AMA BETA

PROPELLER BLADE PITCH ACTIVITY & TEACHER NOTES

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PROPELLER BLADE PITCH

An aircraft's wings generate lift because of the airfoil shape of their cross sections. As the angle of attack increases, both the lift and drag produced by the wing also increase. Similar principles apply to an aircraft's propeller, although this component produces thrust. This is because a propeller blade's cross section is also an airfoil, so the same aerodynamic principles apply. As the blades spin, they produce a low-pressure area in front of the propeller disc and a high-pressure area behind it. This pressure imbalance pushes the propeller forward, which in turn pulls the airframe along with it* (hopefully fast enough for the wings to generate their own lift force)!

A close inspection of the propellers used on the ALPHA and BETA aircraft will reveal that the blades differ from the aircraft's wing in that they seem "twisted." The camber of the airfoil shape is much more pronounced near the center hub of the propeller. Why would this be?

It is important to remember that, as a propeller spins, the root of the blade is not moving at the same speed as the tip. Because the amount of "lift" (really thrust in the case of a propeller blade) an airfoil generates depends on its speed, if the airfoil maintained a constant curvature along the length of the blade, the amount of "lift" produced will vary. Much more thrust would be produced near the tips of the blades, which would put a great amount of stress on the propeller and may even lead to its structural failure.

Many aircraft can adjust the propeller blades' angle of attack during flight to increase the propeller's efficiency.

ACTIVITY

Just as the airfoil of the BETA can be modified to change the aircraft's performance, similar materials can be used to adjust the propeller blades.

Like the Bernoulli/airfoil activity, students should make 600-turn test flights to determine what performance characteristics they want to modify. In the case of the propeller, these can include speed, acceleration, rate of climb, flight duration, etc. Record them in writing.

MATERIALS:

- Card stock
- Printer paper
- Scissors
- Tape
- BETA aircraft

PROPELLER MODIFICATION PERFORMANCE DATA SHEET

	What are you trying to change? (Speed, acceleration, rate of climb, duration, etc.)	What modifications did you make? (Lengthened blade, widened blade, etc.)	600 or 800 turns?	What was the effect?
Modified Flight #1				
Modified Flight #2				
Modified Flight #3				
Modified Flight #4				
Modified Flight #5				
Modified Flight #6				
Modified Flight #7				
Modified Flight #8				
Modified Flight #9				

Using the same materials from the Bernoulli/airfoil activity, student groups can make minor, temporary modifications to the propeller blades. Record them in writing.

- *This may include lengthening the blades, widening them, increasing the angle of attack, etc. See the photos for examples.*
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- *After one set of modifications has been made, make a 600-turn test flight to determine whether further changes, or different changes altogether, are needed. Record results and findings in writing.*
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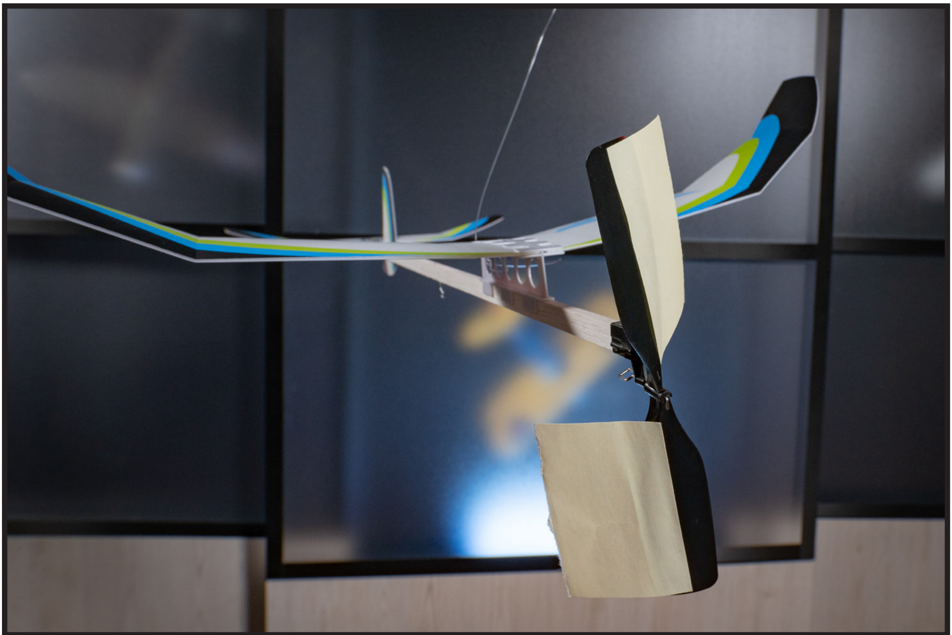
- *If/when the desired performance is achieved, the number of turns can be increased to 800. How does the performance change, if at all? If time permits, further modifications can be made.*



Example of how the propeller blades can be lwidened.

Example of how the propeller blades can be lengthened.

*Note that some aircraft, which are called pushers, have their propellers mounted at the rear of the airframe. The principles at work are the same, apart from the airframe being pushed by the propeller instead of pulled.