School

Common Science

Joe Jeffers, Ph.D.

(EDITOR'S NOTE: "Common Science" is a science column written by Joe Jeffers, Ph.D. Jeffers received the Ph.D. in molecular biology and biochemistry from Purdue University. He teaches chemistry and biology at Ouachita Baptist University in Arkadelphia, Arkansas. "Common Science" is sponsored by The National Science Foundation and appears periodically in The Dallas Post.) Bacteria are microscopic creatures that are found everywhere. Some forms of bacteria make us sick. Most do not. In fact we have large colonies of bacteria living in our intestines. Not only do they not hurt us, these bacteria, E. coli, actually help by digesting some food materials for us that we do not digest.

Bacteria are single celled creatures with a very simple structure. They do not have a nucleus as most of our cells do, but they do contain DNA. In addition to the large circular DNA molecule that provides the genetic information for each bacterial cell, a second much smaller circle of DNA can be absorbed by bacteria under certain conditions. This smaller type of DNA is called a plasmid.

Plasmids can be manipulated in the laboratory. They can be cut open and "foreign" DNA can be added to the plasmid DNA. When the circle is reclosed, a larger plasmid results. For example, think of a black hula hoop. Take a razor blade and cut through the hoop in one place. Now add a 24 inch section of red hula hoop plastic by inserting it into the cut place. Tape the junction at each end of the red section where it joins the black. You now have a larger circle because of the added red section. The red section corresponds to the foreign DNA added to a plasmid. If this new plasmid is mixed with bacterial cells that have been treated with calcium chloride, the cells will absorb the plasmid and the foreign DNA will be placed in the bacterial cell. If everything goes well, the bacteria will use the foreign DNA to make a protein.

Insulin is currently being made this way. Until recently, diabetics depended on insulin isolated from the pancreas of slaughter house animals like cows and pigs. Now bacteria can make human insulin from human insulin DNA (a gene) placed in a bacterial plasmid. Other such genetically engineered products are already available; human growth hormone; a vaccine for foot-and-mouth disease; and interferon, an antivirus protein that may be useful against some cancers. And many, many more will be available within a few years.

Several questions arise. How can we tell if a bacterial cell has taken up the plasmid with the insulin gene? Fortunately, the plasmids used for these techniques contain genes of their own. Each plasmid has one or more genes that code for resistance to certain antibiotics. Once the bacterial cells have had a chance to absorb the plasmid, an antibiotic is added. Any cells which do not have a plasmid will be killed by the antibiotic. Those that do have the plasmid will survive.

How can an insulin gene placed in a microscopic cell produce enough insulin to be of value to people? Bacteria grow very rapidly at body temperature if they have plenty of food. In twenty minutes one bacterial cell splits into two. Twenty minutes later, two become four. Every twenty minutes they double again. If this continued for 48 hours under ideal conditions, there would be a mass of bacteria equal to the mass of the earth! That doesn't happen, of course, because they run out of food or they begin to die from the accumulation of their own waste products. Still, from one cell billions upon billions of cells can be produced in a short period of time, each making insulin molecules. A few of the cells can be saved and the whole process can be begun again and again.

Where does the human insulin gene come from? This is trickier. As was mentioned last week in Chemical Morse Code, a human gene contains DNA that has interruptions in its coding information. Bacterial DNA does not. If the human insulin gene were placed directly into bacteria, the protein molecule that would be made would contain too much extra material, so it would not work. Instead the messenger RNA made from human DNA in the pancreas is isolated after the original RNA has been cut and spliced to the form of RNA used to assemble amino acids into insulin. The processed RNA is purified and mixed with a special enzyme that can make DNA from RNA. This new synthetic gene for insulin can be inserted into a plasmid and then put into bacteria. Now the bacteria can make human insulin that will work.

What does the future hold for these genetic engineering techniques using bacteria? The sky is the limit. Any gene or protein made by any living system could be produced in large quantities by the bacterial factories. You may see products like dynorphin, a pain killer 200 times as effective as morphine; Factor s, a sleep promoting peptide; bombesin, a peptide that signals the body that it has had enough to eat; and a hormonal combination called MSH-ACTH, which facilitates learning, concentration and memory.

New arrangements of genes in bacteria may reduce or eliminate the need for nitrogen fertilizer by placing nitrogen-fixing genes into soil bacteria that can be used with any crop. Genetic defects of the blood cells like sickle cell anemia or B-thalassemia could be corrected by removing bone marrow cells from an individual, adding the gene to correct the defect and replacing the bone marrow into the individual. Bacteria, of course, could be used to produce large enough quantities of the correct genes using the same techniques described above.

Only the tip of the iceberg has been uncovered. The world of pharmacy as we know it will be turned upside down by the products of this genetic engineering explosion. For further reading see the December 1984 issue of NATIONAL GEOGRAPHIC.

Chabaku speaks

Penn State student protests against apartheid were applauded by a South African minister and activist when she visited the Wilkes-Barre campus of Penn State University earlier this week. Motlalepula Chabaku, former national President of VOW, Voice of Women, A South African multi-racial women's organization, and founder of the Black Women's Federation of South Africa, addressed a group of more than 100 students, faculty, administrators and community residents at the Hayfield Community room. Her visit to campus was sponsored by the student Liberal Arts Society. Shown above is Motlalepula Chabaku with members of the Liberal Arts Society at Penn State Wilkes-Barre who sponsored her visit to the campus. From left, John Rusnak, Andrew Hubner, Ms. Chabaku, Dr. Fred Stefon, advisor, and Rod Price, club president.

Area rallies around DHS girls

Over 75 area businesses, school and community groups, and individuals supported the Dallas High School Cheereleaders in their fundraising efforts for their recent trip to Florida to compete in the Universal Cheerleading Association's National Championship. According to Varsity Coach Sheila Bonawitz of Shavertown, the "community really rallied around the girls, and gave us a tremendous boost. There are so many people and groups to thank, that I just have to say one big thank you to the whole community. We have been totally overwhelmed by the response."

Among the groups who aided the Cheerleaders was the Dallas Unico Club which sponsored a Spaghetti Dinner and gave the proceeds to the girls. The Junior High Student Council donated sweatshirts and the Senior High School Council contributed $100.00. Many area businesses allowed Donations Buckets to be placed in their stores, as well as posters announcing the various fundraising activities. Several businesses donated food and provided equipment for Hoagie Sales. Other area high school squads demonstrated their talents at a Cheerleading Exhibition.

DALLAS SCHOOL NEWS

DAWN ROTHROCK

MICHELE FARRIS KRISTYN POST

SHERI PROKOPCHAK is the daughter of Mr. and Mrs. Michael Prokopchak of Dallas. Sheri has been involved in majorettes and the spring play in her junior year. She is now a member of the Senior Steering Committee and of the yearbook staff. Sheri likes to go out with friends, dance, cruise, and listen to music when not working part-time at the Acme. Her future plans include pursuing a career in the medical field.

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MARTY KRINER is the son of Larry and Jann Kriner of Trucksville. Marty enjoys hunting and fishing in his free time. He plans to attend college to later become an optometrist.

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LISA CHANEY is the daughter of Mr. and Mrs. Edgar Chaney of Trucksville. She is involved in candystriping at the Nesbitt Memorial Hospital. She has played the organ for five years, and likes to listen to the radio. Lisa would like to become a nurse, but is undecided as to where to attend school.

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DEBBIE HONEYWELL is the daughter of Thomas and Bev Honeywell of Dallas. Debbie is the vice president of the Key Club. She likes to dance, play tennis and to attend plays. Debbie plans to attend Wilkes-Barre Vo-Tech's nursing program.

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SHARON CHUPAS is the daughter of Ron and Gloria Chupas of Dallas. She takes art lessons at Sue Hand's where she likes to paint. Sharon works part-time at Bonanza. She is planning to go to art school for commercial art.

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PEGGY "PIGGLES" SMITH is the daughter of Don and Helen Smith of Dallas. She likes to drive and go out with her friends. Peggy works at McDonald's. Her future plans include atending secretarial school or attending Empire Beauty School.

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GENA "GEAN" MURPHY is the daughter of Al and Anna Winkler of Dallas. She enjoys to play volleyball, to go out with her friends, to go shopping and to talk on the phone. Gena works part-time at Burger King. She plans to attend junior college for secretarial studies.

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CONGRATULATIONS to the cheerleaders for placing second in a state invitational cheerleading competition.