What do you plan to research for your project?

Problem:

Topics related to the problem:

1) How does mass relate to water buoyancy?

2) How do water striders float on water?

*3) How does a floating water strider compare and contrast from other water dwelling animals?**
*4) How does a water strider move across the water while floating?**
*5) On average, how heavy are water striders?**

Star three topics you will research during research time

ONE MAIN IDEA I SHOULD RESEARCH IS… How do the indents that water striders create in the water's surface benefit the water strider?
The folks at MIT dissected WS propulsion. The feet of the WS create tiny dimples on the water where they sit. When they locomote, their feet push down and back, forming a small indentation off of which they rebound, moving forward as if bouncing on a trampoline (for every action, there is an equal and opposite reaction—life is physics) Magnified photos show that the water strider's feet dimple the surface of the water much like your feet press big dimples on a bed if you stand on it. It looks like there is a film or skin on top of the water, but there isn't. It is just water. Water holds together, especially on the surface Under each leg, the water surface bends down creating a dimple (meniscus). Heavier water striders create deeper dimples, which produce stronger upward force from the downward stretched water surface that supports the insect body.
Website Address (copy exactly): https://uwm.edu/field-station/bug-of-the-week/water-strider-revisited/#:~:text=The

%20folks%20at%20MIT%20dissected,solve%20the%20problem%20with%20cannibalism

https://assets.bouldercounty.gov/wp-content/uploads/2018/05/nature-detectives-water-striders.pdf

https://phys.org/news/2023-07-world-largest-striders.html

A SECOND MAIN IDEA I SHOULD RESEARCH IS… How do water striders withstand rainstorms?

The extremely water-repellent micro hairs covering their bodies help water striders resurface. These hairs trap a bubble of air, called a plastron, around a strider's body to create extra buoyancy. Water striders additionally use their plastron to breathe while submerged, like a scuba diver's air tank.

Website Address (copy exactly):
https://northernwoodlands.org/outside_story/article/water-striders

A THIRD MAIN IDEA I SHOULD RESEARCH IS… How do water striders float on water?

If they become submerged in water, air bubbles trapped in the hydrophobic hairs will make them float back to the surface. Their long legs are splayed out from the body and tipped with the fine hydrophobic hairs that catch air to provide flotation, therefore, the insect does not break the surface tension of the water.If they become submerged in water, air bubbles trapped in the hydrophobic hairs will make them float back to the surface. Their long legs are splayed out from the body and tipped with the fine hydrophobic hairs that catch air to provide flotation, therefore, the insect does not break the surface tension of the water.
This is made possible by their six legs which are covered with thousands of microscopic hair-like structures called microsetae that measure about 50 micrometers long (less than two-thousandths of an inch) and number more than a thousand per square millimeter. They are etched with grooves which trap air and take advantage of the natural membrane-like quality of water surface-tension.

Website Address (copy exactly):
https://gvmecology.com/wildlife/water-striders/
https://www.nps.gov/articles/pecies-spotlight-water-strider.htm

FIVE WORDS I NEED TO KNOW FROM MY RESEARCH ARE…
1)Word: Buoyancy Definition: “**buoyancy**, tendency of an object to float or to rise in a fluid when submerged. This fluid can be either a liquid or a gas.”
Website Address (copy URL from definition website exactly – No ‘Google Search’): https://www.britannica.com/science/buoyancy
2)Word: Hydrophobic Definition: “tending to repel and not absorb water”
Website Address (copy URL from definition website exactly – No ‘Google Search’): https://www.vocabulary.com/dictionary/hydrophobic
3)Word:Hydrophillic Definition: “having a strong affinity for water; tending to dissolve in, mix with, or be wetted by water”
Website Address (copy URL from definition website exactly – No ‘Google Search’): https://www.vocabulary.com/dictionary/hydrophilic
4)Word: Meniscus Definition: “the curved upper surface of a nonturbulent liquid in a vertical tube”
Website Address (copy URL from definition website exactly – No ‘Google Search’): https://www.vocabulary.com/dictionary/meniscus
5)Word: Biomimicry Definition: “the imitation of natural biological designs or processes in engineering or invention”
Website Address (copy URL from definition website exactly – No ‘Google Search’): https://www.merriam-webster.com/dictionary/biomimicry

Water striders are bugs that have the ability to float and walk on water. They have many details that allow them to do things that not many other animals can do. Researching important parts about the bugs that make them float on water, how the indents or dimples a water strider makes in the water help it to move across the water, and how they withstand rainstorms, will help to make a model water strider that can float like one.

Water striders float on water with air bubbles trapped inside of hydrophobic, or repellent to water, hair on their legs and by using the surface tension of the water. According to Glacier View Meadows Ecology, air bubbles that are trapped inside hydrophobic hairs on water striders' legs help them float. This is important because even if they break the surface tension of the water, the trapped air will push it back up to the surface. This will affect my science fair project because the water strider model will need to have air trapped with its legs by using something light that doesn't interfere with the weight of the model or disturb the surface tension of the water. Based on the information provided in Species Spotlight, water striders have thousands of mini hair like structures that are each about fifty micrometers long and there are more than a thousand of them on their legs per millimeter. This is important to my project because the model will need a way to have trapped air within itself that mimics the microscopic hairs on real water strider legs. This also means that it's not possible to perfectly recreate a model of one with household equipment because the hairs on water strider legs are microscopic and are too small to work with basic household equipment.

Water striders withstand rainstorms for a few reasons like how bubbles of air trapped in their legs help them to resurface quickly. If they are submerged for too long, they will use those air bubbles to breathe underwater until they reach the surface. As stated in Species Spotlight, "A direct impact from a large raindrop can indeed sink a strider, and a nearby hit can launch it feet into the air. It is their strong exoskeleton which allows them to survive by absorbing the impact." This shows that the exoskeleton of a water strider can help to absorb the force of a raindrop hitting down on it. Based on the information in Species Spotlight-Water Striders, a lot of insects sink in water but water strider legs can hold up to fifteen

times their weight. This explains how striders can withstand raindrops, because their legs are so strong that they can counter the force of the raindrop. As stated in Northern Woodlands, "The extremely water-repellent micro hairs covering their bodies help water striders resurface. These hairs trap a bubble of air, called a plastron, around a strider's body to create extra buoyancy. Water striders additionally use their plastron to breathe while submerged, like a scuba diver's air tank." This is important because it shows that a water strider's entire body is very buoyant because they store air bubbles all around their body. This means that the model of a strider will need to have trapped air anywhere possible to achieve the mimicry of the water strider as best as possible.

The dimples that water striders make on the water are important for their survival because they use them to glide around on the water's surface by pushing off of the water which holds together better at the surface than underwater, and the push that it gives can be weaker or stronger depending on the weight of the strider. According to Water Strider Revisited, water striders push off of the small dimples to move forward, thanks to Newton's third law of motion. This is important because this is one way they move that could be incorporated into the model by using the middle pair of legs and manually pushing them to make the model water strider move. As stated in Nature Detectives, "Magnified photos show that the water strider's feet dimple the surface of the water much like your feet press big dimples on a bed if you stand on it. It looks like there is a film or skin on top of the water, but there isn't. It is just water. Water holds together, especially on the surface." This matters for my project because the quote explains how the surface tension of the water helps water striders, and a model of one stays above the water. It also helps to explain in depth how they can push off of their own dimples to move across the water. Based on the information in "Examinating how the world's largest water striders jump on water," water striders create a dimple, called a meniscus, under each leg that is bigger the heavier the water strider is in order to counteract the force of gravity on it. This impacts my project because there isn't one perfect weight that allows for biomimicry of water striders. There are multiple weights that work for the experiment, they just can't be so heavy that the surface tension of the water breaks.

One fact learned is that water striders stand on the surface tension of the water rather than floating in it to stay afloat. Another fact is that hydrophobic hairs located on their legs trap air that helps them to stay on the surface tension, which also helps water striders to float back up to the surface if they're submerged by raindrops or otherwise. A third fact is that striders move across the water by pushing on dimples that they create in the water's surface with their middle pair of legs that can be compared to pushing off of a trampoline to jump. These functions help the water strider survive on top of the water and they would not be able to survive without these adaptations. A model of one of the bugs would not be able to compare to a real one without traits that mimic hydrophobic hair, and other traits that have the potential to greatly impact how a model of a water strider behaves.

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