Demonstrate the Rock cycle using Crayons.
(This exercise modified from Donald L Birdd, Color Me Metamorphic, *The Science Teacher*, April 1990, p. 20 – 25)

Equipment needed for this exercise:
1. Safety goggles
2. Vise (one that clamps to the table top is best)
3. 2 – 2.54 cm x 12.5 cm x 20 cm pieces of boards (plywood or solid wood) for each vise in use.
4. Hot plate, must have a flat surface, (one hot plate per 4 students)
5. 2 – pair of Tongs per group
6. Pocket pencil sharpener (one per student)
7. Petri plates or finger bowls (one per group of 4 students)

Materials
1. Wax crayons, red, green blue, yellow (4 to 6 of the same color crayon per student)
2. Aluminum foil, heavy duty, (one – 45 cm x 45 cm square per group and one piece to cover the hot plate)
3. Aluminum disposable pie plates, the smaller pie plates about 10 cm in diameter work best)
4. Wax paper
5. 4 – Envelopes per group
6. Newspaper – enough to cover the lab table tops, have lots on hand)

Part 1: Weathering
Cover all desk tops with newspaper. Each student should have a sheet of wax paper, a pocket pencil sharpener, and 4 crayons of the same color. Each student in each group of 4 people should have a different color of crayons.

Answer Questions A on the worksheet.

Each student should carefully shave each of the crayons with the pencil sharpener, keeping all of the fragments in a small pile.
As you are "weathering" the crayons onto the wax paper, look at the fragments you are making.

Answer Questions B on the worksheet.

When the weathering is complete, Place the fragments on their wax paper and place them in the center of the table.

Part 2: Erosion and sedimentation

Once rock fragments have been created, they are usually moved by some natural force.

Answer Questions C on the worksheet.

Place the four piles of crayon pieces in an area accessible to everyone in the group. Each group needs one sheet of foil 45 cm x 45 cm, which must be folder in half (now it is 22.5 x 45 cm).

Carefully, one student should spread one color of "rock" fragments onto the center of the foil, spreading the fragments into a 1 cm-thick layer covering an area approximately 8 cm x 8 cm. Each student should spread their color of "rock" fragments onto this same 8 cm x 8 cm area creating layers of colored "rock" fragments.

Answer Questions D on the worksheet.

Once you have recorded your observations of what you have collected on the foil, you should fold the foil over the "rock" fragments. CAUTION: Leave a 1 cm distance between the shavings and the folds of the foil. The foil should be crimped so the shavings will not fall out of the folded foil container. What works the best is to have the shavings in the center of the foil, the longer length of the foil is folded over in thirds over top of the shavings, and then the sides are folded in so they seal up the container.

Part 3: Lithification – Sediment to Sedimentary Rock

Place your folded foil container between two boards. The "sandwich" should then be placed in the vise. It is best for the foil container to be placed on one board while flat on the table and then the second board placed on top, and then the top board is pushed down by hand onto the package to begin the process. This will insure that the final product will be layers and not mixed "sediment".

This process does not need a great amount of pressure. The rock sandwich only needs to be mildly compressed. Maybe one half to one rotation of the vise handle.

Answer Question set E on the worksheet.

Once the rock sandwich has been mildly compressed, remove it from the vise. Carefully open your package and observe the new product. Look at the central region which is more tightly compressed. Lift this portion from the non-compressed fragments and carefully break it into two parts.

Answer Question set F on the worksheet

Place the loose fragments of "rock" into an aluminum pie plate. Break off a piece of the more compacted "sedimentary rock" and place it in a Petri dish. Place the two pieces of "Sedimentary rock" back into the aluminum foil package and wrap it back up as you had it originally.

Part 4: Metamorphism – the BIG SQUEEZE

Place the foil package between the boards and in the vise again. Add as much pressure to the vise as the you can, but NOT so much that you break the boards.

This part of the activity demonstrates the need for greater pressure. One group will place their aluminum foil package on a hot plate for a few seconds (3 seconds is ideal) before they place it on the boards and squeeze.

Answer Question set G on the worksheet.

Take your packet out of the vise and remove the foil package to examine the newly formed "metamorphic rock". Break the rock open and examine it carefully, noting what has happened to the thickness, the shape of the fragments that made up the "sedimentary rock", and the surface that was against the foil.

Answer Question set H on the worksheet.

Place one piece of the "metamorphic rock" in the Petri dish with the "sedimentary rock".

Part 5: Igneous Rock formation

SAFETY NOTE: STUDENT SAFETY IS ESSENTIAL DURING THIS PORTION OF THE SIMULATION ACTIVITY. WHILE STUDENTS SHOULD HAVE BEEN WEARING GOGGLES THROUGHOUT THE ACTIVITY, THIS PORTION REQUIRES SAFETY CONSCIOUSNESS! YOU WILL BE WORKING WITH HOT PLATES AND MELTED WAX.

Igneous rocks form deep within the Earth. They originate in magma chambers embedded in solid rock. These rocks are either extrusive or intrusive in nature. Extrusive are products of volcanic eruptions where the molten rock is cooled on the surface. Intrusive rocks are those where the molten rock remains inside the interior of the earth so it cools much more slowly. Intrusive rocks are only found on the surface of the earth if they are exposed by the processes of weathering and erosion.

Each group will need 10 aluminum pie plates.
Tray 1. In one pie plate fill it with crushed ice.
Tray 2. In another pie plate fill it half full with crushed ice
Tray 3. In another pie plate fill it half full with water and ice
Tray 4. In another pie plate fill it half full of warm water
Tray 5. In the 5^{th} pie plate fill it half full with hot water (boiling water would be best, but be careful)

Place the remaining crayon fragments into 5 pie plates.

BE ESPECIALLY CAREFUL HERE! This portion of the activity requires the hot plate to be heated. You will be placing each of the pie plates with the crayon fragments onto the hot plate and heating them until they melt.

HEAT EACH PIE PLATE SEPARATELY!

AVOID DROPPING HOT WAX ONTO THE HOT PLATE OR YOURSELF!

Cover the hot plate surface with aluminum foil before you begin heating the hot plate.

Place one tray on the hot plate and turn on the hot plate to medium heat. Melt the wax, but be careful so the melting process does not occur so rapidly that the molten wax splatters. When most of the "rock" is in the molten state, turn the hot plate off. There is enough energy in the molten wax to melt the remaining solid mass. CAUTION: DO NOT LET THE WAX MASS HEAT TO THE SPLATTERING POINT OR SMOKING POINT!

For the pie plate with molten wax:
Tray 1. Lift the tray with the molten wax off of the hot plate with tongs and pour the molten wax over the full tray of crush ice.

Tray 2. Heat the second pie plate with crayon fragments. Once molten remove the pie plate from the hot plate and place the pie plate on the half full pie plate of ice (molten material will remain in the pie plate). Place a piece of aluminum foil over top this pie plate and place crushed ice on top of the aluminum foil. This piece of foil can be pushed down into the pie plate with molten material, but don't touch the surface of the molten material with the foil.

Tray 3. Heat the 3rd pie plate with crayon fragments. Once molten remove the pie plate from the hot plate and place it into the half filled pie plate with ice water.

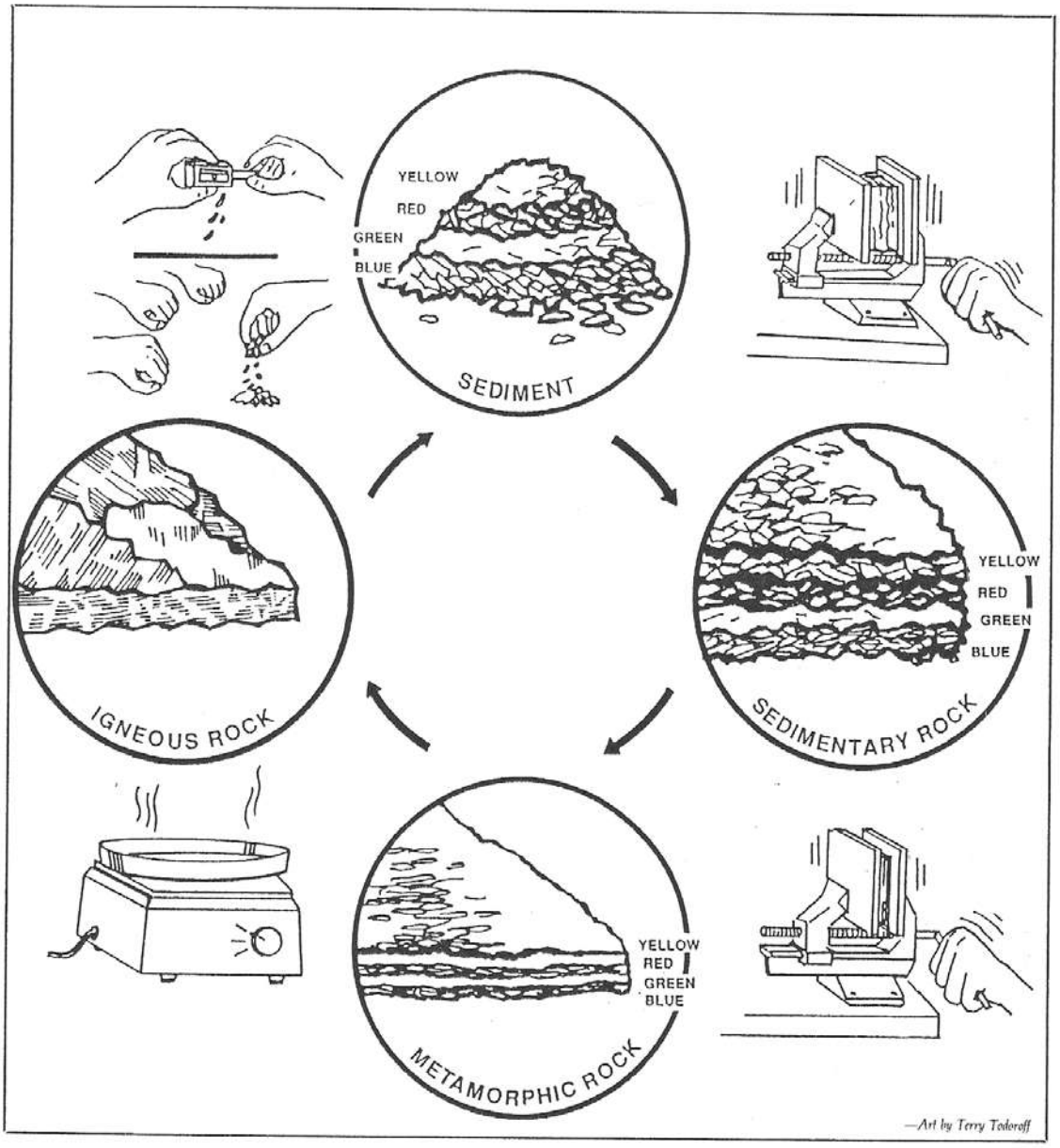
Tray 4. Heat the 4th pie plate with crayon fragments. Once molten remove the pie plate from the hot plate and place it into the half filled pie plate with warm water.

Tray 5. Heat the 5th pie plate with crayon fragments. Once molten remove the pie plate from the hot plate and place it into the half filled pie plate with hot (boiling) water. The pie plate with water could be placed on the hot plate to boil the water. Once the water is boiling, heat the pie plate with crayon and place in the pie plate with boiling water. You could keep this assembly on the hot plate with the hot plate turned off to allow the molten material to cool, thus you don't have to worry about the boiling water spilling on to someone.

Allow each pie plate that are warm or hot to cool to room temperature. This may take overnight so we may need to set aside the trays until the next class period. Those on ice and ice water you should be able to remove them and make your observations.

Break the cooled molten lump and observe the “crystal sizes” for each cooling history. Look at the top surface and the bottom surface of the lump to compare each of these surfaces.

Answer Question set I on the worksheet.



(From Color Me Metamorphic by Donald L. Birdd, *The Science Teacher*, April 1990)