

PCR Basics Worksheet

Designing a PCR experiment in space is a critical component of your Genes in Space submission. This worksheet is intended to help you test your knowledge of PCR and its uses. If you are new to PCR, we recommend familiarizing yourself with the technique. There are great resources on the internet including [Learn.Genetics](#) and the [DNA Learning Center](#). There are also two excellent videos available on the Genes in Space website [here](#) and [here](#).

Answers can be requested from genesinspace@minipcr.com.

Activity 1: Write your PCR recipe

You want to study a gene and need 1 billion copies to analyze. Write up a recipe for DNA. First list the ingredients needed. Next list the steps to make 1 billion DNA molecules. Use as many steps as you need and be sure to highlight the ingredients acting at each step.

Time: About 1 hour

Servings: 1 billion DNA molecules

Ingredients	Instructions
<ol style="list-style-type: none"> 1. Your gene (template DNA) 2. 3. 4. 5. 	<ol style="list-style-type: none"> 1. Add ingredients to PCR tube, mix 2. Place tube in thermal cyclor

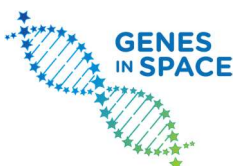
Activity 2: Base pairing – be the polymerase!

Using the forward primer: 5'- G A T A C → locate where it binds to your template DNA. Next, act as the polymerase and fill in the rest of the new strand of DNA.

Forward Primer: 5'-

-3'

Template DNA: 3'-TAGCTATGCGGACCTCATGCATTAGAGTAG-5'



Activity 3: PCR Story Board

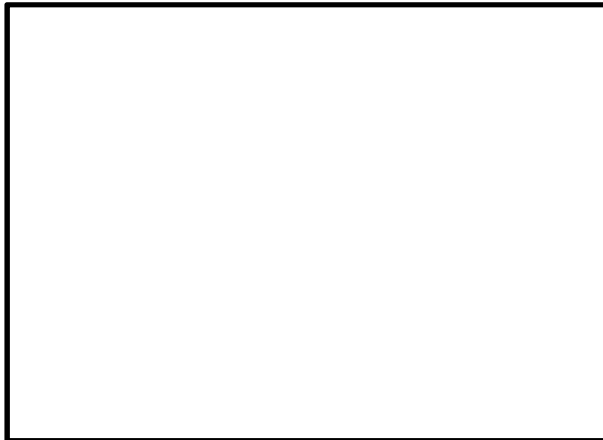
Use the three boxes to illustrate the steps of PCR as if they were a comic strip. On the lines beside each box, describe what is happening in each drawing. Use and underline the following words: **template**, **primers**, **dNTPs**, **Taq DNA polymerase**, **thermocycler**, **denaturation**, **annealing**, **extension**, **amplification**.



Name of Step: _____

Temperature: _____

Description: _____



Name of Step: _____

Temperature: _____

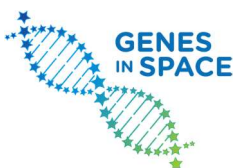
Description: _____



Name of Step: _____

Temperature: _____

Description: _____



Activity 4: PCR Examples ... in SPACE!

PCR is an important technique with many applications on Earth. For each scenario on the International Space Station (ISS) explain how PCR can help answer the question.

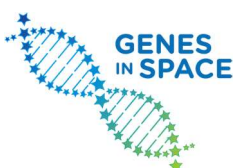
Scenario 1: The commander of your mission has fallen ill. You suspect they have infectious mononucleosis caused by Epstein-Barr Virus (EBV). You need to test the commander for EBV so that you can devise a treatment plan.

Scenario 2: Scientists recently discovered a gene, HLP, that helps protect the body from unwanted cell death. The HLP gene contains a repetitive region where the sequence GACATC is repeated on average 18-20 times in humans. However, it has been shown that this region is particularly susceptible to mutation; the number of repeats can increase or decrease changing the overall length of the gene. Studies in human stem cells have shown that increasing the number of repeats above 25 gives the cells cancer-like properties. You want to know if this region of HLP is mutated more frequently in human stem cells are grown aboard the ISS than in human stem cells grown on Earth.

Activity 5: DNA Replication vs PCR

PCR relies on many of the same principles as DNA replication, the process by which your genome is copied during cell division. However, PCR often uses slightly different mechanisms to achieve the same result. To further understand the connection between PCR and DNA replication, complete the comparison table below.

	DNA Replication	PCR
When copying DNA, the two strands of the molecule must be split apart to expose the nitrogen bases. What is used to accomplish this?	The helicase enzyme breaks the hydrogen bonds between the two DNA stands	
Where does the polymerase begin copying the DNA?	At short RNA primers bound to the template strand near an origin of replication	
What molecules are used as the building blocks of the new DNA strand?	Nucleotides	
At what temperature does the polymerase prefer to function?	37°C (Body temperature)	
How does the polymerase know to stop copying the DNA?	It reaches the end of the chromosome or the start of another replication bubble	



Activity 6: Genes in Space Glossary

Test your Genes in Space vocabulary by defining the following terms.

Annealing:

Gene:

Base pair:

Genome:

Cosmic Radiation:

International Space Station (ISS):

Denaturation:

Microgravity:

DNA:

Nucleotide:

DNA Sequencing:

Polymerase Chain Reaction (PCR):

Extension:

Primer:

Gel Electrophoresis:

Taq DNA Polymerase:

Congratulations, PCR expert!

Submit your DNA experiment in space to www.genesinspace.org today!

