

GENETIC ENGINEERING



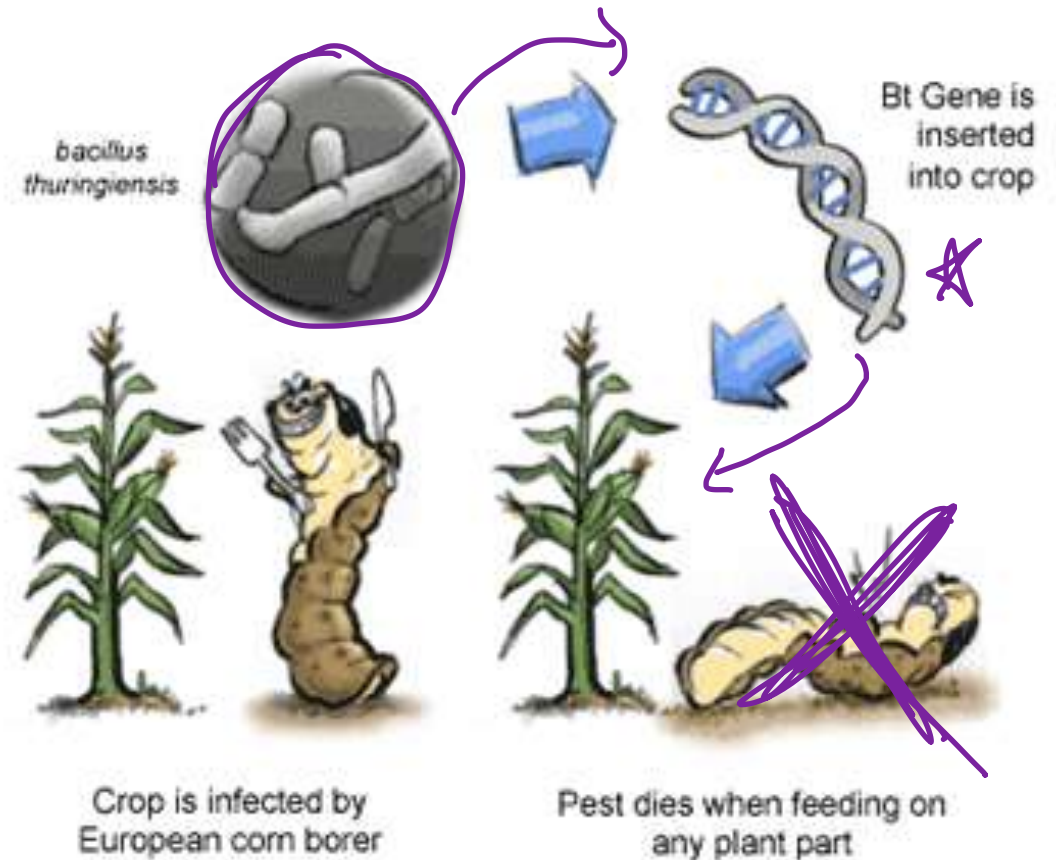
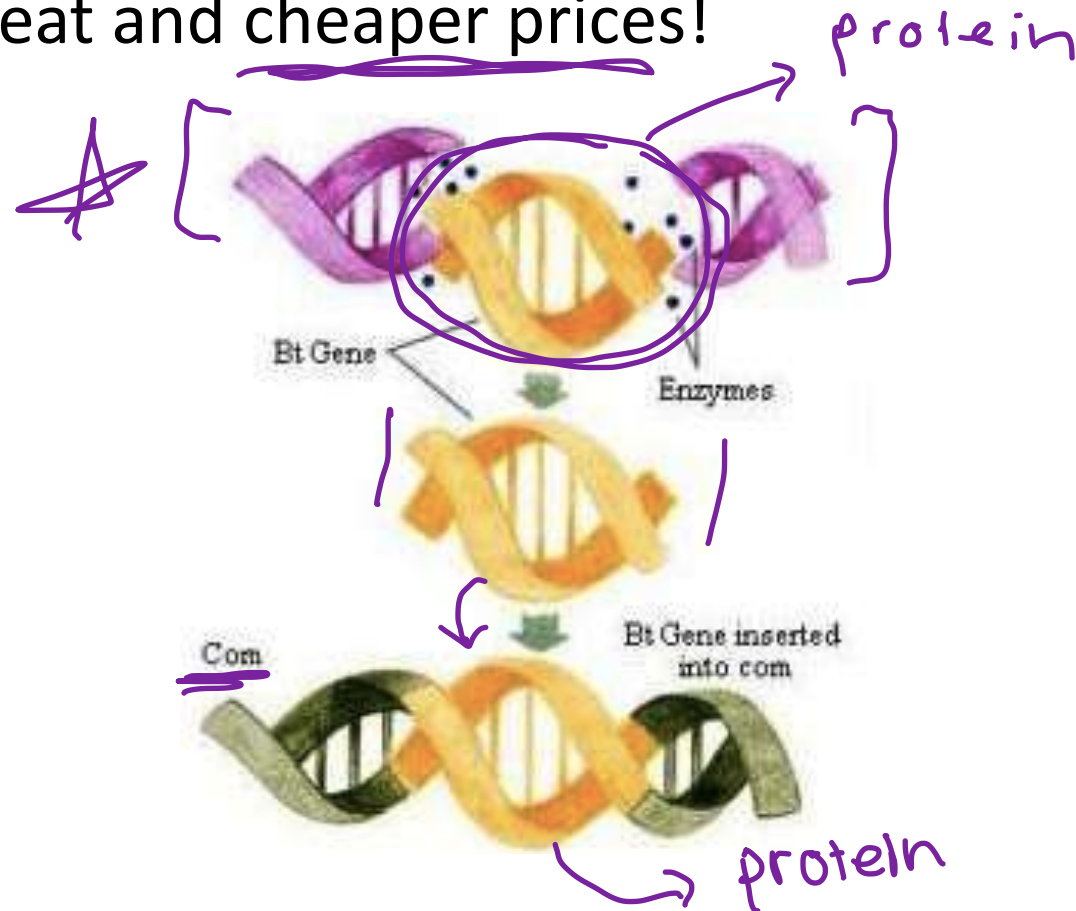
- Did you know that DNA wasn't even discovered until the 1950s!? Since then, our knowledge of DNA, genes, and inheritance has increased tremendously. Did you know that in 2003, the *Human Genome Project* was completed? Scientists identified *every single human gene, which chromosome every gene was located, AND the base sequence of every gene??* That's cray.



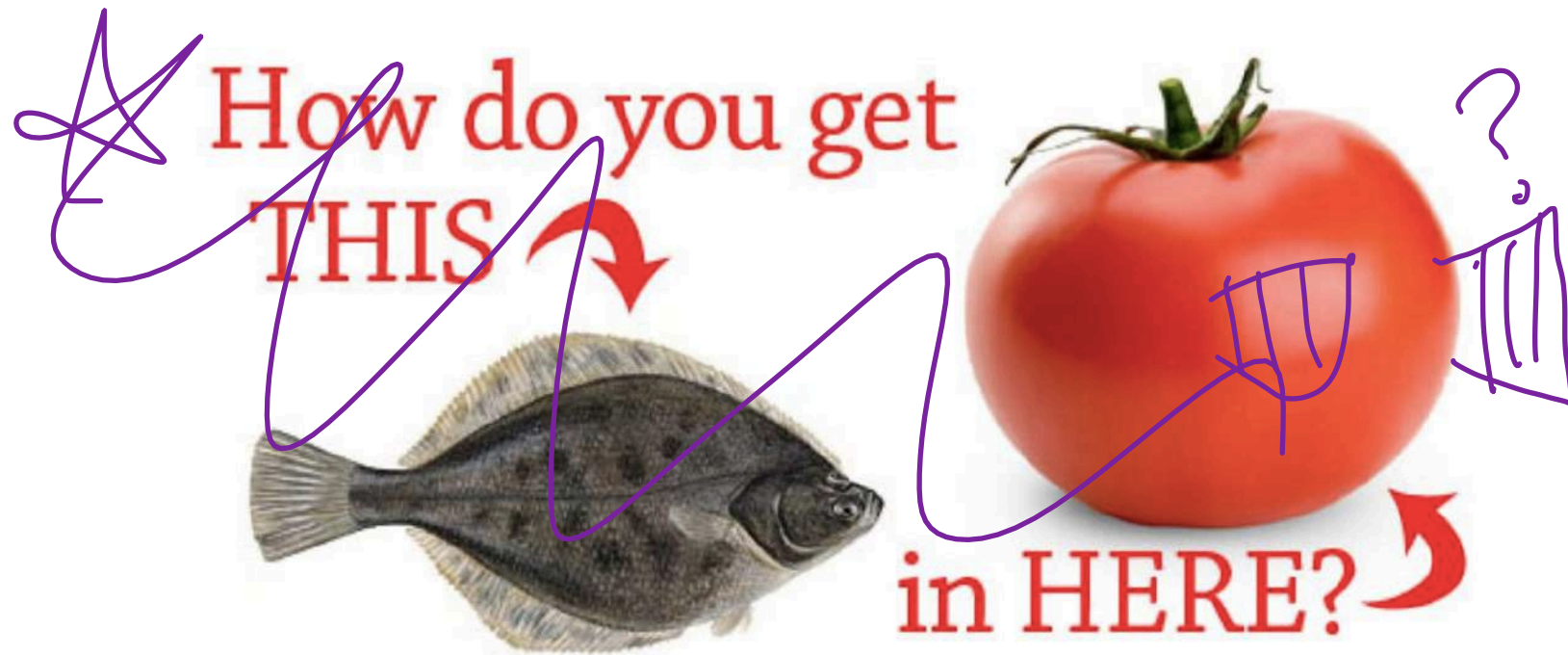
Our knowledge of genetics has led to new technology and advancements in the field of **agriculture** and **medicine**. One technique you need to know about is genetic engineering. **Genetic engineering** is a technique in which scientists **transfer genes** from *one organism* to *another*. By giving an organism a *new gene*, the organism is able to make a *new protein*, which will give the organism a *new trait*. Because DNA is a **universal genetic code**, we can transfer genes between *different species*. Scientists have transferred genes from bacteria to corn plants, from fish to tomatoes, from salmon to salmon, and from humans to bacteria! The organism that *receives* the gene is called a “**genetically modified organism**,” or a **GMO**. How do we benefit from GMOs??



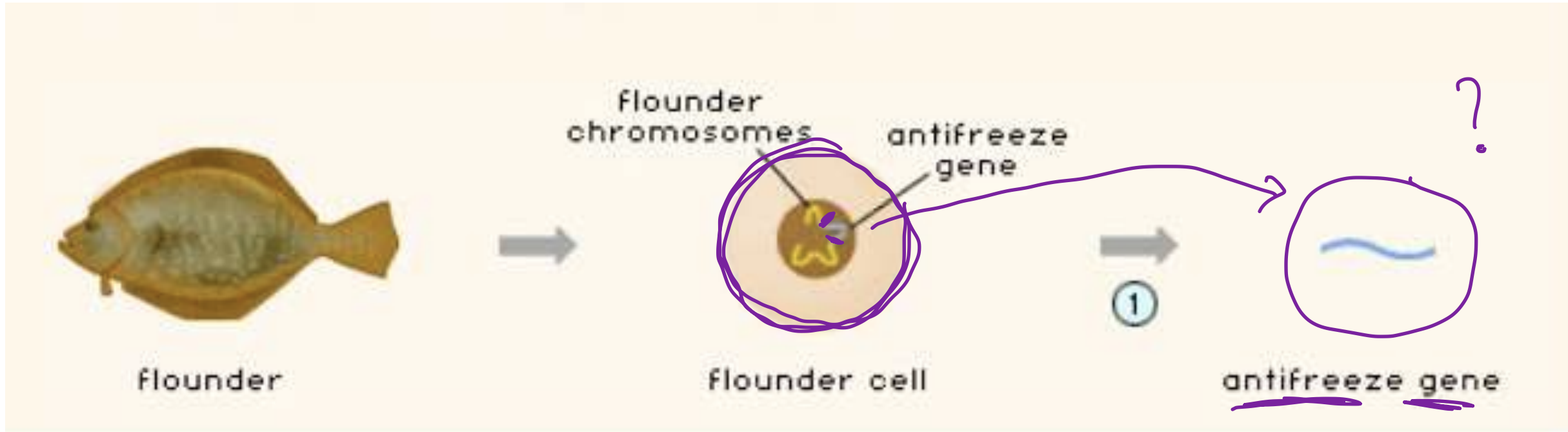
Scientists have taken a gene from a soil bacteria and inserted it into corn. This gene allows the corn to produce a protein that helps to repel harmful insects. The protein is safe for humans and for the corn, and allows the corn to be insect resistant. This means that farmers have to use less pesticides (chemical sprays) and that more corn survives. This means more corn for us to eat and cheaper prices!



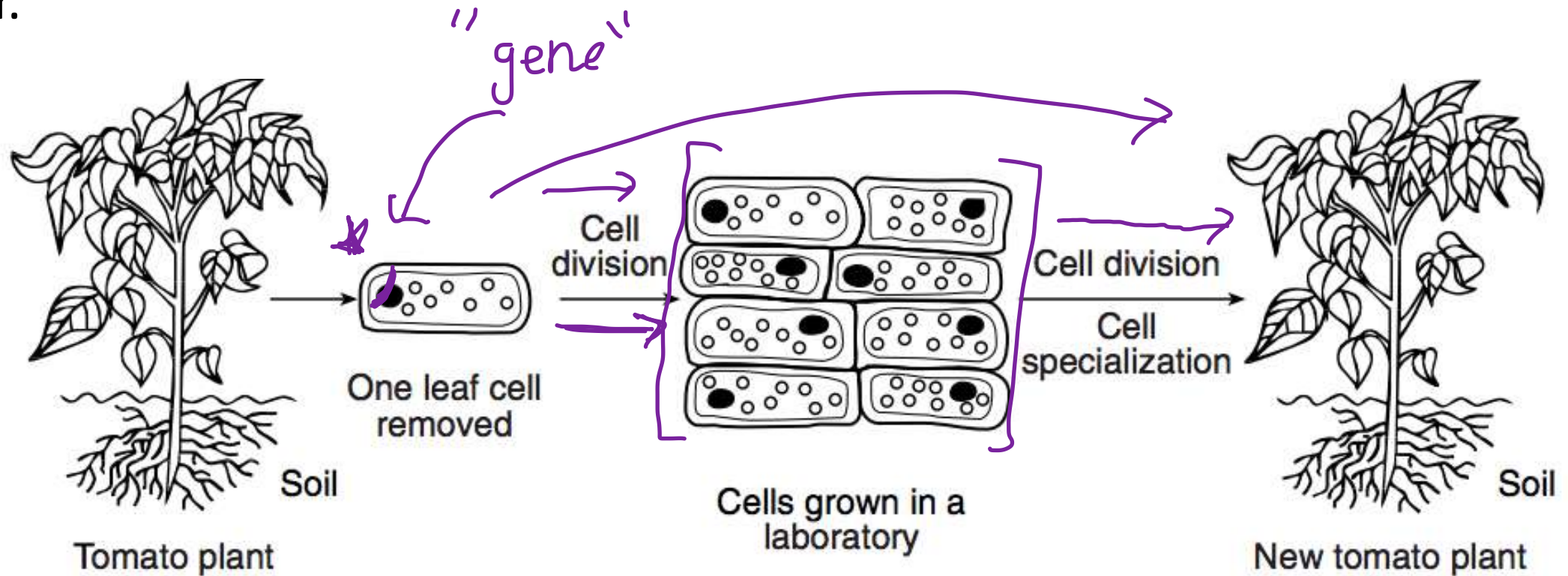
Scientists have taken a gene from an Arctic flounder (fish) and ***inserted*** it into tomatoes! This gene codes for an “antifreeze” protein that allows the fish to survive in frigid waters. The gene also gives the tomato the ability to survive freezing temperatures. This means that the tomato could be grown year-round in cold climates. Will this make the tomato taste like fish? **NO**- we have transferred one gene for one protein that has nothing to do with flavor.



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- Humans have **transferred a gene** from one species of salmon (that we don't like to eat) to another species of salmon (that we do farm for consumption). This gene controls growth. The GMO salmon grow twice as fast and twice as large compared to non-GMO salmon. This means more food for humans.



Chinook Salmon



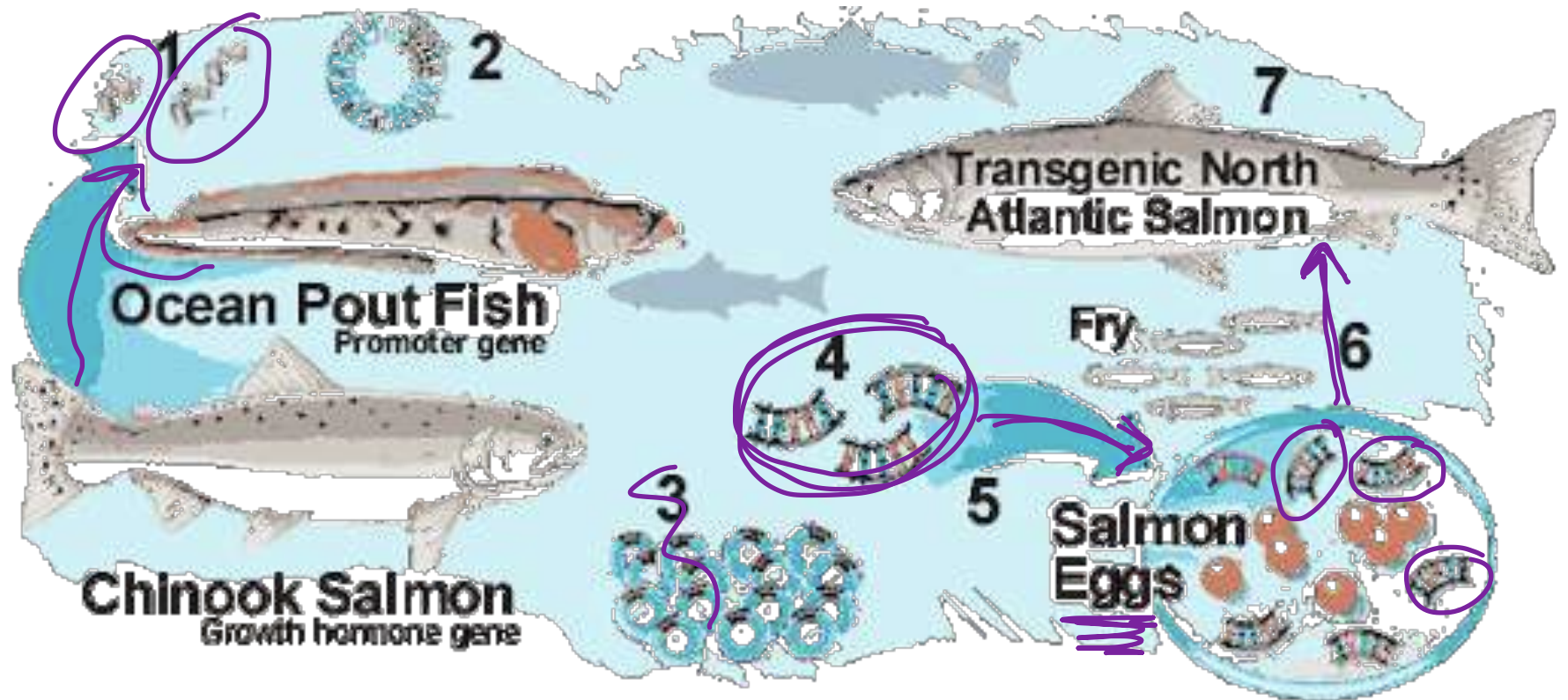
Ocean Pout



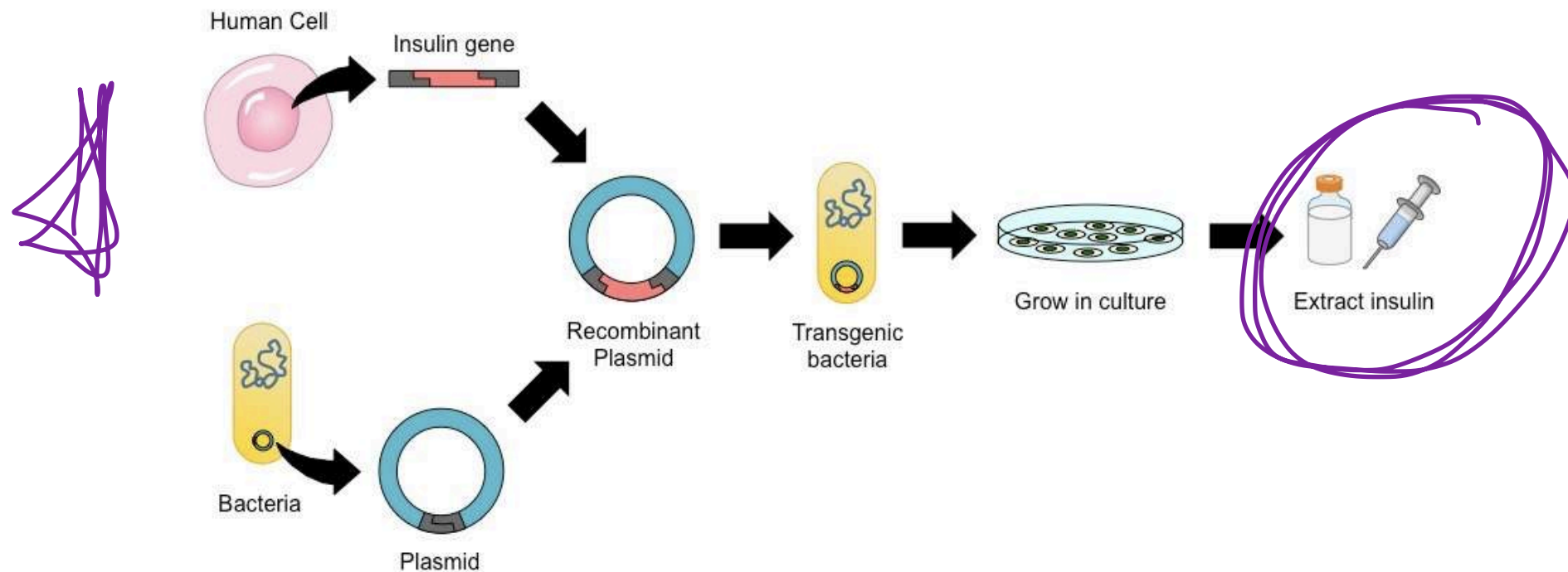
Atlantic Salmon

2x

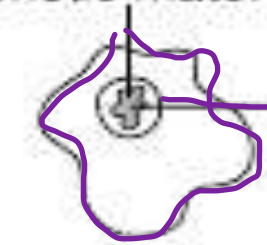
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Scientists have **transferred the human gene for insulin** into *bacteria*. Bacteria are asexual, so all it takes is one genetically engineered bacteria to produce many GMO bacteria. Each time a bacterium divides, *it will pass on the **inserted gene** as well*. The genetically engineered bacteria will express the human gene for insulin, and *will produce human insulin*! Scientists can extract and purify the insulin and give it to patients with **diabetes** who cannot produce sufficient insulin on their own! This is one of the most important applications of genetic engineering. Since enzymes and most hormones are proteins that are coded for by genes, we have genetically engineered bacteria to produce the human hormones and enzymes. We give these hormones and enzymes to people with disorders who cannot produce the chemicals on their own.

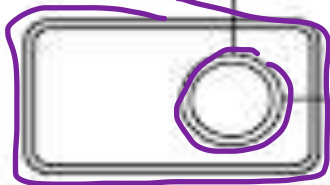


Genetic material



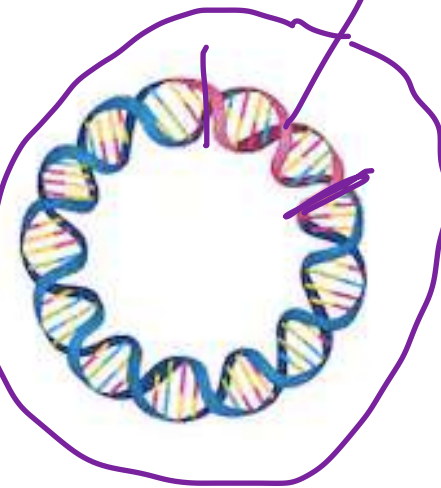
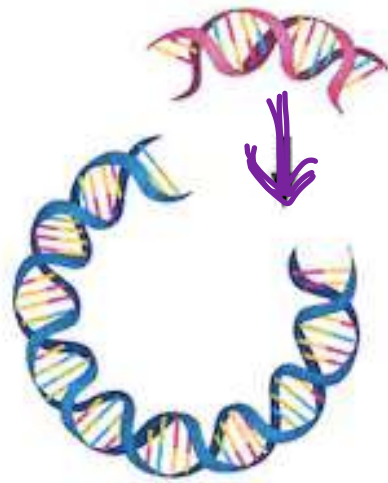
Human cell

Genetic material

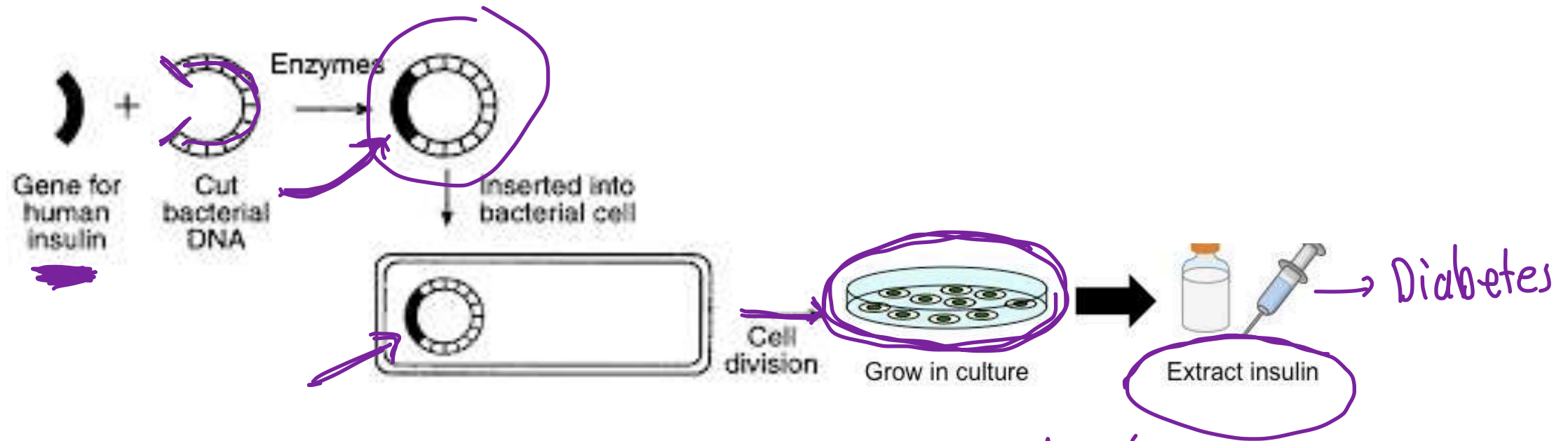


Bacterial cell

~~✗~~ "plasmid"



protein



The end!