- beliefs about the nature of science,
- students not morally or emotionally ready to evaluate controversial issues, and
- the preferred learning style of some students' (e.g. those who are shy or quiet) not suiting the class discussion and group work which characterises many of the learning activities.

Dawson (2001) suggests that science courses need to be designed to provide both the time and resources to examine one topic in depth, and this may require the modification of existing courses. A topic may even be examined over an extended period, with students preparing a portfolio or oral presentation. In addition, teachers may need professional development to update their understanding in emerging areas of science, and to equip them with the skills and resources needed to facilitate learning about controversial issues. Appropriate learning experiences include discussion forums, structured debates, hypotheticals, role-playing, student-led seminars, drama, and simulation games, as well as community service and social action. The latter could include writing letters to the editor of a local newspaper, attending a protest rally, writing a petition, lobbying politicians, and conducting a study of local waste management practices.

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Traveling Through The Curriculum: A Method of Holistic Teaching

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Abstract

Reality-based teaching methods involve the meaningful application of knowledge. The goal of this holistic method is to apply knowledge about specific geographical locations to the curriculum. First-hand knowledge of a location enables teachers to constantly address the student question "Why do I have to learn this?" As a result, students are better prepared to associate cultures, subjects, and interests across curricular lines.

"Why do we have to learn this?" was the student-mumbled phrase that plagued my first years of teaching. Anxious that I was not demonstrating the applicability of Earth Science in everyday life, I changed the way I presented the curriculum. The solution was to use the curiosity of my students to drive the curriculum. By focusing on the *how* and *where* of Earth Science concepts, I reorganized the curriculum via

sites and locations both close to home and around the world. Since I first utilized this teaching technique, my students have been better able to explain why the course and content are pertinent.

Locations that the teacher has visited can be used to cover many curricular points, and usually have the greatest application value to the classroom. Earth Science is a cornerstone to understanding various other subjects and interests, even across cultural and political lines. It therefore provides an easy-to-use vehicle for presenting ideas and concepts. To date, Pennsylvania (Gettysburg and Johnstown), New York (Syracuse and Tully), Kentucky (Mammoth Cave), Norway (BodØ and Svartisen Glacier), Alaska, Ireland, Idaho, Montana, China, Iceland, and Costa Rica are locations I utilize in addressing numerous curricular points. The information that follows focuses on how to best prepare for using such travel experiences to integrate locations into the teaching repertoire.

Although locations most frequently can be used to cover one obvious topic (e.g. Alaska with glaciers), most can be enhanced for use by researching the local sites, mines, geologic events and so forth. More often than not, the value of a site can be enhanced by using it to cover portions of many different topics. By way of storytelling, maps, slides, student-/teacher-gathered props (paraphernalia gathered while traveling to a location), and student questioning, a locale can come alive for students who may never have considered the site before.

Engaging the Students

Introduction to a location via storytelling engages students more earnestly than any other technique I have found (Wilson, 2000). It "sets the stage" for the upcoming topic, while promoting student curiosity and inquiry. Though initially time consuming, students' interest and the quality of questions that result makes this technique worthwhile. Quality time spent on this interaction prepares students to understand the relevance of the curriculum.

I have yet to find a location that can adequately and efficiently cover all detailed points within a topic. Therefore, it becomes necessary for the teacher to organize the points addressed by a location into the topic, eventually to be tested. Fortunately, this site-based method permits students to question openly what they see and readily relate memories of previous discussions (review) to new information. Using a particular location as a vehicle, students have an easier time making the connections between the two seemingly unrelated topics within the curriculum. These transitional topics permit the students to spend more time reviewing previous curricular points without needing a structured introduction. Students walk away with a good overall understanding of why the information is important, where it is used, and when they may need to use it. For example, students who have studied the basic tenets of

topographic mapping in its relation to the Battle of Gettysburg are better prepared to understand the concept of gradient and how in Alaska, glaciers flowing over high gradients develop crevasses.

Points within the curriculum are addressed via slides and paraphernalia collected during my own and my students' travels. When students practice slide interpretation, it is first necessary to explain what they are observing, and help them put the images into perspective. Students are given time to observe and question their interpretations of the slides. For students who have traveled to these and other locations (previously polled in class), this stage becomes highly interactive. I point out the item used for scale, I explain where the image was taken, and share an unusual aspect of the location that they can relate to. After the first slide, I ask open-ended questions of the students (Reynolds & Peacock, 1998). Later, students are asked to explain all details observed (including scale), predict probable events in that environment, create safety plans, or simply explain the results of these events. This practice enables students to question more openly and vigorously. After only 1 or 2 days, students' skills improve to the point where we can revert almost entirely to vocabulary and processes evident in the slides.

One slide I use every year shows myself standing on the Sheridan glacier (Alaska), and in the distant background are sharp-peaked, snow-capped mountains. I am dressed in shorts, short-sleeved shirt, and hiking boots standing in full sunshine, obviously comfortable with my surroundings. One of the first things I would do as a facilitator is not to say anything. Silence enables the students to first observe and then gather information about what they think they see, before I tell them what they see. Often, this short time to observe in silence will foster questions. How far away are the mountains? Why are you in shorts if you are standing on ice? How cold is it there? Is it dangerous to walk on the glacier? What season is it? If necessary, I would explain the scale of the objects in the slide (how far away the mountains are from me in the picture, etc.) before addressing their questions. Of course, this opens various lines of discussion and the flexibility of the teacher to make choices about the curriculum that is required. Allowing the students to address their interests first allows the teacher to proceed with an interested audience. It also makes it much easier to help the students apply previously covered topics and information to the photograph.

Objects used in photographs to provide scale are invaluable for successful interpretation. Periodically, I will make myself (or my husband) the object of scale. As a result, students observe how my appearance has changed over the past 6 years, and as a result they become more personally involved in the photograph. Engaging the students in topical discussions becomes easier, but only after they comment on how short my hair was or ask why I wasn't cold on that glacier (in shorts!).

Assignments and assessment vary, but include critical thinking exercises, questioning, and the application of existing knowledge of curricula. Hands-on, inquiry-based activities directly related to the locations and the curriculum, repeated verbal assessment, and written and verbal inquiry of meaningful current events (about the localities) are all utilized, as well as the typical quizzes and written tests, where appropriate. Activities that assist the more kinesthetic or tactile students include an earthquake epicenter-location activity (focusing on an epicenter in Alaska), and a Plate Tectonics activity that focuses on both the subduction zone along the Aleutian Trench (earthquakes) and the Ring of Fire (volcanism). Students also create a topographic map of the Gettysburg battle area.

Students will often inquire about their own travel experiences as they are able to better apply the concepts covered in class. These impromptu, inquiry discussions can serve as an important vehicle for review, or to launch into the next area to be addressed in the curriculum. For this reason, the teacher must be well versed in the curriculum that remains to be covered, and keep track of those points that have been covered throughout the year. Written quiz and exam questions often ask students to observe a slide/object. Depending upon the information and skills being tested, the students may be asked to explain the ramifications of an event shown in the slide, or explain basic information about the stream age, climate, topography, and so on. Students would be asked to relate this information to the curriculum that had been covered, as well as to the topic that may have been most recently addressed in class. The written exams pose a challenge for the teacher, due to the possible changes made in the order of topics throughout the year, the integration of current events, and line of student questioning. This teaching method provides an opportunity to show how various topics are interconnected, but it makes the traditional test on something like ‘sedimentary rocks’ obsolete. Testing must constantly reflect the select areas of the curriculum that were covered - the slides used, current events, student questions, and the curriculum points that the teacher chose to cover.

Overwhelming support for this approach was evident in evaluations filled out by students. Mainly, they didn’t feel like they were doing the “same old thing.” Comments and assessment revealed that students with strengths in visual and auditory learning benefited most from the slides and verbal questioning. The tactile or kinesthetically-oriented students benefited more from the hands-on activities designed and implemented to integrate their strengths. Of the various locations I use each year, Ireland, Alaska, and Gettysburg (Pennsylvania) provide some of the best examples for implementation.

Ireland and Rocks

The United States has always had forested land to build shelter and burn for fuel. These uses of wood have shaped our American culture. The lack of wooded land has

shaped the Irish culture. Their main heat source (even today) is peat. Undecayed vegetative matter that has accumulated over thousands of years builds up in bog areas and can today be cut by a family, stacked in bricks, dried over a period of days to weeks, and burned as fuel in the hearth. There remains so much peat in certain locations that it is commercially harvested.

Though not obvious to the students at first, this information relates directly to the Earth Science curriculum. Deposition rates, rocks, radiometric dating, and geologic time are all topics that can be addressed in detail from this one location. Though I use this to introduce the topic of sedimentary rocks, I will tell the story of one of the bog people to gain initial student interest (Deem, 2002). Later in the year when I cover climate, details of absolute age dating, and radiometric decay rates, it is appropriate to relate back to the location, culture, and curriculum points already addressed.

Gettysburg (Pennsylvania) and Topographic Mapping

In introducing topographic mapping, I begin with a storyline that begins with the location of Gettysburg, Pennsylvania. Students follow the storyline I lay out for them about the Battle of Gettysburg, and some recall facts they have learned about President Lincoln and the American Civil War. I concentrate at first on the historical significance, how it came to be that the troops came to meet at Gettysburg, the strategy used by the commanders, and the importance of the commanders' knowledge of local geology and geography to win the battle, and so on. Both road and topographic maps of the Eastern U.S. (New York and Pennsylvania) are used as props during the story. Students question me throughout as I transition from story (history) to the ongoing significance Gettysburg poses in our classroom and lives (Wilson, 2000). Knowledge of topographic skills, awareness of local geology, and proficiency with latitude and longitude are the points I stress from this visceral battle of the American Civil War.

I apply information about the Gettysburg location to demonstrate differences in active erosional agents between New York and Pennsylvania, transported versus residual soils (and why), chemical and physical weathering, porosity, permeability, capillarity, the water cycle, and climate factors. Due to the great differences in underlying bedrock (and therefore soil), I also touch upon curriculum points on the mineral and chemical composition of underlying bedrock, and the amount of time required for soil formation (and the Geologic Time Scale). Depending upon student interest and questions, I can even cover the differences between soil and regolith that can lead a short discussion on terrestrial planets. Though Gettysburg is introduced early on, it is constantly revisited via student questioning and new topics throughout the year.

Alaska and Plate Tectonics

The entire topic of Plate Tectonics is presented via the Alaska locale. Slides of the West Coast and Alaska Tsunami Warning Center (in Palmer, Alaska) are used to introduce tsunamis and stimulate questions on how they work (Sokolowski, 2002). The "Travel Section" of my website (McArdle, 2002) links to the Tsunami Warning Center website, where we analyze updated earthquake data that may have created tsunami's during the last hour. This initiates more discussion and questions. Seismology, volcanology, and Plate Tectonics are all easily related to Alaska.

Due to climatic differences from New York State, and other locations around the world, glaciology can also be addressed in detail. Glaciology can be tied in to visible geologic damage (via slides) from the 1964 Earthquake. Landslides resulted from seismic waves shaking steep-sided slopes and vast amounts of angular debris were deposited atop glaciers (Sheridan and Sherman Glaciers). Topographic maps are used to determine latitude, longitude, and landscapes and hands-on critical-thinking activities are used to stress these concepts.

Implementation Challenges

As with any large scale change to the methods teachers use to teach their curriculum, this one will take some practice to utilize well. Each of the following challenges, though, is surmountable.

Time and flexibility. Undertaking to teach the curriculum differently every year (depending upon student travel and current events), in a seamless flow that enables students to inquire about relationships among subjects, locations, and interests, is a challenge.

Poor photographic skills. Options exist for the teacher with poor photographic skills. Students willing to share images of their own travels or observations have made for better student inquiry than some of my own. Student photographs of recently drought-reduced reservoirs prompted immediate inquiry from students and resulted in an impromptu presentation of curriculum points. Slides available for purchase are taken during good weather and from advantageous angles. Images are readily available on the Internet, although they often require permission for use and appropriate credits (Reynolds, 1998).

Getting started. Before traveling to a location you may want to use for this teaching method, look for opportunities for curricular integration by researching local governments, state/national parks, the culture, and languages used. Survey your students about their travel experience. Use your working curricular knowledge to plan for integrating images and props from your travel, and that of your students, in a

holistic presentation. Travel with a camera (remember film and batteries), items for scale, Zip-close bags (for carrying rock or soil samples home), permanent marker, pocket-sized field notebook, and special writing implements, such as a grease pencil in tropical climates.

Implementation Benefits

There are many benefits in sharing the curriculum with students via personal experience and specific localities. These include:

- Low cost to implement.
- Applicable to all locations on Earth.
- Provides meaningful student work for a substitute teacher during the absence of the regular teacher.
- Addresses why, when, and where the importance lies in understanding Earth Science.
- Engages students in inquiry and higher-level thinking skills.
- Students begin to inquire and view Earth Science with a global perspective.
- Students become holistically aware of science, interests, events, and subjects.

Engaging students in discussion and hands-on activities about Earth Science globally and here at home improves their inquiry skills and potential for success in other fields of study. Students' abilities to interpret their observations and identify holistic connections between the curriculum and locations improves quickly with practice. Engaging students in the identification of scientific and cultural ties to different locales permits students to use higher-level thinking skills to address current events. Holistic methods require organization, flexibility, and perseverance toward integrating a location into the curriculum. Student inquiry of the applicability of their travel experiences to the curriculum becomes the means to successful integration of the curricula into their lives (McArdle, 2002). Methods involving travel experiences not only enrich the classroom experience and enliven the interests of individuals and communities they share, but lead one toward becoming a holistic educator.

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