

Building Critical Thinkers Brick by Brick

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In 1963, **B. K. Forscher** wrote an article in *Science* called “Chaos in the Brickyard.” In it, he said “Once upon a time... there was an activity called

scientific research and the performers of this activity were called scientists. In reality, however, these men were builders who constructed edifices, called explanations or laws, by assembling bricks, called facts...” But, back then, brickmaking was slow. Forscher stated “...builders realized that they were sorely hampered in their efforts by delays in obtaining bricks. And then it came to pass that a misunderstanding spread among the brickmakers... The brickmakers became obsessed with the making of bricks.”

Fast forward to 2004, when **Ken Jennings** began the longest winning streak in game show history on Jeopardy! But then, in 2011, he and **Brad Rutter** (the highest grossing player) played against the supercomputer Watson—and lost. Watson’s victory represents the culmination of a fundamental shift in how we acquire, store, use, and interact with information—or “bricks.” Jennings and Rutter have an amazing talent—how to access bricks. But their talent pales in the face of Watson. The current reality in our computer-fueled instant access online-driven world is that everyone has access to all the bricks, and facts are a readily available commodity. The new challenge is assembling well-built edifices, coalescing the facts correctly to develop explanations and laws of science.

Today, bricks aren’t just the obsession of builders, but educators. Science, as it is taught in so many schools, requires the memorization of bricks. But the bricks aren’t

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used for construction. They are simply bricks, perhaps beautiful bricks, but they aren’t used by students to build anything resembling knowledge. Students memorize bricks, are tested on bricks, and are told to behold the power of bricks. They were told they must accept the brick. They just don’t understand what the larger purpose of a brick is, because no one bothered to teach them that brick-making is both art and science. It takes a lot of effort to create a brick, and that making a brick is a process, and that it is part of an edifice that is an even greater process.

Unfortunately, the emphasis on the rote memorization of facts in science education has the net effect of removing critical thinking from the imparted skill set. Rote memorization is easier for students, as preparation and studying becomes predictable and easier. And it’s easier for educators, as assessing correct and incorrect becomes much clearer. But it leads to unquestioning acceptance of any information as fact, when in reality every brick needs to be checked to assure that it is actually a brick.

Some groups, empowered by their own sources of information, started creating their own building blocks—we call these cards. They never understood bricks, and really, the bricks were just in piles. And some of the bricks were like no other bricks they had ever seen: genetically modified bricks that were

conglomerates they had never seen together, but regularly used apart; other bricks were nanoscale, and some bricks, they heard, caused cancer or death. And so it came to quickly pass that many people rejected bricks, because cards were simpler. Cards made sense. The cards were made to build elaborate houses on social media to promote cards. And the ranks of card dealers soared.

Without critical thinking, it’s pretty hard to separate the house of cards from the edifices of brick, until things come crashing down around you. Science and plant pathology face a daunting challenge these days, communicating the need for science funding and science education in a world that’s increasingly filled with conflicting misinformation. Now more than ever, it’s in the best interest of scientists and plant pathologists to promote critical thinking in the general public, one class at a time. The question is “How?”

We welcome your comments and ideas on how we teach these things. Send us your ideas in 1,000 words or less and you might author the next column on leadership. ■