THE GENE EXPLAINED
(activity sheets for those without microscopes)

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Oh No! Everything is Changing!

A baby caterpillar has a long (and kind of gross) journey before it can open its wings and take to the sky. And at every stage, its genes are hard at work to unlock its inner butterfly. **Use the Word Bank to fill in the squares to help the genes do their job!**

### 1. Egg
A's DNA holds every instruction it will ever need in its life. But as it develops in the egg, each cell will use its copy of the DNA differently to do its own job — to become part of a leg, part of a mouth, part of a stomach.

### 2. Little Caterpillar
As a caterpillar eats and grows, it eventually gets too big for its skin. It must create a whole new outside inside its skin before it breaks itself apart and wiggles free. This process is called molting. The caterpillar's have to coordinate and time everything perfectly, so it doesn’t leave its skin before it's ready.

### 3. Big Caterpillar
A chemical called juvenile helps molting go smoothly by blocking genes that control this next step. When the caterpillar is big enough, that hormone drops, unlocking those genes. The caterpillar gets a flood of new instructions to wrap itself up and release chemicals to dissolve its body.

### 4. Chrysalis
Though most of the caterpillar's body is dissolved into a protein-rich stew, some parts remain. These are called and act like seeds for the's new body. Each seed follows a set of pre-loaded genetic instructions and unfurls to build a body part. When it touches another part, they stitch themselves together. Soon, there’s a whole butterfly ready to break free of the and fly away.

### 5. Butterfly
This whole gross process going from egg, caterpillar and chrysalis is called (Hint: Go back through the other stages and collect the letters fall on the pink squares, then unscramble to make the final word.)

**Word Bank**
- CATERPILLAR
- BUTTERFLY
- CHRYSLALIS
- IMAGINAL DISC
- GENE
- HORMONE
Gene Damage

DNA is a pretty tough and secure system to store all of our genetic instructions to keep our body running. Each cell works hard to keep all 3 billion base pairs in tip-top shape throughout our entire lives. But even with a team of proteins to keep watch and build in safeguards, DNA can still change or be damaged.

Fill out the crossword puzzle using words from the word bank.

Down
1. When a cell copies its DNA to divide, sometimes it accidentally makes a _________ and puts in the wrong code.

2. Humans have 3 billion __________ in their DNA.

5. _________ are stretches of DNA code that contain instructions.

Across
3. The __________ light in sunshine can break a strand of DNA.

4. A __________ is a string of repetitive code that protects genetic information.

6. DNA is shaped like a double __________

Help the cell put its DNA back together again!

Oops, the proteins copying this DNA made a couple of mistakes. Circle the mistakes in the first diagram and write the correct code in the second. Remember that A always should pair with T and C with G.
Have You Seen My Genes? Wordsearch

Read the fun facts about DNA below and find the highlighted words in this wordsearch.

Neanderthals, an extinct relative of ours, shared the gene that gives us red hair.

Identical twins aren’t exactly identical genetically; their DNA differs by a few dozen letters in the code.

Hermit crabs have 254 chromosomes – humans only have 23!

About 8% of the human genome is made up of ancient viruses that slipped themselves into our code and then evolved to stop making us sick.

Any two humans share 999 in 1000 letters of their DNA.

Fruit flies might not look like us, but they share enough of our genes that they can give scientists important clues about diseases like cancer.

Some people have what’s called genetic chimerism – some of their cells have one set of DNA and other cells have an entirely different set.

Your Genetic Next of Kin

Every family tree has a few oddballs. Since every living thing on Earth is related, we are all part of the same family tree. Scientists can look at how similar the genetic code is between two animals to figure out how related they are. Help them place the missing organisms in this global family tree.

Word Bank

OSTRICH • PUFFERFISH • E. COLI • REDWOODS • DOGS • BABOONS • DUNG BEETLE

S. AUREUS

Mushroom

Shark

Chimpanzee

Chicken

Dragonfly
Cooking Up Great-great-great-great... Grandma's Mammoth Cobbler

Having mammoth for dinner isn’t as easy as skipping down to the supermarket and popping a few frozen flanks in your cart. You’re going to have to cook that woolly beast from scratch. Fill out the recipe card below to show the ingredients and steps you’ll need.

### Recipe Card

**Ingredients**

Unscramble the ingredients and fill out the recipe!

- MMATMHO AND
- PNHAETL GGE ELCL
- EETLPNAH KISN ELCL

**Steps**

1. Find a frozen mammoth and collect fragments of ____________ from its cells. Put them together into one genome.
2. Next, grab an elephant and take a cell from its hide. Take the genetic information out of the nucleus of the ____________ and replace it with your mammoth genome.
3. You’ll also need an _____________.
   Take the nucleus out of the egg and replace it with your new mammoth/elephant combo nucleus.
4. Somehow manage to turn all the right genes on to get it growing and let it cook inside an elephant.

**Design-Your-Own!**

Sadly, T-rex ribs are forever off the menu. They’ve been extinct for so long that there just isn’t enough DNA left to put together and bring it back to life. But many other extinct animals do have enough DNA and one day they could be cloned, from giant sloths to saber-tooth tigers. **If you could clone an extinct animal, what would you bring back and what would you do with it?**
The Virus Circle of Life

A virus is a helpless sort of creature. It's just an envelope (little black bag) stuffed with instructions – it doesn't have any of the machinery to grow and reproduce unless it finds a host cell to do all the hard work for it. Fill the correct step number into each blank circle on the diagram to show how a virus hijacks a cell to multiply itself.

STEP #1
A virus sneaks or breaks into a cell by tricking it into thinking that part of the virus envelope is a safe, normal thing to let inside.

STEP #2
The virus shoves its genetic information into the cell.

STEP #3
The viral genetic code starts bossing the cell around. It gives instructions for the cell machinery to make more virus envelopes instead of proteins the cell needs.

STEP #4
The cell is forced to copy the viral genetic code over and over and over.

STEP #5
The genetic copies package themselves up into the new virus envelopes.

STEP #6
The new viruses travel to the edge of the cell and either burst or bubble out.

STEP #7
All those viruses travel around to look for new cells to infect.

Get Creative!
If you were going to make clones of yourself like a virus, what are the most essential parts of yourself that you’d want to make sure your clones had too?
Visit pbs.org/kenburns/the-gene/the-gene-explained to watch the videos!