It's a Rock's Life

I'm what you would call a 'mutt-rock.' Yep – just like your dog I bet – a regular Heinz-57 kind of rock. You see I am made of bits and pieces of a lot of different things. Let's see…. I have soil, some sand and silt and even pieces of other rocks all cemented in me. Some of my friends have seashell parts in them and, if we are really lucky, you might find some fossils in my kind of rock. I have some trilobites embedded in my layers right about here. Oh yeah, I didn't introduce myself. I am Lynn Limestone Rock from the Rock family. Specifically – I am from the Sedimentary branch. At least I am right at the moment but not forever. You see, over time all us Rocks change and we have since the beginning of time on this planet. We are all made of the same material, just re-processed into different rocks. It's kind of like going into the witness protection program or undergoing major personality changes. We just get churned up and spit out as some new rock as the Earth moves through its normal cycles.

A rock's life can be summed up in one word: CHANGE! We have no control over it either. Like it or not, we just keep on rolling through the Rock Cycle of life…

The Rock Cycle is a process that continues over and over and over and has been churning away since this planet was formed some 4.6 billion years ago! New rocks are constantly being made while old rocks are always in the process of being destroyed while the Earth's crust is recycled continuously. When the Earth was formed, there were no hard rocks at first. In the beginning the Earth was just a gigantic planet of molten rocks called magma and lava and it stayed that way for billions of years. Those were tumultuous times with volcanoes erupting and heaving magma up to the surface of the earth where it is called lava. All kinds of asteroids and meteoroids bombarded the planet causing complete chaos compared to today. It was a hot place here on Earth and that's an understatement! But finally, the Earth began to cool and as it cooled, vapors escaped into the air and the rains began to fall. The cooling temperatures caused the lava to harden and form the rocky crust that covers the Earth.

The first rocks were probably igneous rocks that were formed from the cooling lava. Those are rocks formed as a result of volcanic activity with a lot of heat and pressure from material that was once deep inside the Earth. Once out in the open above the surface of the Earth, these rocks and all rocks for that matter continue

to change. Let's look at what happens to rocks that spend some time on the surface.

Over time all rocks weather but some rocks weather faster than others. In the end however, we all break up into smaller pieces and become a pile of gravel, sand, and dirt. Several things cause us rocks to break up. The temperature is a huge factor. When it's hot, rocks expand because the molecules that make us up expand and when it's cold, the opposite happens. Rocks contract because … you guessed it. Our molecules move closer together. Now you won't see a rock growing or shrinking as you stare at it but over hundreds of years that is exactly what happens and little by little, pieces and even chunks of rocks break off from the wear and tear of expansion and contraction. Rain also helps break rocks apart. When it rains, the constant pressure on rocks can break off pieces. It's worse when it rains and freezes. Rain finds its way into the cracks and crevices of rocks and if it freezes in there, the ice expands and makes the cracks even bigger. All this comes from temperature changes and eventually, rocks crack and break up. These processes are called physical weathering.

Chemical weathering also causes rocks to break apart because some chemicals actually dissolve rocks and that makes them break apart even faster. Even the water in rain or rivers and streams can dissolve some rocks. Of course polluted acid rain causes chemical weathering too. There's another kind of weathering called biological weathering. That's when living things like tree roots force themselves into small cracks in rocks and eventually break them apart. So, you can see the surface of the Earth is not a good place to be if you want to maintain your rock shape and characteristics forever. The fact is… rocks weather from physical, chemical, or biological weathering processes.

As rocks break apart into pieces they are easier to move around. In fact, some of the rock pieces are so small they are grains of sand. These small pieces of rock are moved by erosion and there's no telling where they will end up. Broken off pieces of rock fall to the ground and can roll or slide down hills by the forces of gravity. Rock pieces can be carried off by water moving in rivers ,streams and oceans or even in floods. Even wind can cause erosion by carrying small grains of rocks (sand) to different locations. Another erosion process that you may not think of is ice. Glaciers are really ice rivers and they are so strong that they can move the largest pieces of rock. So, once rocks are broken apart into pieces, big

and small, they are moved to different locations by erosion which can occur as a result of gravity, water, wind and glaciers.

Just like everything else on Earth, pieces of rocks cannot keep moving forever. At some point, rivers reach the oceans, the wind stops blowing, glaciers melt, and moving rock pieces come to a halt. And when this happens, the rock pieces that were being carried are dumped. This process is called deposition. Deposition results in rock pieces being laid down in layers with the heaviest pieces on the lower layers and the finer rock particles on the upper layers. The particles that are layered on top of each other are called sediments and these sediments build up over time.

As the layers build up over time, the pressure of the weight of the upper layers builds up on the lower layers. Imagine what it would feel like if all your friends piled up on top of you? You would feel squished and so do the layers of sediment as the layers increase. As the layers are squeezed together and the pressure on the layers increases with the weight, any water mixed in with the sediments is squeezed out. This process is called compaction. As the sediment layers are being compacted, the sediments begin to stick together and become cemented by clay or minerals like silica and calcite. Finally, after the rock particles are compacted and cemented into layers, they become a sedimentary rock.

Sedimentary rocks like limestone, shale and sandstone are different from all other rocks. They are formed from layers of sediment built up over a long time and are actually grains of sediment that have been cemented together by minerals. Sedimentary rocks are also the only type of rock that can contain fossils. Fossils are the remains of dead animals and plants that were caught up in the sediments as they were being deposited, compacted or cemented together.

Not all igneous rocks turn into sedimentary rocks. The Earth's crust can be a very stressful place. The crust is not a solid rock but instead is like a giant jigsaw puzzle. The pieces of the puzzle cover the entire surface of the earth on land and on the sea floor. These puzzle pieces are called plates and they are constantly moving in different directions. This causes all kinds of stress on the crust because sometimes these plates collide (bump into each other). Imagine that you are walking straight ahead and in front of you stands a kid who weighs twice as much as you and… this kid is walking straight toward you! If both of you keep on

walking until you bump into each other, one of you is going down! The same thing happens when the plates collide. The heavier plate (large portion of the Earth's crust) is pushed down under the lighter plate and the end result is that the rocks on the heavier plate get pushed down deeper into the Earth while the rocks on the lighter plate are pushed upward. This process is called uplift and it can cause rocks that were once underground to come up above the Earth's surface. Once these rocks are moved to the surface they begin to weather and erode and you know what happens after that.

You might be wondering what happens to those rocks on the heavier plate that was pushed down deeper underground. Way down inside the Earth, it very hot and there is a lot of pressure. It's so hot and there is so much pressure that rocks that get pushed deep into the Earth actually change. This process is called metamorphism. Any rock can be metamorphosed. All it takes is for the rock to be pushed deep down inside the Earth. Igneous rocks like granite can turn into gneiss (pronounced 'nice') and sedimentary rocks like limestone can change into marble when they are pushed down into the hot pressure-cooker inside the Earth.

Some rocks get pushed down so far underground that they melt and become molten rock called magma. Magma also exists in the mantle, the layer between the Earth's crust and the core that is at the center of the Earth. Magma in the mantle and in the crust rises upwards because it is hot and because it is less dense than the surrounding rock. The rising nature of magma creates more stress on the crust of the Earth. Eventually the magma from the mantle joins the magma in crust that is underground and forms a magma chamber – a huge pool of magma within the Earth's crust. If the magma chamber is left alone for hundreds of thousands of years, it will eventually cool and crystallize to form intrusive igneous rocks like granite and gabbro. Intrusive igneous rocks are left to cool and form over a long time and that gives the crystals a long time to grow so these rocks are large grained. If the intrusive igneous rock is uplifted or the material around it erodes and is carried off, the igneous rock can end up on the surface of the Earth. A good example of this process is Stone Mountain.

Sometimes the magma chamber is located under a thin part of the Earth's crust or under a crack or fault in the rocky crust. This can happen when the plates of the Earth's crust are moving in opposite directions and are literally pulling away from each other. In this case, the magma is hot and rising and when it finds a fault or a thin space in the crust, it pushes out over the earth's surface as a

volcano. The rocks formed from volcanic eruptions are called extrusive igneous rocks. Basalt, pumice and scoria are extrusive igneous rocks and all of them are created from volcanic eruptions. Because the magma is pushed out of the volcano very quickly and becomes lava when it flows on the surface of the Earth, the molten rock cools very quickly. This doesn't leave a lot of time for the crystals in the rock to grow so these rocks tend to have very fine or small grains that aren't easy to see without magnification. Another outcome of the quicker cooling is that these rocks may contain gas bubbles formed. These are holes in the rock where gas bubbles existed when the rock cooled and hardened. Some extrusive igneous rocks like obsidian cool so quickly that they don't have time to form crystals. Obsidian is volcanic glass and not really a rock at all. Extrusive igneous rocks end up on the surface of the Earth where they are subjected to…. Yes! You guessed it. Weathering, erosion, and so on …. Or being pushed down into the earth when plates collide.

Sometimes extrusive igneous rocks stay deep inside the Earth's crust and as the heat and pressure increase they become … metamorphic rocks and you know what happens from there. Rocks and their pieces and particles just keep moving through and on the Earth. They are uplifted to the surface and pushed down deep underground and keep changing their shape and composition as they shift among the three types of rocks: igneous, sedimentary and metamorphic rocks.