axle tube. Straighten the axle.
3. Place the car on the floor and give it a gentle, push. If it does not roll, the wheels may not be perfectly round. Trim their edges.

*Your car is going in circles.*

Try turning the axle tube and the motor mount slightly to one side.

*The AirCar is flipping over.*

This could be caused by a number of things: The propeller may be too long, the rear axle may be too short, or the rubber band(s) may be wound too tightly.

*The body tube of the car folds up.*

Place the pencil back in the body tube for support. Make sure you don't wind the rubber band(s) too tightly.

*Your car's wheels are folding or the propeller is flopping around and not working.*

These problems indicate that the L-shaped ends of either the axles or the propeller shaft are not properly taped to the outside of the wheels or to the propeller. Remove the old tape and attach the ends properly.