The experiments explained

1. The balloon and the water
   The balloon becomes charged when Matthew rubs it on his hair.
   The short explanation is that charged objects pull gently on uncharged objects and we notice this when those objects can move easily. A small stream of water moves easily.

   The longer answer is that when the balloon rubs on his hair, tiny negatively charged particles called electrons have been transferred from his hair to the balloon. This makes the balloon negatively charged. When it is brought near the water the electrons in the surface atoms of the water are repelled leaving the water slightly positive on the surface next to the balloon and this causes the water to be attracted to the balloon.

2. Cup tips upside-down

We live in a sea of air. The air is made up of tiny particles which move around very quickly randomly colliding with every surface and this creates a force (push) on all surfaces including the outside of us – so we are pushed inwards by the air. In fact the air pushes on the surfaces quite hard. We call this push inwards on us from the air "atmospheric pressure". It pushes in on surfaces in all directions, even upwards. We don't implode because our body pushes outwards with the same pressure.

Again there is a short answer and a longer answer.

The short answer is that the air pushes up on the bottom of the card and holds it there.

The longer answer involves explaining why the weight of the water doesn't push the card down. Isn't the weight of the water enough to overcome the atmospheric pressure pushing against the card? If you look at the top of the glass of water (formerly the bottom), you'll notice a small pocket of air. There isn't much of an opportunity for air to get into that space, so what we've created is a small pocket of low pressure (a place where there really isn't that many air molecules to hit the sides). There are more air molecules pushing up against the bottom of the card, creating a higher pressure upwards compared with the lower pressure area inside the air pocket in the glass pushing down. The force from the atmospheric pressure up holds the card up balancing the total force down from the low pressure air inside added to the weight of the water and the weight of the card. So the card stays put.

3. Card and coin trick
   All still objects want to stay still. This has a physics word which is "intertia". To make it start to move an object needs a force. This could have been provided by the card as it was pulled if the surface was rough. This would make a force called friction, gripping the coin to make it move with the card. However, the card is smooth so there is very little friction so there is almost no force on the coin to make it move with the card and so it stays put.

4. Food colouring and soap
   This is the same idea. If you drop the soap on quickly enough some of the food colouring is still at the top to show us the surface water moving.

5. The lava lamp

   The oil is on top of the water as they don't mix and the oil is less dense. This means that a volume of oil is lighter than the same volume of water. Less dense things float in more dense things. Dense things have lots of particles in a small space making them heavy for their size. When the alka selzer is dropped in to the water, bubbles of gas are created. Gas particles are very spread out so gases are not very dense (not very heavy for their size). The bubbles are much less dense than the oil. These float up through the oil and take a little of the blue coloured water around the edge with them.

6. The Cartesian diver

   The sachet floats because it is less dense than the water. The sachet contains mayonnaise and some air. Air is a gas so its particles are very spread out so aire not very dense (not very heavy for its size).The air is what makes the overall density of the sachet smaller than the density of water, much like the air in a steel ship allows the ship to float. When we squeeze the bottle the sachet sinks. The water in the bottle can't shrink (compress) as particles in water are already close together, so as Caitlin pushes on the bottle, her force acts through the water (each water molecule pushes on the next) and squeezes the sachet which can shrink (as air particles in the sachet can get closer together) and become a little more dense. The sachet becomes denser than the water as a result and sinks.