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Did You Know ?

Water walkers

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Scientists at MIT have found the way tiny insects use molecular forces in the surface of water to zip about like speedboats

David Hu and John Bush have reported in *Nature* that insects move at 30 body lengths a second v strike a pose and move up the slope of water at the edges of a puddle, without even moving their l

The water surface

Water molecules consist of 2 positively charged hydrogen atoms linked to one negatively charged atom, but the way the atoms are placed is not symmetrical. Thus, at short distances, water molecu *polarity,* like magnets with N and S poles, and exert powerful electric forces.

When well within a body of water, where other molecules surround a molecule, there is no net effe forces. But at the surface, with a mass of water on one side and nothing on the other, the surface feel a strong inward pull. The surface of water is thus like a tight membrane, which resists anythin gap in the surface and getting in.

The surface can thus support a reasonable weight and the surface of ponds or puddles supports a universe of tiny, millimeter-scale life-forms, which find the water surface as rigid as any other.

Getting their feet wet

This is so long as the insects' feet stay dry. If they got wet and the separation between the feet an of water then disappeared, the feet would sink. We may have seen that a drop of water on a glass is just a little greasy does not spread out, but forms a little bubble, as it tries to pull itself into a ball surface. But if the glass is clean, then the forces between the water molecules and the glass are a

the force of the water mass and the drop spreads out.

The attraction of glass for water molecules, in fact, is quite strong and we can see that the edge of glass tumbler slopes upwards at the sides of the tumbler. If we dip a thin glass tube into water, the raise the water to a considerable height. This *capillary effect* is what helps nutrients flow up the roc and trees.

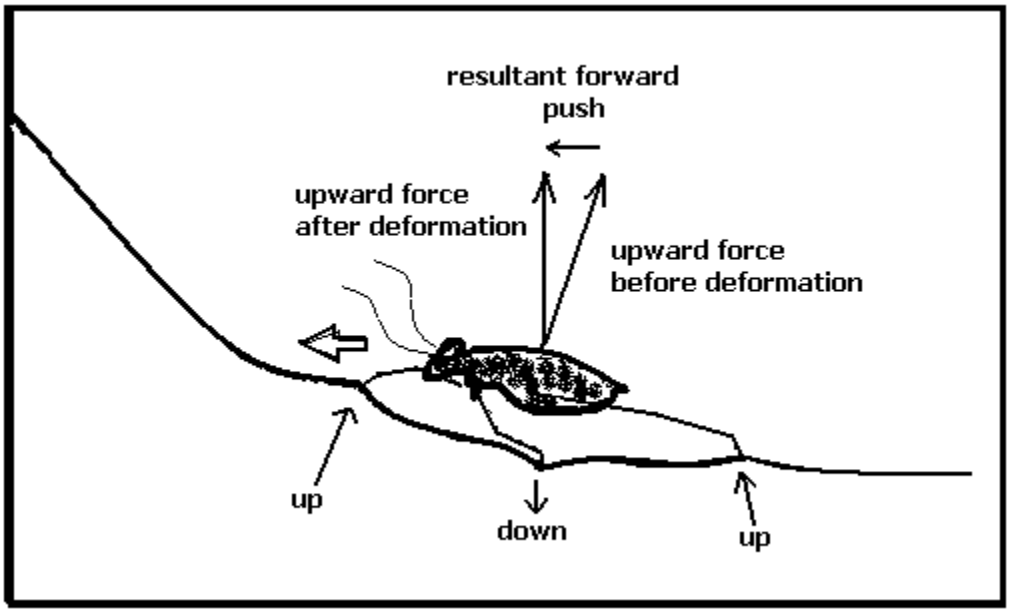
But if the insects' feet are dry, the surface of water does not break and the insects can ride the sur sledge over snow, using the fore and rear legs as support and the middle legs as paddles. The ins is that their feet are covered with the fine hair which traps air, to keep the water away from the feet

The research at MIT

For all the facility of moving over the water surface, tiny insects face a challenge when they come of the surface. At the edges, the surface slopes upward, like at the side of a glass tumbler. And for millimeter-scale insect, the slope is high and steep and slippery! Many insects do need to come to But they may well be trapped on the water by the gradient-barrier at the water edge.

The MIT scientists used high speed video – 500 frames a second – to capture the action. They fou insects adopt a specific posture along the edges of the pond or puddle and then make capillary for them out of the water! The insect does this by selective wetting of its front and rear feet, while kee middle ones dry.

As the insect approaches the sloping edge of the water, it lets down claws that it otherwise keeps from its front and rear feet. They then take up a stance where the front and rear limbs pull up the s water while the middle feet push down. The capillary forces that draw the feet that are wet then ad net force that pulls the insect up the slope.



It is a delicate operation, with the limbs to be stretched just so, somewhat like a sailor 'tacking' the move against the wind. But the insects manage to reach speeds of around 10 cms a second!

"The normal locomotion of animals is to use muscles to move or raise things", say Hu and Bush. B water walking insects, the muscular force is used to deform a surface, to tap molecular forces.

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Photographs courtesy David Hu and John Bush . More photographs of the insects in action can be
following url:

http://www-math.mit.edu/~dhu/Climberweb/climberweb.html

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