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Keeping warm with fur in cold water: entrainment of air in hairy surfaces ALICE NASTO, MARIANNE REGLI, PIERRE-THOMAS BRUN, Massachusetts Institute of Technology, CHRISTOPHE CLANET, PMMH, ESPCI / LadHyX, Ecole Polytechnique, ANETTE HOSOI, Massachusetts Institute of Technology — Instead of relying on a thick layer of body fat for insulation as many aquatic mammals do, fur seals and otters trap air in their dense fur for insulation in cold water. Using a combination of model experiments and theory, we rationalize this mechanism of air trapping underwater for thermoregulation. For the model experiments, hairy surfaces are fabricated using laser cut molds and casting samples with PDMS. Modeling the hairy texture as a network of capillary tubes, the imbibition speed of water into the hairs is obtained through a balance of hydrostatic pressure and viscous stress. In this scenario, the bending of the hairs and capillary forces are negligible. The maximum diving depth that can be achieved before the hairs are wetted to the roots is predicted from a comparison of the diving speed and imbibition speed. The amount of air that is entrained in hairy surfaces is greater than what is expected for classic Landau-Levich-Derjaguin plate plunging. A phase diagram with the parameters from experiments and biological data allows a comparison of the model system and animals.

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