



DNA Fingerprinting Lab

Shark Attack

Important update

- In 2026, Shark Lab: Great White Migration (KT-1500-01) replaced the DNA Fingerprinting Lab: Shark Attack! (KT-1500-03).
- While the new lab focuses on transoceanic migration rather than attacks, this guide helps you adapt the updated samples to the original "shark attack" scenario. See page 8 for details.



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At a glance

Lab overview

In this DNA gel electrophoresis investigation, students will be helping marine biologists understand the source of shark attacks that have been frightening Australian beachgoers. Is it a single shark?

TECHNIQUES

Micropipetting
Gel electrophoresis

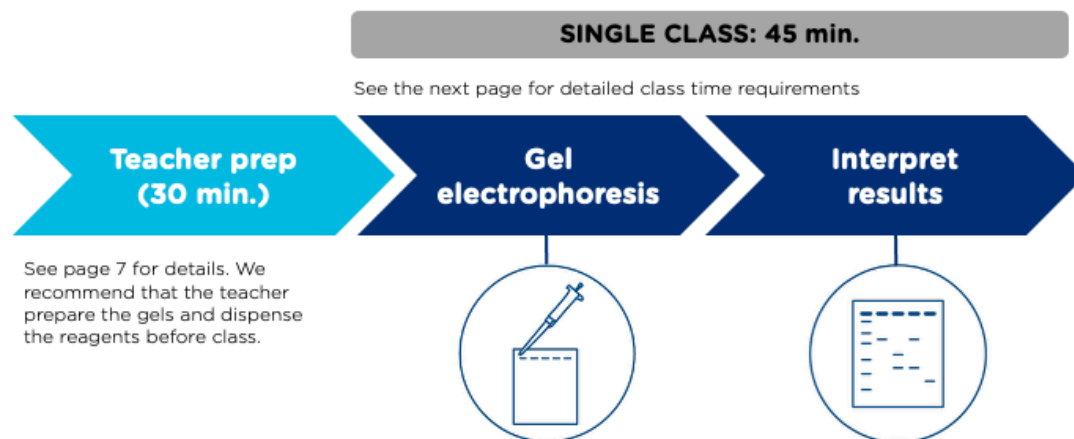
TOPICS

Genetics

GRADE LEVEL

Middle school
General high school

Planning your time



Important update

- In 2026, the DNA Fingerprinting Lab: Shark Attack! (KT-1500-03) was replaced with the Shark Lab: Great White Migration (KT-1500-01).
- While both activities use DNA fingerprinting to identify individual white sharks, the new version of the lab (KT-1500-01) asks students to help scientists determine whether white sharks are migrating across oceans rather than identifying shark attacks.
- If desired, you can use the samples from the updated Shark Lab: Great White Migration (KT-1500-01) with the previous shark attack scenario. See page 8 for details.

Technical support

If you have any questions about implementing this activity, contact support@minipcr.com

Class time requirements

This activity can be completed in a single 45-minute class period if the gels have been prepared in advance.

Steps		Time required
Prep	Make gels (can be prepared up to five days in advance)	We recommend that the teacher prepare the gels outside of class (see page X). Allot 30 minutes of class time if you opt to have students prepare the gels.
1	Load gel	10 minutes
2	Run gel	15-20 minutes The gel does not need to be actively monitored during this time.
3	Interpret results	5 minutes

Materials needed

Supplied in kit (KT-1500-01)

- Kit contains DNA samples for eight lab groups.
- If kept in the freezer, reagents can be stored for 12 months after receipt. If kept in the refrigerator, reagents can be stored for 6 months after receipt.
- Reagents for preparing gels, plastic tubes for distributing samples to individual groups, and pipette tips are sold separately. Refer to the section below for details.

Contents	Provided	Required per group	Storage
Simulated shark DNA samples • Australia sample • California sample • Hawai'i sample • South Africa sample	150 µl each	15 µl each	Freezer

Electrophoresis reagents and plastics sold separately

- This lab kit does not require a DNA ladder. However, if you want to include a DNA ladder, we recommend the [1 kb Ladder](#). If you choose to use the 1 kb ladder, we recommend using 1% agarose gels instead of 2%.
- This lab requires 2% agarose gels with a fluorescent DNA stain (e.g., SeeGreen™ or GelGreen®) and plastic tubes to distribute reagents to individual groups.
- The [Learning Lab Companion Kit](#) (KT-1510-01) provides sufficient reagents to prepare and run eight gels using the blueGel or Bandit electrophoresis systems, as well as plastic tubes to distribute samples to student groups.
- Alternatively, [bulk electrophoresis reagents](#) and [plastics](#) (tubes, pipette tips) are available for purchase from miniPCR bio.
- Gel electrophoresis reagents and plastics can also be purchased from other suppliers.

Required equipment

- This lab is compatible with any horizontal gel electrophoresis system in combination with:
 - A fluorescent DNA stain (e.g., SeeGreen™ or GelGreen®)
 - A transilluminator that is compatible with the DNA stain used. Fluorescent DNA stains typically require blue light (~470 nm) or UV (~260 nm) illumination.
- The table below outlines gel electrophoresis equipment from miniPCR bio that meets these requirements:

Item	Recommended quantity
Gel electrophoresis and visualization system	
Option 1: Electrophoresis systems with integrated blue light transilluminator	
• blueGel™ • Bandit Duo™ • GELATO™	1 blueGel can be shared by two groups 1 Bandit Duo can be shared by two groups 1 GELATO can be shared by four groups
Option 2: Bandit™ STEM Electrophoresis Kit paired with a blueBox™ blue light transilluminator	1 Bandit per group + 1 blueBox for the class to share
Micropipettes and tips	
2-20 µl adjustable or 10 µl fixed volume	1 pipette per group
2-20 µl adjustable	1 pipette for teacher prep

Other materials supplied by user

- Distilled water
- Microwave or hot plate
- Heat-resistant flask or beaker
- Disposable laboratory gloves
- Protective eyewear
- Fine-tipped permanent marker

Teacher prep



Protective gloves and eyewear should be worn for the entirety of this experiment.

Overview

The table below provides an overview of the teacher prep, and the subsequent pages provide detailed instructions.

Prep	Time required	Timeline
Dispense reagents	10 minutes	Can be completed up to one week before use.
Prepare electrophoresis buffer and agarose gels	20 minutes	Varies - If using gel reagents from miniPCR, gels can be prepared up to five days before use.

Dispense reagents

- DNA samples can be dispensed up to one week in advance and stored in the refrigerator until use.
- This kit provides sufficient reagents for eight lab groups.

Materials needed

From the lab kit (stored in the freezer):

- Australia sample
- California sample
- Hawai'i sample
- South Africa sample

Supplied by user:

- Plastic tubes for dispensing reagents (1.5 ml or 0.2 ml tubes can be used)
- 2-20 μ l micropipette and tips
- Fine-tipped permanent marker

1. Thaw reagents by placing tubes at room temperature.
2. Collect the liquid at the bottom of each tube. Either spin briefly in a microcentrifuge or shake the liquid down with a flick of the wrist.
3. When you open each tube, check for liquid stuck inside the cap. If necessary, put the cap back on and repeat step 2.
4. For each lab group, dispense reagents into labeled plastic tubes as shown in the table below. 1.5 ml or 0.2 ml plastic tubes can be used.

Reagent	Volume per group	Label tube as
Australia sample (substitute for Crown Beach DNA)	15 μ l	C
California sample (substitute for the Doom Cove DNA)	15 μ l	D
Hawai'i sample (substitute for the Hoppa-Hoppa DNA)	15 μ l	H
South Africa sample (substitute for the Wave Crest DNA)	15 μ l	W

5. Dispensed DNA samples can be stored at room temperature for 24 hours or in the refrigerator for up to one week before use.

Prepare gel electrophoresis buffer and agarose gels

1. Prepare electrophoresis buffer.
 - Follow the manufacturer's instructions to prepare buffer solution.
 - The volume of buffer needed varies depending on the gel electrophoresis system.
 - For the blueGel and Bandit electrophoresis systems, 600 ml of TBE buffer is sufficient for at least eight gel runs.
 - For other systems, refer to the manufacturer's instructions for:
 - (1) The buffer volume needed to prepare agarose gels.
 - (2) The buffer volume needed for use as running buffer.
2. Prepare 2% agarose gels with fluorescent DNA stain.
 - Each group will need four lanes.
 - This lab kit is compatible with any molecular grade agarose and fluorescent DNA stain (e.g., SeeGreen™ or GelGreen®).
 - The volume of gel needed varies based on the gel electrophoresis system you are using. Refer to the manufacturer's instructions.
 - If using gel electrophoresis reagents from miniPCR bio, gels can be prepared up to five days in advance. Store prepared gels at room temperature in an airtight container protected from light. Do NOT soak the gels in buffer or wrap them in paper towels.

Detailed instructions for preparing buffer and gels for miniPCR electrophoresis systems



blueGel

<https://links.minipcr.com/gelpouring>



Bandit

<https://links.minipcr.com/BanditDNAgel>

Student workstation setup

At the start of this experiment, every lab group should have:

DNA samples:	15 µl each
• Crown Beach DNA (tube C) • Doom Cove DNA (tube D) • Hoppa-Hoppa DNA (tube H) • Wave Crest DNA (tube W)	
2-20 µl micropipette or 10 µl fixed volume micropipette	1
Micropipette tips	At least 5
Electrophoresis buffer *Volume depends on your electrophoresis system	30 ml TBE if using a blueGel or Bandit
4 wells in a 2% agarose gel with fluorescent DNA stain	



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Background information

A series of shark attacks has terrified vacationers at a remote Australian surfers' paradise. Following four shark attacks, you will receive DNA samples collected at each of the sites and use DNA fingerprinting to determine whether the attacks were committed by the same shark or by more than one.

Shark attacks

Shark attacks on humans are rare. Unprovoked incidents where a shark attacks the swimmer without prior shark aggravation are even rarer. In 2025, there were only 65 unprovoked shark bites of humans around the world. Scientists think sharks may bite humans when they mistake them for marine mammals, such as seals, which are a favorite shark meal. From below the water surface, surfers lying on their boards and sea lions do look similar.

DNA fingerprinting

Members of a species have mostly identical DNA sequences, but some locations in the genome have considerable sequence variation across individuals. This genetic variation can help scientists identify individuals based on their unique DNA profiles. DNA profiling or fingerprinting is generally used to uniquely identify individuals, for example, to analyze evidence in forensic law enforcement cases, to conduct paternity testing, and in other applications. A unique pattern of electrophoretic DNA bands, or "fingerprint", can be generated for each individual as a result of specific differences in their genomes.

The first step in fingerprinting studies is to extract DNA from tissues or bodily fluids and to amplify these minute quantities of DNA using the Polymerase Chain Reaction (PCR). Amplified DNA samples are then cleaved by restriction endonucleases and separated by gel electrophoresis. The relative positions of DNA bands on a gel, resulting from differences in restriction fragment sizes, reflect variations in DNA sequences.

Restriction endonucleases (a.k.a. restriction enzymes)

Restriction enzymes act like molecular scissors, cutting DNA at specific sequences that they recognize. Most restriction enzymes cleave double-stranded DNA at short, palindromic sequences 4-15 base pairs (bp) long. A palindromic sequence is a sequence that reads the same on the forward strand and the reverse strand when both are read in the 5'-3' direction.

For example, the restriction site 5'-TTAA-3' is palindromic (both strands have TTAA if read 5'-3'):

5' TA**TTAA**CGG 3'

3' ATT**AATT**GCC 5'



Restriction Fragment Length Polymorphism (RFLP)

Restriction Fragment Length Polymorphism (RFLP) analysis has been an essential technique in molecular identification for many years. It was first described by geneticist Alec Jeffries in 1985. RFLP analysis relies on variations, or polymorphisms, in the genetic sequence that can create or destroy a restriction enzyme recognition site. For humans, each region tested is typically shared by 5-20% of the population. If ten polymorphic regions are tested, the probability that two people have the same RFLP pattern across all regions is $<0.000001\%$. This means that the probability of a random match is extremely low, making this a very high-confidence test.

After digesting the DNA with restriction enzymes, the size of the generated fragments can be resolved using gel electrophoresis. Each individual's DNA will migrate differentially because of size differences across their unique RFLP fragments.

RFLP analysis became the first DNA identification method and has been widely used for gene mapping, paternity testing, to determine risk for disease, to identify species, and for other molecular genetic needs. It is a convenient technique that can be simpler to implement than DNA sequencing. But as DNA sequencing becomes faster, cheaper, and more ubiquitous, it is likely to gain more relevance in personal identification applications.

Today's lab

There have been unusual shark attacks in Australia at four different locations: Crown Beach, Doom Cove, Hoppa-Hoppa, and Wave Crest. Is a single shark responsible for these attacks?

It's time to complete the key step of DNA fingerprinting: you will use gel electrophoresis to determine if more than one shark was involved in these four attacks.



Student lab protocol



Protective gloves and eyewear should be worn for the entirety of this experiment.

1. Place the prepared gel into the electrophoresis chamber.
2. Add enough electrophoresis buffer to fill the chamber and just cover the gel.
 - You will need 30 ml of TBE buffer for a blueGel or Bandit electrophoresis system. Do not overfill the chamber.
 - If using another electrophoresis system, refer to the manufacturer's instructions for the recommended buffer type and volume.
3. Use a micropipette to load samples in the following order. To prevent contamination, use a new tip for each sample.
 - Well 1: 10 µl Crown Beach (tube C)
 - Well 2: 10 µl Doom Cove (tube D)
 - Well 3: 10 µl Hoppa-Hoppa (tube H)
 - Well 4: 10 µl Wave Crest (tube W)
4. Run the gel for 15-20 minutes.
 - The blueGel and Bandit electrophoresis systems run at a fixed voltage.
 - If using another gel electrophoresis system, set the voltage in the 70-90 V range.
5. To visualize the DNA samples, turn on the blue light in your electrophoresis system or move the gel to a transilluminator.
6. If needed, continue to run the gel until there is sufficient separation between the bands in the samples to interpret the results.
7. If desired, take a photo to document the results.

Detailed operating instructions for miniPCR electrophoresis systems



blueGel

<https://links.minipcr.com/blueGelRun>



Bandit

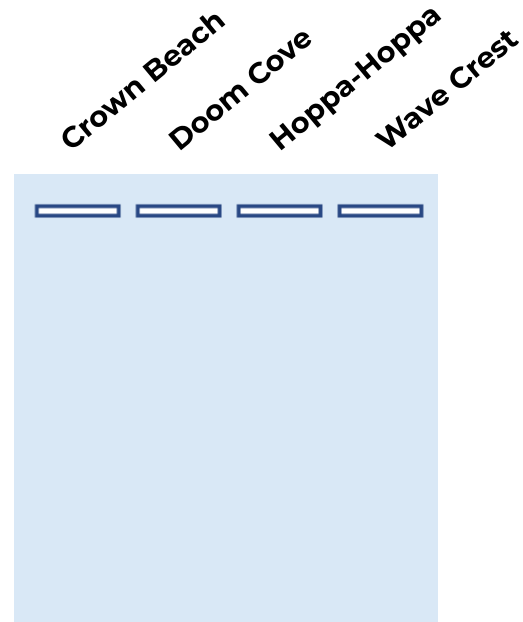
<https://links.minipcr.com/BanditViewit>



Post-lab questions

Interpreting results

1. Use the schematic gel on the right to draw what your results look like. For each sample, draw the bands that you see on your actual gel.
2. How many individual sharks are on this gel?
3. Which samples, if any, are from the same shark?





CER table

Fill in the table based on your results from the lab. Refer to the rubric on the next page.

Question:

Which samples, if any, came from the same individual shark?

Claim

Make a clear statement that answers the above question

Evidence

Provide data from the lab that supports your claim

Reasoning

Explain clearly why the data you presented supports your claim. Include the underlying scientific principles that link your evidence to your claim.



Score	4	3	2	1
CLAIM A statement that answers the original question/problem.	Makes a clear, accurate, and complete claim.	Makes an accurate and complete claim.	Makes an accurate but incomplete or vague claim.	Makes a claim that is inaccurate.
EVIDENCE Data from the experiment that supports the claim. Data must be relevant and sufficient to support the claim.	All of the evidence presented is highly relevant and clearly sufficient to support the claim.	Provides evidence that is relevant and sufficient to support the claim.	Provides relevant but insufficient evidence to support the claim. May include some non-relevant evidence.	Only provides evidence that does not support claim.
REASONING Explain why your evidence supports your claim. This must include scientific principles/ knowledge that you have about the topic to show why the data counts as evidence.	Provides reasoning that clearly links the evidence to the claim. Relevant scientific principles are well integrated in the reasoning.	Provides reasoning that links the evidence to the claim. Relevant scientific principles are discussed.	Provides reasoning that links the evidence to the claim, but does not include relevant scientific principles or uses them incorrectly.	Provides reasoning does not link the evidence to the claim. Does not include relevant scientific principles or uses them incorrectly.

We recommend that teachers use the following scale when assessing this assignment using the rubric. Teachers should feel free to adjust this scale to their expectations.

Rubric Score	3	4	5	6	7	8	9	10	11	12
Equivalent	55	60	65	70	75	80	85	90	95	100



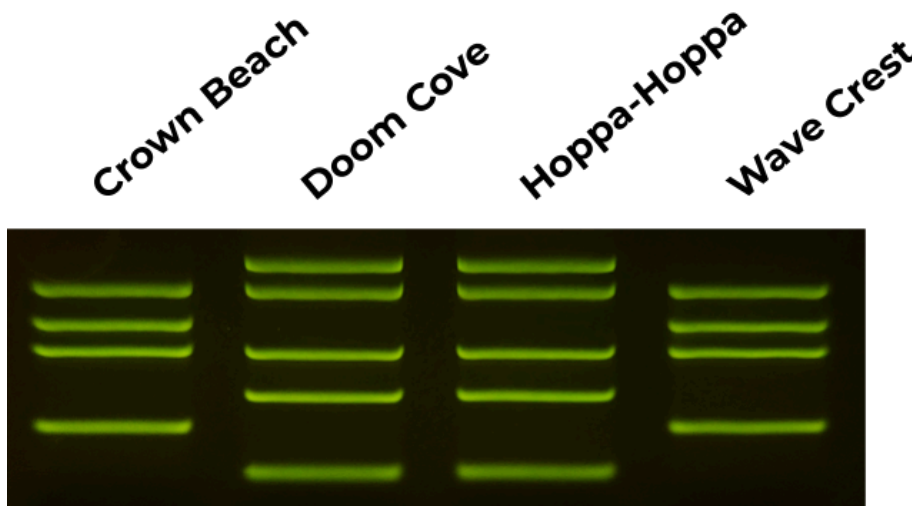
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Expected results

Gel electrophoresis results are expected to resemble the photo below:



- The samples from Crown Beach and Wave Crest match, indicating they belong to the same shark.
- Likewise, the samples from Doom Cove and Hoppa-Hoppa match, indicating they belong to the same shark.

For technical support, contact support@minipcr.com

For answers to the student questions, email answers@minipcr.com

Please include in the body of the email:

- The name of the lab
- Your name, school, and job title



Unexpected results and troubleshooting

If **fluorescent DNA bands are not visible on the gel**, the following may have occurred:

- Failure to use a fluorescent DNA stain: This lab requires agarose gels made with a fluorescent DNA stain (e.g., SeeGreen™ or GelGreen®). DNA stains that reveal DNA with a visible blue compound are less sensitive and are not compatible with this lab kit.
- Incorrect visualization conditions: Fluorescent DNA stains (e.g., SeeGreen™ or GelGreen®) must be viewed using a blue light or UV transilluminator. The blueGel system has an integrated blue light transilluminator. For DNA visualization, ensure that you have turned on the blueGel's blue light by pressing the light bulb button.
- Samples were run off the gel: If you run the gel too long, DNA samples may migrate off the gel. Monitor progress by occasionally checking the DNA samples under a transilluminator or tracking the loading dye, which is visible to the eye. Stop the run before the colored loading dye reaches the end of the gel.
- Reagents were stored improperly and/or are expired: DNA samples can be stored in the freezer for up to twelve months after receipt or in a refrigerator for six months. Storage under different conditions or in excess of this guidance may impair performance.

If **some or all of the bands appear faint**, the following may have occurred:

- Failure to load the DNA samples: Loading DNA samples for gel electrophoresis takes a little practice. The bands will appear faint if students do not successfully deposit the full sample volume into the well. Refer to <https://www.minipcr.com/how-to-load-a-gel-electrophoresis/> for gel loading tips.
- Non-optimal visualization conditions: Dimming the lights in the room can make the fluorescent DNA stain easier to see in the transilluminator. If using the blueGel, viewing the gel using the Fold-a-View documentation hood and a smartphone camera will provide the best results.
- Old or improperly stored gels: Agarose gels can generally be prepared in advance, but the storage time and conditions depend on the fluorescent DNA stain being used. If using SeeGreen™ or GelGreen® DNA stain, gels can be prepared up to five days in advance. Store gels at room temperature in an airtight container protected from light. Do not soak the gels in buffer or wrap them in paper towels.
- Old or incorrectly prepared buffer: Gel visualization defects not directly ascribable to other causes may be remedied by using freshly prepared buffer compatible with your gel electrophoresis system. If using the blueGel, TBE buffer is recommended.

For tips on picture-perfect gels, see <https://www.minipcr.com/gel-electrophoresis-troubleshooting/>

For additional technical support, contact support@minipcr.com



Notes on lab design

This lab serves as an introduction to using DNA to identify individuals.

We believe this approach provides the right balance between intellectual engagement, inquiry, and accessibility. The design of this lab has simplified certain elements to achieve these goals. Some of these elements include:

- This lab uses prepared DNA to simulate DNA fingerprinting results.
- Although DNA fingerprinting is a powerful tool for studying and identifying wildlife, today, individual identification typically relies on DNA sequencing.

Additional student supports

miniPCR tutorials: Access an extensive set of free resources to help your students succeed in molecular biology techniques. Visit <https://www.minipcr.com/tutorials/>. The resources most relevant to this lab are listed below.

- **Micropipetting:** Video, worksheet, and hands-on activity resources to train students in the basic use of a micropipette.
- **Gel electrophoresis:** Video and worksheet activity instructing students on the fundamentals and practice of agarose gel electrophoresis.
- **PCR:** While students do not perform PCR in this lab, the samples they analyze represent PCR products. If you want to discuss PCR in more detail with your students, we have a video and worksheet activity instructing students on the fundamentals and practice of PCR.

miniPCR Digital: Interactive tools for experiment-based learning with or without hands-on lab kits. Visit <https://digital.minipcr.com/>

DNA Fingerprinting DNAdots: Learn more about how DNA fingerprinting works and explore real-world applications. DNAdots include background reading and study questions.

<https://dnadots.minipcr.com/dnadots/dna-fingerprinting>