TEACHING THE GENOME GENERATION

PROTOCOL 2: PCR

BEFORE YOU BEGIN

DESIGN YOUR PCR EXPERIMENT BEFORE PROCEEDING BY CONSULTING THE WORKSHEET AT THE END OF THIS PROTOCOL. A blank Student Worksheet should be completed PRIOR to starting the protocol. See NOTES on page 2 for further details.

The Jackson Laboratory
Leading the search for tomorrow's cures

PRE-REQUISITES & GOALS

PRE-REQUISITES

Prior to implementing this lab, you should understand:

- The central dogma of how DNA bases code for mRNA and then for proteins
- How DNA samples were collected and prepared for PCR
- The steps that occur during the process of polymerase chain reaction (PCR). Watch Polymerase Chain Reaction (PCR) *www.youtube.com/watch?v=2KoLnIwoZKU*
- How PCR reflects cellular DNA replication
- The use of primers in amplifying DNA
- The purpose of PROTOCOL 2 is to amplify human DNA for downstream protocols

LEARNING GOALS

1. Practice essential molecular biology techniques
2. Implement mathematical formulas for preparing solutions
3. Use lab equipment including the thermal cycler.

NOTES

1. You should always use a Negative Control that contains no DNA but includes all other components in addition to your DNA samples. This will test whether your reagents are contaminated with DNA or if previous PCR products are lurking around the lab.
2. Cleanliness and care in setting up the PCR experiment are absolutely necessary for useable results.
3. Use extreme caution as you do all of your pipetting. Do not allow yourself to be distracted during this process.
4. Observe the volume in the tip at every pipetting step to make sure you have obtained and dispensed the desired amount.
5. Use fresh tips during every solution transfer to avoid contaminating the stock DNA, primers and reagents.

MATERIALS

REQUIRED LAB MATERIALS

Ice bath or crushed ice

Refrigerator

Markers for labeling

Gloves

DNA samples from PROTOCOL 1

Micropipettors & tips (1000, 200 & 20)

1.5 mL tubes

0.2 mL PCR tubes in strips

Thermal cycler

Sigma RedTaq ReadyMix

PCR Primer Mix (F and R, 10 µM)

Tube holders/racks

Mini-microcentrifuge

Molecular biology grade water

Vortex

WORKSTATION NEEDS

Set out frozen reagents 10 minutes prior to use to defrost. These materials should be at each workstation.

Micropipettors and tips

1.5 mL tubes

0.2 mL PCR tubes in strips

Sigma RedTaq ReadyMix (on ice)

PCR primer mix

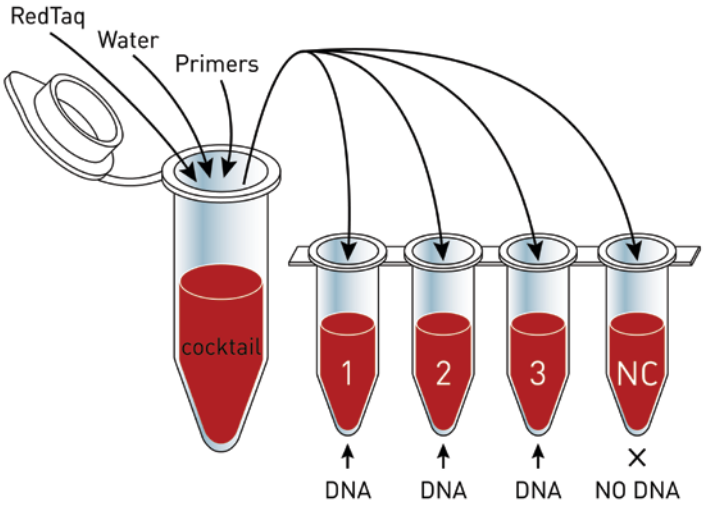
Molecular biology grade water

Tube holders and markers for labeling

DNA samples

PROCEDURE

Each group will make one Cocktail to create multiple PCR samples.



☐ STEP 1

Use Table 1 – Quantities of Components to Add to Each Tube from your Student Worksheet to determine how much of each component needs to be added to create the Cocktail.

☐ STEP 2

Obtain a 1.5 mL micro-centrifuge tube and label it "Cocktail"

☐ STEP 3

Create your PCR cocktail using the quantities from Table 1 of the Student Worksheet.

Check off as reagents are added:

☐ Add the RedTaq to the Cocktail tube (return RedTaq to ice)

☐ Add the Molecular biology grade water to the Cocktail tube

☐ Add the PCR primer mix to the Cocktail tube

NOTES

NOTES:

a. Use the P200 micropipettor for quantities over 20 µL.

b. Use the P20 micropipettor for quantities 20 µL or less.

c. Use extreme care in pipetting the amounts accurately as this is critical in the success of the PCR process. Keep in mind that the product of PROTOCOL 2 will be used in subsequent protocols. If mistakes are made now, they will affect results for all future protocols.

☐ STEP 4

Once the Cocktail is complete, cap tube tightly and mix by gently flicking the tube.

☐ STEP 5

Place all cocktail tubes created by students in centrifuge following the previous instructions for proper balancing (PROTOCOL 1, STEP 13).

☐ STEP 6

Centrifuge at room temperature for 10 seconds by pressing the "short" button.

BREAK POINT IF NEEDED

☐ STEP 7

Label each PCR reaction tube in the strip of tubes provided (0.2 mL micro-centrifuge tubes) Table 2, column 1 of the Student Worksheet. Carefully label on side of tubes, not on caps. (See photo for example)

NOTES

Tubes are provided in strips – more strips can be used as needed. In this example, there are four samples (numbered 7-10) and a negative control (NC). Extra tubes can be removed with scissors.

☐ STEP 8

Using the P200 micropipettor, add 24.0 µL of the PCR cocktail to each of your labeled PCR reaction tubes.

NOTE: Cap the Negative Control tube to avoid accidental addition of DNA.

☐ STEP 9

Using the P20 micropipettor, add 1 µL of DNA sample to each sample tube with the corresponding label.

Note: DO NOT ADD ANY DNA TO THE NEGATIVE CONTROL TUBE.

☐ STEP 10

Tightly cap the tubes and mix the contents thoroughly by gently flicking the tube.

☐ STEP 11

Place tubes in the mini-microcentrifuge. Balance with tubes on both sides.

☐ STEP 12

Spin the tubes briefly in the mini-microcentrifuge to collect the solution.

BREAK POINT IF NEEDED

NOTES

Expected result is to have one tube per DNA sample (plus negative control) with 25 µL of PCR reaction.

☐ STEP 13

The thermal cycler should be pre-programmed for amplification of the ACE gene.

Amplifies the ACE loci

PCR Cycling Conditions

1. Initialization	94° C	2 min.
2. Denaturation	94° C	30 sec.
3. Annealing	54° C	30 sec.
4. Extension	72° C	40 sec.
5. Back to #2 40X (Exponential Amplification)		
6. Final extension	72° C	5 min.
7. Final hold	4° C	forever

☐ STEP 14

Consult your teacher for proper use of the thermal cycler provided.

BREAK POINT

The PCR reaction will proceed for a couple of hours

NOTES

☐ STEP 15

Remove the samples after the protocol is complete, stop the program and turn the machine off.

Nothing should look different about the solution after the PCR reaction.

The samples are now ready for

PROTOCOL 4 – GEL ELECTROPHORESIS (ACE)

NOTES

STUDENT WORKSHEET

STUDENT VERSION

To be completed prior to beginning the protocol

Name: _____

Date: _____

Number of DNA samples to be used: _____

Gene of interest: _____

___DNA samples + 1 for Neg. Control = ___**tubes**

___**tubes** + 1 for error = ___**(MULTIPLIER for cocktail)**

☐ TABLE 1 — Quantities of Components to Add to Each Tube

Component	µL per reaction	MULTIPLIER	µL in cocktail mix
Sigma RedTaq ReadyMix	12.5		
Molecular biology grade H_2O	10.5		
Primer Mix (eg ACE-F/R)	1		
Total Cocktail volume	**24.0 µL**		**µL**

☐ TABLE 2 — Labels for PCR Microcentrifuge Tubes

PCR Strip Tube Label	DNA Sample	Primer Mix