# Comparing DNA Sequences to Understand Evolutionary Relationships with BLAST

How can bioinformatics be used as a tool to determine evolutionary relationships and to better understand genetic diseases?

Name: _____ Date: _____ Class/period: _____

Dataset ID: _____

https://biologylabbench.com/lab03

## How to use this guide

Check off each numbered step as you work in the online simulation. Follow your teacher's assigned sections and repeat counts. This guide explains the workflow; enter your measurements and responses in the lab or your assigned worksheet.

Use Data for tables and editable calculations, Graph for plots, and Scene for the simulation. Some controls are under More options. Write predictions before running an experiment and scroll below the simulation for response boxes.

## Overview

- ☐ 1. Read the driving question and your teacher's assignment. Note which sections, optional extensions, and number of trials your teacher wants you to complete.
- ☐ 2. Sign in with your name and class period. Copy your Dataset ID onto this guide. Keep using the same dataset for the investigation; classmates may have different numbers.

## Background

- ☐ 1. Read the background explanations, diagrams, and vocabulary. Review the reference formulas you will need and identify the variables you will measure.

## Pre-lab

- ☐ 1. Complete the pre-lab questions and any practice activities. Use Check answer, read the feedback, and revise your reasoning before starting the investigation.

## Morphology

- ☐ 1. Read the organism evidence cards and complete the trait table. Use Check my table, then revisit the evidence for any highlighted entries.
- ☐ 2. Select organisms sharing a trait and use Group selected organisms to build clades. Inspect the resulting tree, choose a fossil placement hypothesis, and explain the evidence for your placement.

## BLAST the genes

- ☐ 1. Write your prediction. Select fossil gene A, press BLAST, and open at least two alignments to inspect the matches.
- ☐ 2. Use Record top 5 hits. Repeat for genes B and C. Record organism names, percent identities, scores, and E-values from your own results. A distance tree is available under More options if assigned.

## Place the fossil

- ☐ 1. Compare the recorded molecular results with your morphology hypothesis. Use the placement controls on this page to place the fossil on the tree.
- ☐ 2. Explain your final placement using evidence from multiple genes and the morphology comparison. Discuss any limits or disagreement between the evidence sources.

## Design

- ☐ 1. Write a molecular-clock question, hypothesis, and variables. Choose a query organism, a gene, and the organisms to search, then BLAST your query and Add all hits to clock table.

- [ ] 2. Adding hits again replaces the clock rows for that query and gene with the current search; other comparisons remain. Repeat for other genes only as needed for your question. In Graph, examine percent identity versus divergence time. Record the gene, cutoff, number of fitted points, slope, intercept, and $R^2$.
- [ ] 3. Use the displayed cutoff when checking a regression; points outside it are shown but do not contribute to the fit. Keep genes separate. Describe the pattern, limitations, and conclusion.

## Analyze

- [ ] 1. Answer every assigned analysis question using your own recorded data. Include numbers, units, and comparisons from the appropriate Data and Graph panels.
- [ ] 2. Complete the requested calculations or statistical comparisons. Show your method and explain what the result means biologically. Write the claim, evidence, and reasoning response if shown.

## Evaluate

- [ ] 1. Compare your original predictions with your results. Explain any disagreement, limitations of the simulation, and one way to improve the investigation.
- [ ] 2. Complete the assigned reflection/evaluation questions and AP-style response if shown. Use your own data where requested. Rate your confidence if you wish; ask your teacher about any unfinished or unclear work.

## Submit

- [ ] 1. Review the completion checklist and Preview my report. Check your name, period, Dataset ID, calculations, units, graphs, and written responses.
- [ ] 2. Download .docx or use Save as PDF as directed by your teacher. Open the downloaded file and check that it contains your work, then upload or hand it in where your teacher specifies. Downloading alone does not submit it.
- [ ] 3. Save a progress file using Move your work to another computer if you need a backup or will change devices. Keep recordings separately if assigned; a report cannot restore editable progress.

## Teacher instructions / notes