

TEACHER'S NOTES LESSON 24

Present these key points and questions to the students during the *Activities* section of Lesson 24, as your lecture/discussion. Make sure that as you are speaking, students are taking notes.

How was DNA discovered to be the genetic material? During the early 1900's scientists were debating whether the genetic material was proteins or nucleotides. Most scientists believed it must be proteins because they were larger and there were more kinds of them. How did they finally come to believe that DNA was the genetic material?

In 1928 Frederick Griffith did experiments in order to develop a vaccine against pneumonia. Show an image of the experiment, which can be found in Starr's textbook *Biology concepts and applications*. Information about the experiments can be found on the Biology web site <http://gened.emc.maricopa.edu/Bio/BIO181/BIOBK/BioBookDNAMOLGEN.html> or use one that you have from another source. Griffith cultured two different strains of the bacterium. He noticed one was rough and the other was smooth, therefore he called them strains R and S, respectively. He found the following:

- Laboratory mice injected with live R cells lived and didn't develop pneumonia. *The R strain is harmless.*
- Mice injected with live S cells died. *The S strain is pathogenic.*
- He killed S cells by exposing them to high temperatures. Mice injected with heat-killed S cells didn't die.
- Live R cells and heat-killed S cells were mixed and injected into mice. The mice died.

Ask the students what they think this experiment means. It means that in some way the hereditary material in the S cells was not killed by heat treatment and was still capable of causing an infection.

In 1944 Avery and coworkers continued Griffith's experiments. Show an image of the experiment. They wanted to know which part the hereditary material was. First, they carefully separated the proteins from the virulent cells and found they could still transform or cause pneumonia. Then they treated these cells with enzymes that destroyed proteins. They still had transformation. Finally, they treated the cells with an enzyme that cut DNA and then had no transformation. Therefore, they concluded that DNA was the genetic material. Yet many scientists still didn't believe or didn't want to believe this was true.

In 1952 Alfred Hershey and Martha Chase did an experiment that confirmed that DNA was the genetic material. They used a bacteriophage, a virus that only infects bacteria. Show an image of a bacteriophage and explain that it is made only of protein on the outside and DNA on the inside. Show an image of the experiment. Again, images can be found on the Biology web site <http://gened.emc.maricopa.edu/Bio/BIO181/BIOBK/BioBookDNAMOLGEN.html>

They made either the protein on the outside or the DNA on the inside of the bacteriophage radioactive. Then they allowed the bacteriophages that had radioactive proteins infect one culture of bacteria and allowed the bacteriophages that had radioactive DNA infect another culture of bacteria. After infection they broke the bacterial cells away from the remaining viral material on the outside by putting the bacteria in a blender. They centrifuged the culture and found that the radioactive proteins were in the supernatant and not in the new bacteriophages found in the pellet. They did the same with the radioactive DNA and found that the radioactivity was in the pellet with the new bacteriophages. From this experiment they realized that the proteins don't enter the bacterial cell. They stay on the outside, which is why the radioactivity was in the supernatant when they labeled the proteins that make up the coat. The DNA enters the bacteria and causes the infection. Therefore, it was labeled in the pellet in the new bacteriophages in this experiment. This was strong evidence that the genetic material was DNA. Finally, scientists had to believe that DNA was the genetic material. In this fashion, "Dogma" is created.