WORKSHEET

Biological Strategy and Design Strategy for an Owl Feather

In the biological strategy summary below, highlight or underline the key words and phrases that show how the owl's wing feather reduces noise while in flight. Afterward, make a drawing of the biological strategy based on what you learned, use the words and phrases you underlined to write a design strategy that explains the key elements that help reduce noise as an object moves through the air and, draw the design strategy.

Owl Wing Feathers Enable Near-silent Flight

Owls are known as silent predators of the night, capable of flying just inches from their prey without being detected. The quietness of their flight is owed to the anatomy of their wing feathers, which have a leading edge that reduces turbulence. Turbulence typically creates a "gushing" noise when released in large forces. But the leading edge of the owl's feathers break up this large turbulence into smaller, micro-turbulences that reduce the amount of noise.

This leading edge is filled with different structures (hooks and bows) that create a stiff, serrated edge of various lengths. As air flows over and through a feather, these varied lengths and structures cause the air to be distributed into smaller vortices that disperse at different times into different directions (oscillations), breaking up an otherwise single, large air force. These smaller vortices oscillate at a higher frequency, creating a pitch that is above the hearing capabilities of most prey, as well as humans.

If not for the feather's serrated edges, there would be only one, large air vortex formed at the trailing edge of the feather's airflow. This large vortex would produce, in turn, a large force on the feather. That force would increase turbulence across the owl's entire wingspan and, ultimately, produce more noise.

In addition to the serrated edges, the owl's feathers are coated in a velvety upper surface and a soft, downy surface on the lower portion. The owl's legs are also coated in this soft down. This layer of softer plumage is believed to absorb more of the micro-turbulences created from air flowing over the leading edge of the feathers. However, the exact mechanism of sound absorption by this down layer is still under preliminary study.

Image: Close up of the leading edge of an owl flight feather and the soft surface of the wing. Photo by Kersti Nebelsiek, CC-BY-SA, via Wikipedia.

Summary: Excerpt from **Asknature**.

Answer Key:

Biological Strategy and Drawing

Here is the biological strategy with the key information underlined. In the third paragraph, notice that the information is about what would happen in the absence of the biological strategy (i.e. the serrated edges). This will be useful for the sketch and explaining how the biological and design strategies are an improvement over alternatives. There is nothing underlined in the fourth paragraph because of the inclusion of the phrases "is believed to" and "the exact mechanism of sound absorption by this down layer is still under preliminary study." While scientists appear to be fairly certain that the softness of the feathers dampen sound, they don't know the mechanism so adding this to the design strategy should be done cautiously.

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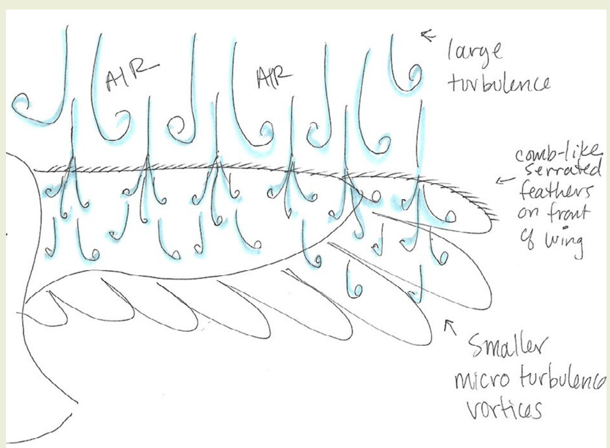


Image: An example of what a drawing of this biological strategy might look like.

Summary: Excerpt from **Asknature**.

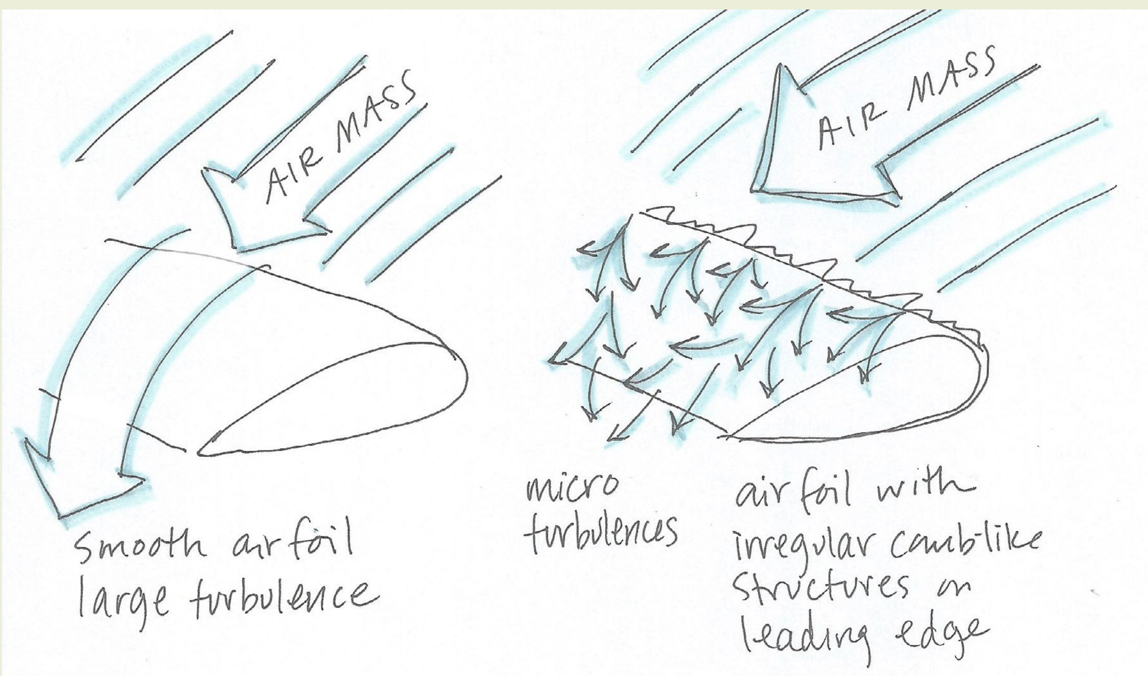
Answer Key:

Design Strategy and Drawing

Here is a design strategy and drawing to go with the biological strategy. Notice that we did not include the information about the softness of the feathers but we could have added that as a possibility for experimentation in the design. Also note that although we say "passing through air," air is a fluid, so you can generalize this by saying "fluid" which might open up other possible design avenues. The design strategy is actually very similar to the biological strategy; there's nothing wrong with using the same wording as in the biological strategy, as long as it is in terminology that non-biologists would understand.

Comb-like structures reduce noise when located on leading edge of an airfoil.

An airfoil reduces noise when passing through air by breaking up large turbulence into smaller, micro-turbulences. It does this by providing the leading edge of the airfoil with comb-like structures of varying lengths and shapes. As air flows over and through the airfoil, these varied structures cause the air to be distributed into smaller vortices that disperse at different times into different directions, breaking up an otherwise single, large air force. These vortices oscillate at a higher frequency than one large vortice, creating a higher pitch that humans can't hear.



An example showing what a drawing of this design strategy might look like.
Note that biological structures (wing, feathers) are not shown in the design strategy.