# Class Starters & Enders

## Making the Most of Instructional Time
## Five Minute Lessons

Class Starters and Enders help utilize the last minutes of class when a lesson ends but there is not enough time to start another, or for an interest approach at the beginning of class. Mini-lessons correlate to GPS in the programs areas below.

# The Enviropig

**Program Areas:** Biotechnology, Agriscience, Engineering & Technology

**Instructions:** Read the narrative and make notes of important points, answer questions, and be ready to discuss this topic.

When an aquatic ecosystem's nutrient concentration suddenly increases, this starts a process known as **eutrophication**. Algae populations increase rapidly, covering the surface in algal blooms and visibly coloring the water, as with red tide. Algal decay consumes oxygen in the water, leaving an insufficient amount for fish, shellfish, and other organisms higher on the food chain. The end result is significant damage to the ecosystem and a reduction in the commercial and recreational capacities of that body. Eutrophication can occur naturally, especially in areas with cycles of dryness and flooding; however, it can also be caused by human interference. After heavy rain, nutrient-rich fertilizer spread on lawns and crop fields is washed into rivers and streams. This is called runoff. Waste from livestock and industrial pollution can also introduce excess nutrients. As a particular example, pig waste contains a high concentration of phosphate, which is a key nutrient for plants and often a limiting factor on ecosystem growth. This is because pigs do not digest phosphate efficiently, so much of what they ingest in their feed is excreted in their waste.

In 1985, researchers successfully inserted the genes of their choosing into a pig embryo, producing the first **transgenic** pig. The first experiment was a proof of concept with random insertions. Since then, techniques have been developed that allow specific genes to be inserted into the genome. For example, insertion of the gene for Green Fluorescent Protein (GFP) found in jellyfish produces pigs which are tinted green in daylight and glow bright green under blue light. This is a technique commonly used with microorganisms to simplify identification of cultures that have successfully acquired a desired gene. Rather than having to do invasive procedures to analyze the pigs' genome, a cursory glance shows that they have the gene. In 2005, Canadian researchers created a viable line of pigs which contain the gene for the production of **phytase**, an enzyme that assists in the digestion of phosphate. Dubbed the enviropig, these pigs are able to process much more phosphorous than other pigs, meaning that there is less of it in their waste. Fertilizer refined from their manure would likewise contain less phosphorous, and so be less likely to cause eutrophication in the event of run-off.

**Review**

1. What causes eutrophication?
2. How does eutrophication impact an ecosystem?
3. How can humans cause eutrophication?
4. Why does pig manure contain a high concentration of phosphate?
5. What is a transgenic organism?
6. Why would we want green-glowing pigs?
7. How is the enviropig different from other pigs?
8. Would you eat meat from an enviropig? Why or why not?

**Language Connection**

Research and write definitions for the terms in notes.

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| Eutrophication | Phytase |
| Runoff | Transgenic |

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