Therapeutic Recreation Protocol: Liquid Science

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General Purpose-Cognitive
- Improve and maintain cognition through novelty and surprise
- Develop and build social communication skills
- To improve concentration and higher-thinking skills
- To engage the senses (touch, smell, taste,)
- To recall and share relevant personal experiences and knowledge

Program Description
Participants will learn about surface tension and emulsification through several hands-on experiments.

Materials Needed
- Clear narrow plastic containers—3-4 inches wide by 10-12 inches long
- 2 clear glass jars with tight lids (about a quart each)
- Clear dish soap
- Small bottle of store-bought salad dressing (Kraft Zest Italian is a good example)
- Measuring cups
- Measuring spoons
- Red wine vinegar (not white vinegar since it is important that the vinegar has color)
- Vegetable or olive oil
- Prepared dijon mustard or prepared grainy mustard (not yellow hot dog mustard)
- Salt
- Pepper
- Salad dressing spice(s) such as Mrs. Dash Garlic and Herbs or Herbs de Provence
- "Boats" cut in the shape of bread closure tabs with a hole cut in the end (waxy cardboard from a milk carton works well because it is waterproof)
- Cotton swabs (some with short handles and some with long handles (like medical swabs)
- Paper towels
- Paper plates with a slight rim and plastic coating (not the real cheap ones)
- Tiny containers to hold a very small amount of dish soap (to-go salad dressing cups perhaps)
- Several gallon jugs to hold water for experiments
- Five gallon bucket (to dump used water from experiments)
- Handout showing photo of water strider insect and water on top of a coin
- Small plates to hold salad dressing
- Bread for dipping into salad dressing made by participants
- Hand towel and/or paper towels

Populations
Targeted primarily at high-functioning participants.

Contraindicated Criteria
Participants with limited arm and hand abilities may need assistance.

Cautions
Know participants' allergies and diet restrictions

Setting Up the Environment
Participants will sit at tables (preferably long tables) where they can see each other and the facilitator and have access to a hard surface to do experiments.

Note that after a drop of liquid soap is applied to the water, the water must be discarded and replaced before trying the activity again. Carrying shallow water-filled trays to a sink could be messy. Instead, it is recommended that a bucket or large waste basket be brought to the trays so the trays can be emptied right at the work space.

Activity

Introduce yourself and get all participants' names.

We are going to explore liquid science today. You will likely have observed some of the things we are going to see and do today, but we are going to find out how these things happen and have some fun, too.

Water Strider

Who knows what a water skeeter is? Sometimes they are called water skimmers., pond striders, or water striders.

What does this insect do?

Show video or refer to handout of water strider.

BBC Invisible World: Water Strider
https://www.youtube.com/watch?v=0y2oLPH3l6E

What do you see? What is this insect doing? How does he do it?

Did you notice this? Where his feet make contact with the water, it sort of dents in almost like when you sit on a mattress. You don't sink through the mattress and this insect doesn't sink through the water.

What happens when we step into water like a tub or swimming pool? Do we stand on top of the water like the water strider? We are a lot heavier than a water strider, that's for sure.

Let's figure out why the water strider can stand on the water—which is not just because he doesn't weigh a lot.

Let's do some experiments.

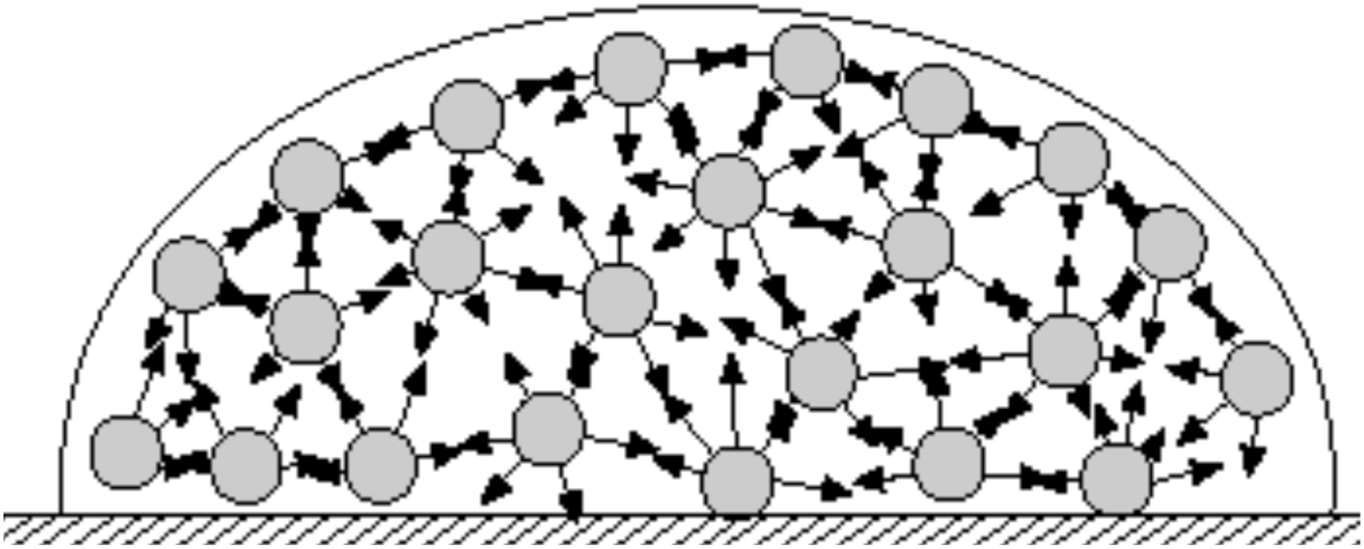
You have a plate of shallow water in front of you and some pepper. Shake some pepper gently into the water.

What happens? It just sort of floats on top. Why is that? It is light weight so it doesn't sink.

But let's see what happens when we do this. You have a cotton swab. Dab it into some dish detergent. And—1-2-3—all together—dab your swab into the water.

What happens to the pepper? It scatters. Why do you think that a happens?

How many of you have ever washed greasy dishes? Did you ever notice that when you put dish soap into a greasy pan that already has water in it that you can see the grease move away from the dish detergent? That's what is happening here.



As we saw in the water skeeter video or photo, the water has sort of a skin on it. When you add dish detergent , you introduce a type of chemical (called a surfactant) that breaks that skin and the lightweight items floating on top—the pepper—try to flee to a place that still has that skin.

So that delicate "skin" on top of the water is called surface tension. Surface tension is created by molecules of water. What is a molecule? The little tiny, tiny bits of matter that make up everything! Water molecules do not bond as strongly with soap molecules as they do with themselves.

Show or draw diagram above showing molecules with the molecules below the surface clinging to each other and the ones on top stretching and clinging to those molecules next to them. The diagram shows a droplet of water—and water drops are round. Surface tension is what makes the drop round. If the water were in a cup with all sides, it would be flat but the top molecules still cling tightly to their neighbors on each side.

So when water molecules get together they cling together. The water molecules below the surface have other water molecules surrounding them on all sides and they are all happy clinging together because it's easy when you are being supported by "friends" on all sides. But the water molecules on top, only have friends supporting them on the sides and beneath them—no "friends" to cling to above them. The molecules on top do not have other like molecules on all sides of them and consequently they hold on more tightly to their "friends" next to them. By holding on so tightly with no molecules above them, they create a "skin" or what is called surface tension. This diagram shows water in a round drop on a surface. The bottom photo in the handout shows a water droplet on a coin. Does it look round?

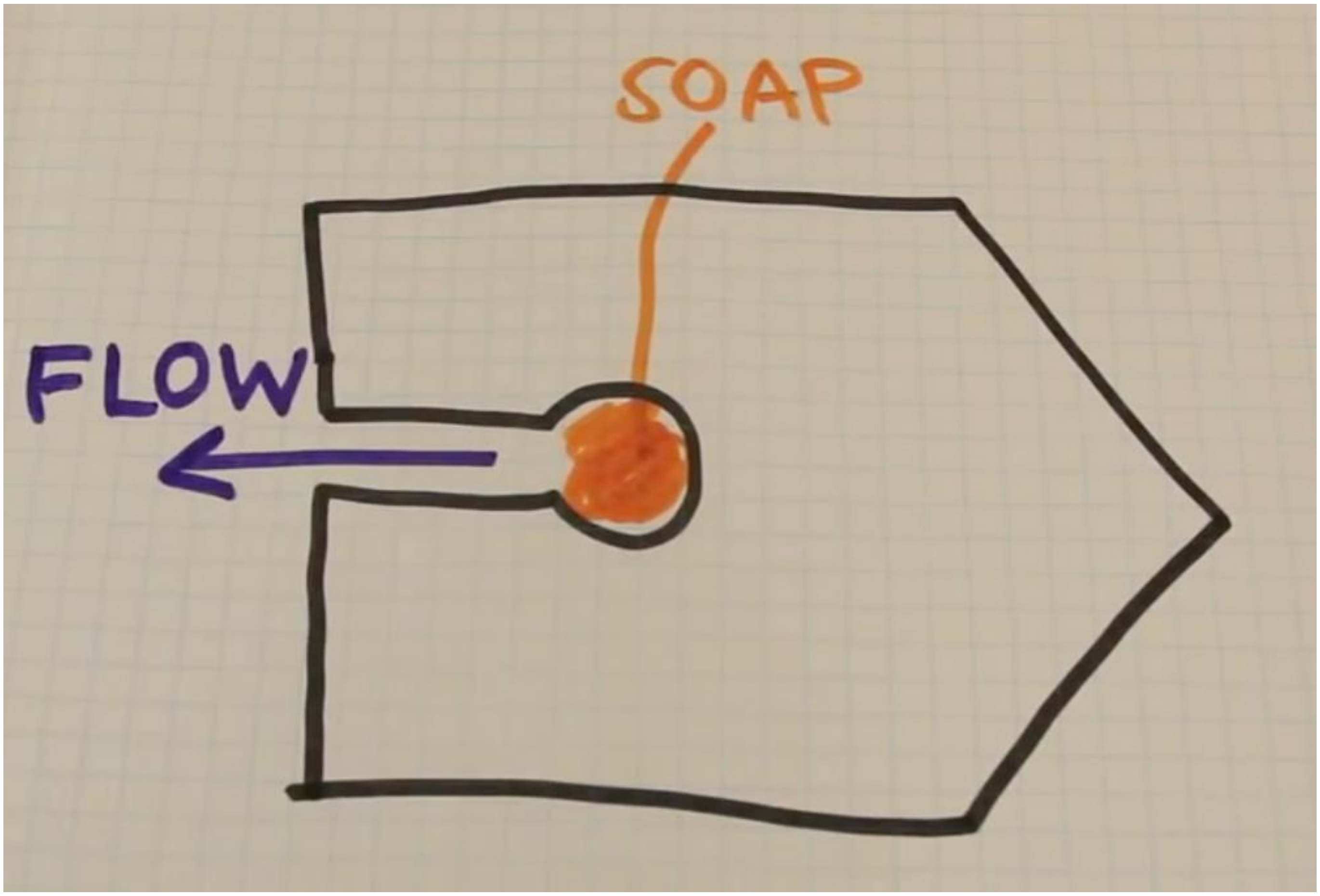
The photos of the water strider and the coin with the round droplet are demonstrations of surface tension. The scattering of the pepper away from the soap is also an example of disrupting surface tension.

<u>Let's do something a little bit more fun with surface tension.</u> I have several narrow trays of water. Can you all see one tray pretty well?

I am going to give you "a boat" to go with each tray of water. This little cardboard cut-out is what I am calling a boat. What does it look like?

What do you notice about this miniature boat? Is it square? Is it pointy? Are parts of it cut out? So this is our miniature boat. It looks sort of like a "bread tab" that keeps your bread bag closed. And what do boats do? They float.

Make sure everyone can see a narrow water tray. I am also giving you a swab and we will dip it in dish



soap again. Make sure your water is still. We don't want waves so your boat starts floating around in all directions. Gently put your boat in the end of the water tray closest to you so that it doesn't get water on top. Now do you see the little cut-out hole on the back of the boat. Dab the soap quickly through the hole.

What happened? Did the boat move? Did it move fast or slow? This is a fun thing to do with little kids. Do you think your grandkids would like this?

What do you think will happen if we try this again? Will the boat move again and go fast? Let's try it. You can even have a new boat.

What happened? It didn't move very well did it? Why? The dish soap is still in the water and breaking up that top layer of molecules that makes that skin—the surface tension. To make the boat move again, what would we need to do? Get clean water and start over.

Destroying the surface tension of the water by adding soap (also called a surfactant), we have experienced the Marangoni Effect.

So we now know that water has a very thin skin on it created by that top layer of water molecules stretching to cling to the molecules on either side of it. And that is called surface tension.

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Does surface tension help keep the water strider afloat? Yes.

So we are going to explain another liquid science phenomena: Salad dressing!

Have you ever made a simple salad dressing? What are two main ingredients of most salad dressing? Vinegar and oil.

So let's pour some vinegar and oil into two jars. What color is this vinegar? How does the vinegar smell?What color is the oil?. We better make sure the lid is on tight. Check this for me and tell me if that lid is on tight. Who can I have shake these jars to mix the vinegar and oil. Does it look mixed? Let's set them on the table and see what happens. What do you think will happen? What do you see? What color is on the bottom? And that color is what? The red vinegar has fallen to the bottom and the oil is on top.

Here's a bottle of store bought salad dressing. The first two ingredients are oil and vinegar. Does this salad dressing look like it is mixed well? Why is it mixed when it has been sitting on a shelf in the store for months probably? The answer is that there are some ingredients that help vinegar and oil mix. Some of them are natural and some are invented and are chemicals.

On the store bought salad dressing, the ingredient that keeps the vinegar and oil mixed is something called xanthum gum. Store bought products often use polysorbate 80, carboxymethylcellulose, mono- and diglycerides , casein and lecithin to keep foods mixed together—things we don't find in our pantry. Peanut butter is another food that needs help staying mixed, as well as ice cream, even baked goods need help staying mixed before they are baked. A lot of processed and prepared foods have added chemicals to keep them mixed.

Kraft Zesty Italian Salad Dressing: Vinegar , Water , Soybean Oil , Canola Oil , Sugar , Salt , Contains 2% or less of the following: (Garlic Dried , Garlic , Peppers Bell Red Dried , Onions Dried , Xanthan Gum , Spices , Oleoresin Paprika , Potassium Sorbate , Calcium Disodium EDTA)

These items that keep food mixed together are called emulsifiers. Vinegar is a water-type molecule and oil is obviously an oil-type molecule and they do not get along. So we need a molecule that likes both water and oil. And that molecule is called an emulsifier. An emulsifier molecule is half water-loving and half oil-loving so it can cling to both and create a good mixture.

We don't have chemicals so we are going to use something very simple: mustard. Let's add some mustard to one of the jars—and while we are at it, let's make a salad dressing that tastes good. Let's add some herbs and a little salt. Do you like the way this seasoning smells? Okay, we are ready to shake the jars again. Let's let them sit on the table for a few minutes to see if they stay mixed. Is one staying mixed more than the other? Mustard will keep the salad dressing mixed for awhile but not permanently. So that's why we have to eat it now rather than letting it sit around.

Closure

Let's use our salad dressing as a dipping sauce for bread. Pour a small bit of salad dressing on a small plate and distribute small pieces of French bread. How does our salad dressing look? Still mixed? Better than without the mustard? We will all get a bit of salad dressing in a small and we can dip our bread in it.

Thank each participant by name.