The Mathematician and the Cactus. What is "mathematical thinking?"

We can imagine many ways a person might look at a cactus. A designer of western-wear might be developing a cactus logo, and would be interested in getting the shape correct. A gardener would wonder if he could grow such a cactus in his own yard. An ornithologist would be interested in the birds that live in nests built into the cactus.

A mathematician might think of questions about the structure of the cactus: can you estimate the age by the number of "arms" it has? We have also discussed the estimation of the number of these plants, based on a sample distribution. The mathematician might also estimate the volume of water contained in a cactus, or make other conjectures about the structure of the plant.

Note that the mathematician might also be a gardener who likes western shirts, has an interest in ornithology and worries about endangered species of plants and animals. Being able to think mathematically does not restrict your appreciation of the world -- it extends your views.

Are some students born with a "mathematical brain?" I think some people are born with a better potential for making neural connections. Their early childhood experiences then determine how well this potential is realized.

Does learning to factor polynomials develop "mathematical thinking?" Practice with factoring develops skill at recognizing certain structural patterns in our standard "order of operations" notation. A student could get 100% on a factoring quiz, but not understand how to create an interesting mathematical problem about a cactus.

We will look at a variety of situations that in themselves don't seem "mathematical." For example, a cactus, bridges in a town, etc. Then we'll find an underlying mathematical structure.

Euler's Koenigsberg Insight
1. In what key fashion did Euler "think mathematically" about the walking problem?

2. What is a mathematical way of looking at
a. a butterfly?
b. a flower?
Note: this is NOT a mathematical problem about a butterfly -- "If butterfly flew at 0.2 miles per hour for 20 minutes, how far would it fly?"

3. Find a subject that seems to be "outside mathematics." Find a mathematical description that gives us a new insight into the subject. Discuss