Technical Definitions

Introduction

The purpose of this assignment is to learn how to write definitions for a specific audience that may not have the technical knowledge of the term being defined. This assignment serves to highlight the importance of definitions in technical writing and how audience and purpose indicate the need for definitions.

The Situation

In the fall, Janice will be starting her new role as a biology teacher at a high school. For the biology curriculum at her school, she must introduce a common laboratory technique used in molecular biology to senior students with limited biology background. She has chosen to teach her class about polymerase chain reaction. As such, she needs to prepare a definition for polymerase chain reaction that will be handed out to students in class and posted on the class website for reference.

Parenthetical Definition

Polymerase chain reaction (PCR; reaction used to make many copies of DNA) is commonly used in molecular biology experiments.

Sentence Definition

Polymerase chain reaction (PCR) is a molecular biology technique used to generate millions or billions of copies of a specific segment of DNA.

Expanded Definition

Polymerase Chain Reaction (PCR)

What is PCR?

PCR is a common molecular biology technique used to amplify (make many copies of) specific regions of DNA in the test tube (Karp, 2013). PCR provides researchers a way to study or identify functions of genes (Karp, 2013). The aim of PCR is usually to make enough of a certain target DNA region for subsequent analysis using other methods (Reece et al., 2010). For example, the DNA can be sent for sequencing or cloned in bacteria for further experimentation (Karp, 2013). By using PCR, many copies of specific segments of DNA can be made within a few hours, faster than any methods previously developed (Reece el al., 2010).

What is the origin of PCR?

The origins of PCR traces back to the early 1980s at Cetus Corporation in California, where many of the key research for the development of the technology was performed (Bartlett & Stirling, 2003). At the time, researchers wanted to find a simple method to generate large amounts of DNA (Mullis, 1990). In 1983, while driving in a Honda Civic on Highway 128 from San Francisco to Mendocino, Kary Mullis conceived of the idea to develop a new method to amplify specific segments of DNA (Mullis, 1990). This technique became known as PCR (Mullis, 1990). The emergence of PCR transformed fields in the life sciences. PCR formed the foundation of the human genome project and became

fundamental in numerous molecular biology laboratory protocols (Bartlett & Stirling, 2003). As a result of the significant contribution of PCR to scientific research, Kary Mullis was awarded a $10,000 bonus by Cetus Corporation, as well as the 1993 Nobel Prize for chemistry (Bartlett & Stirling, 2003).

What is needed for PCR?

PCR requires elevated temperatures, DNA template, all four DNA nucleotides (DNA building blocks), DNA polymerase, and primers (Reece et al., 2010).

A double-stranded DNA template containing the sequence of DNA being copied is required for copies of DNA to be made (Reece et al., 2010). In addition, PCR needs a heat-resistant DNA polymerase enzyme, which creates new strands of DNA using the DNA template (Reece et al., 2010). The DNA polymerase typically used in PCR is called, *Taq* polymerase (Reece et al., 2010). This DNA polymerase is from the bacteria species, *Thermus aquaticus*, that is found in hot springs (Chien, Edgar, & Trela, 1976). It is a heat-stable DNA polymerase that can withstand high temperatures (Reece et al., 2010). Since PCR must create copies of DNA, it requires the four nucleotides, adenine, thymine, guanine and cytosine, that make up the DNA double helix (Reece et al., 2010).

For specificity, PCR needs primers, which are short pieces of single-stranded DNA usually at least 15 nucleotides long flanking the target region (region being copied) of the DNA (Reece et al., 2010). There are two primers needed for the process of PCR, each pairing to the ends of the opposite strands of the double-stranded DNA (Reece et al., 2010). Once bounded to the DNA, the polymerase can extend the template and the target region is copied (Reece et al., 2010).

How does PCR work?

The key steps of PCR are shown in *Figure 1*. For PCR to occur, the key ingredients (DNA template, primers, four DNA nucleotides and DNA polymerase) of the reaction are mixed in a test tube along with other cofactors required by the enzymes and put through cycles of heating and cooling that enable DNA to be synthesized (Karp, 2013). The basic steps of PCR are:

1. Denaturation (95°C) – sample is heated briefly to separate DNA into two strands.
2. Annealing (60°C) – reaction is cooled to allow primers to pair to the target region of the DNA template.
3. Extension (72°C) – temperature is raised to allow DNA polymerase to add nucleotides to the end of the DNA template, generating new strands of DNA.

These three steps are repeated continuously for about 30 more cycles, each time doubling the amount of DNA (Karp, 2013). Consequently, billions of copies of a specific segment of DNA are created.

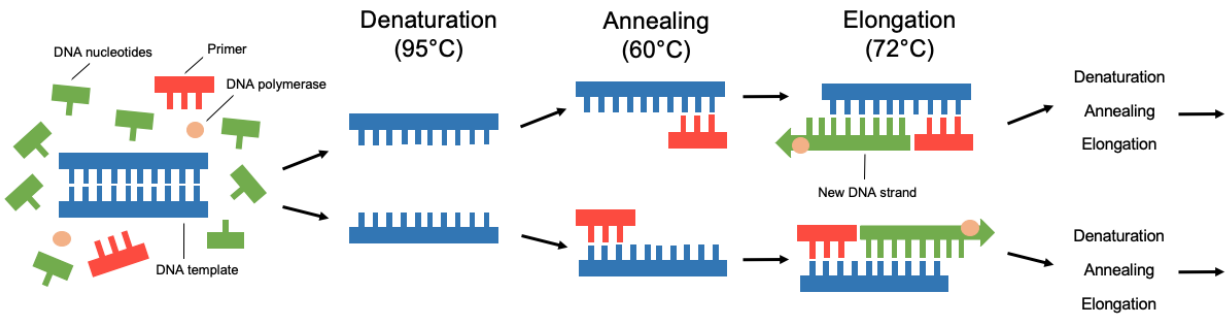

Figure 1 **Polymerase chain reaction (PCR).** Key steps of this reaction are denaturation, annealing and elongation. These three steps are repeated for around 30 cycles to generate large amounts of DNA.

What are the applications of PCR?

PCR has a wide range of applications with thousands of reports of its use published (Mullis, 1990). For example, researchers can send the resulting DNA generated from PCR for sequencing, aiding with genomic studies (Garibyan & Avashia, 2013). PCR can also be used to quantify or test for the presence of specific DNA which support biomedical research efforts in understanding functions of certain genes (Karp, 2013). In addition, PCR has led to the development of medical diagnostic tools that allow for accurate and rapid detection of potentially life-threatening infectious diseases caused by bacteria and viruses (Yang & Rothman, 2004). Furthermore, PCR can assist with forensic science, where small amounts of DNA can be isolated from a crime scene, copied and compared to DNA databases to identify criminals (van Pelt-Verkuil, van Belkum, & Hays, 2008).

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