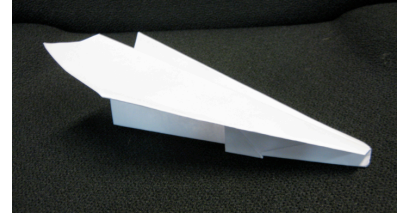


## Evolution in Plane Sight

Evolving with your involvement.



Model directed evolution by making paper fly.

### Materials and Preparation

Paper

Lots of friends

Meter stick or measuring tape

(optional) plastic straws, index cards, tape, scissors, paper clips or other small attachments

### To do and notice

1. Have everyone in the group make their favorite paper airplane.
2. Mark a starting point on the ground, and let everyone fly their planes in the same direction.
3. Determine the average distance that all of the planes flew in round 1.
4. Take the 3 (or so) planes that went the furthest and have the people who created these planes teach everyone else what they did.
5. Everyone should make a new plane based on one of the top designs. Each person should change a thing or two to make their plane fly even further.
6. Line up as before, fly the planes, and take the average of round 2 distances.
7. Have the new 3 furthest plane builders show their designs and repeat for as many rounds as you like.
8. How did the average distance for the group change in each round?

### What's going on?

Evolution is characterized by the generation of diversity within a group through random mutations and the subsequent selection of members whose mutations have resulted in positive adaptations against a selective pressure. Scientists have exploited this idea in the lab to engineer new proteins with enhanced properties in a process called **directed evolution**. If the gene that encodes for a desired protein is known, random mutations can be made in the gene to create a library of slightly different gene sequences that can be translated into slightly different proteins. These proteins are then screened with a selective pressure for the desired trait (faster enzymes, greater thermostability, brighter markers, etc.). The selected variants are then sequenced to determine the beneficial mutations, and the process is repeated. This allows for positive mutations to be discovered, rather than needing to be intentionally inserted. When the process is repeated with the best performing mutants, further evolution is “directed” down the desired path. By selecting and modifying the designs of the top flying planes, the group average distance will (hopefully) increase with each round. This can be repeated until an ideal flyer is identified.

### Going Further

Instead of making paper airplanes, try having everyone make a Hoopster from *The Science Explorer*. You can make these by forming two rings out of cut index card strips and taping them to the front and back ends of a plastic straw.

