TITLE: **Mapping of Caves, Cavers, Intro to Extremophiles, Lesson 4**

TOPIC: Caves

GRADE LEVEL: Middle

TIME REQUIRED: 45 minutes (combine 3 & 4 for 90 min block)

MATERIALS NEEDED:
Images on Explore Caves & Karst CD
Mapping Underground Activity
Power Point presentation on cave with maps
Video – possibly "Journey into Amazing Caves" see below

DIRECTIONS FOR INSTRUCTION:
Refer to pages 18-20

1. Begin with students observing their speleothem activity started the previous class period. Allow them access to rulers and a magnifying glass.
2. Briefly into to Uses of Caves, and where they are located in the U.S. Segue to mapping caves, and how difficult it is. Provide students with some copies of the "Cave Mapping – sketching the details" posters on Explore Caves & Karst CD. It is located in the Teacher Notes. This file has amazing directions on how mapping caves is done, and shows the common symbols used in cave mapping.
3. Do the "Mapping Underground" activity.
4. Show Power Point of cave, pointing out maps. Optional: show clips of Imax video "Journey into Amazing Caves," a MacGillivray Freeman production, funded by NSF and National Geographic, or other videos you may have. This video is available in many public libraries. Here is a rundown so you can pick and choose which sections you want to show: 0-4 minutes discusses extremophiles, so it is an interesting segment for cave life. 5-8 is Grand Canyon cave exploration, looking for bacteria, collecting samples. 8-10 shows amazing footage of getting to the caves, including some extreme kayaking that might amaze the students. 10-12 shows speleothems in caves. 12-21 shows cavers collecting extremophiles from ice crevasse/caves in the ice cap of Greenland. Very scary and amazing. 21-30 Mexico Yucatan Peninsula showing a huge underwater cave system, cave diving, and using dye to find out where the water goes. At 26 there is a blind species of fish, at 28 it shows the cavers going through a very tight spot. 30-36 they find a halocline* and collect samples at various levels. 36 -40 just a wrap up. Using a few sections of this video would give kids a sense of the dangers of caving and the uniqueness of them as well.

***Halocline -** The caves in this section of the video are classic anchialine caves, which means they were formed by, and in many cases still contain, a halocline. The halocline was one of the features of these systems that MFF wanted to capture on this film. It is a layer where freshwater from the aquifer meets, flows over, and slowly mixes with the saltwater of the ocean. The layer, when you first see it, looks like the surface of a lake – except that you're already underwater. When you pass through the halocline you mix the fresh and saltwater layers, completely destroying visibility until you swim out of it. As the saltwater in these caves is directly connected to the ocean, it's a huge sink for dissolved calcite. Hence the greatest limestone dissolution occurs around the halocline (it's also the most unstable area in the cave). This explains the huge network of essentially horizontal caves developed

in this area; the halocline has been stalled at this one depth long enough to dissolve out hundreds of miles of cave passage. From http://www.cavescience.com/yucatan.htm

Extremophiles – life forms, usually bacteria or algae, that live in extreme conditions, including deep in arctic ice, in desert sands, within hot springs, or deep within a cave.