First Weapons

First Weapons

Teacher Resources

Education Resources by Culture Is Life



Culture is Life would like to acknowledge and pay respect to the Traditional Custodians of the lands and waterways of Australia. We pay our respects to Elders past, present and emerging, for they hold the memories, the traditions, the culture and hopes of our nation. We acknowledge that Aboriginal and Torres Strait Islander people continue to live in spiritual and sacred relationships with this country.

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Introduction

About The Series

First Weapons explores the history and innovation behind the weapons used by First Nations peoples for thousands of years. The six part series by Blackfella Films and ABC is an action-packed adventure across Australia to reveal the science and genius of our most ancient, innovative, and deadliest First Weapons!

For tens of thousands of years First Nations peoples have used savvy, skill and science to craft and create weapons to hunt, kill and survive. Practices have evolved but the principles are just as relevant today.

Host Phil Breslin sets out an action-packed adventure across Australia. From Wadi Wadi lands in Victoria to the central desert in the Northern Territory. From South Australia to the Bass Strait and onto the lands of the Menang Noongar people in Western Australia, Phil visits Country and meets the weapon makers. A journey to places of rich culture and unending history.

He learns through the inherent knowledge of the weapon makers. How each weapon is sourced and crafted before facing a crash course in combat. A celebration of craftsmanship, ingenuity, and bravery.

Introduction

From The Resource Writers

There is something truly inspiring when we gain greater understanding of breadth of knowledge that has informed the oldest living culture in the world. First Weapons is a gift to us all.

We thank the brilliant minds behind the series and the Elders past and present for their knowledge, brave resistance, love, strength and generosity in sharing these practices.

The cultural knowledge that has shaped the creation of these weapons, coupled with western science and the stories of our fierce warriors provides evidence of the use of some of the most sophisticated knowledge systems and skills lead by the oldest living culture in the world!

The Contributors

First Weapons is a gift to the world that we thank the brilliant minds behind the series and the Elders past and present for their knowledge, resistance, love, strength and generosity.The cultural knowledge shared in the creation of these weapons, coupled with western science, and the stories of our fierce warriors provides evidence of what makes the oldest living culture in the world! It is an honour to write the resources to connect teachers and students with Aboriginal sciences, cultures and stories, through the minds and hearts of First Nations writers, directors, producers and knowledge holders.

These Resources
Lead Resources Writer: Thara Brown
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The Series
Blackfella Films, Inkey Media, ABC, Screen Australia, Screen Queensland
Presenter: Phil Breslin
Written by Dena Curtis & Jacob Hickey
Director: Dean Gibson
Producers: Dena Curtis and Darren Dale
Executive Producer: Jacob Hickey
Weapons Makers: Moogy Sumner, John Duggie, Frank Holmes, Donald Thompson, Casey Holmes, Brendan Kennedy, Trevor Kirby, Larry Blight, David mangenner Gough and Joseph Williams.
Scientists: Dr Veronica Gray, Dr Adam Griffin, Dr Carney Matheson, Dr Conrad Stacey, Dr Laura Diamond, David John Saxby, and Renee Wootten,
Challenge Guests: Rudi Browning, Juan Bustamante, Daryl White, Josh Lalor, Mitch Argent, Alexandra Roberts, Corey Anderson and Tyr's Warriors.

Introduction

Considerations for Teachers

It's important to consider Aboriginal and Torres Strait Islander students in your classroom and how themselves and their families have been impacted by past policies and history of invasion when talking about connection to Country and cultural practices and knowledge, as their lived experience can greatly differ among First Nations people.

This series and accompanying resources aim to truly embrace all that Australia's First Peoples ingenuity and intelligence has to offer, and in doing this we encourage you to lean into our shared history of colonization that has for too long denied this cultural knowledge and practices to be shared and celebrated.

Teachers can freely access Culture is Life's 'Teaching First Nations Knowledges and Perspectives Guide' for more considerations before delivering these resources.

How To Use These Resources

The discussion and inquiry questions and activities offered in these resources are design to support teachers in facilitating discussions to assist students understanding of the stories and knowledge shared in this series. Activities and inquiry questions are designed to dive deeper into the themes around First Nations cultural practices, knowledge and perspectives within science science, technology, engineering and mathematics and can be adapted for all subjects including English and history.

For personal viewing the series can be watched on ABC iView and for classroom viewing available on ClickView. Episodes can be studies individually or as a whole 6 part series.

Introduction

Curriculum Mapping

First Weapons curriculum is designed for teachers of Levels 5-10 to address General Capabilities and the below Cross-Curricular Priorities and Learning Areas.

Remember the below can be taught across all 8 learning areas and are designed to drive deeper engagement and enhance learning through First Nations perspectives.

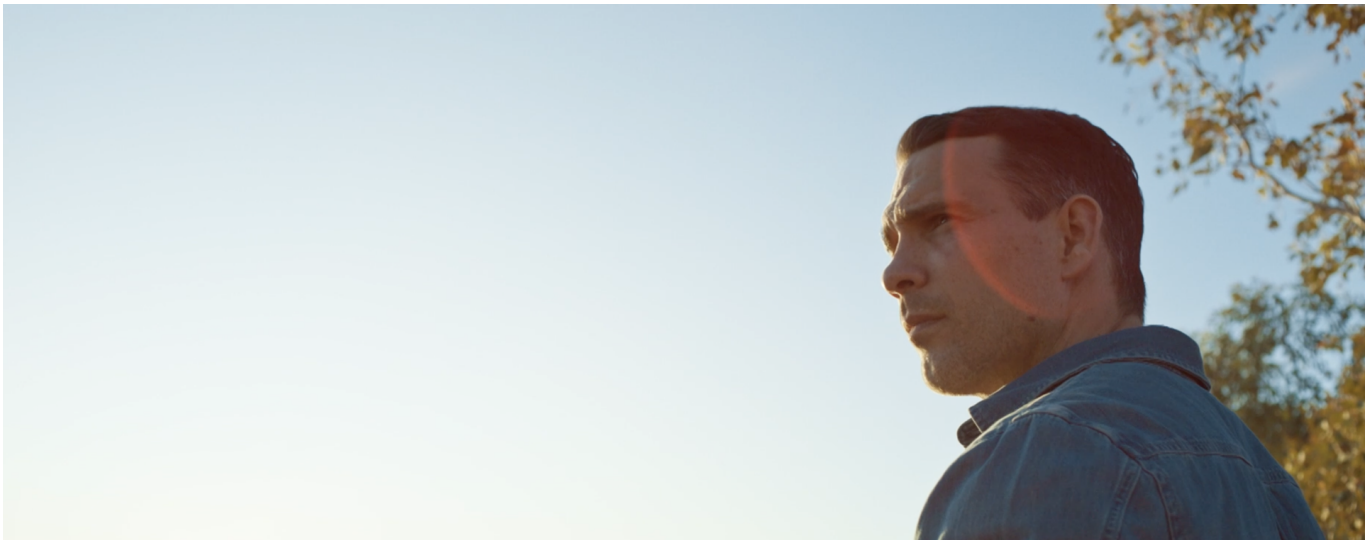
Aboriginal and Torres Strait Islander Histories and Cultures (V8.4)
Sustainability (V8.4)

Learning Areas:
Science (Version 8.4)
Humanities and Social Sciences (Version 8.4)
Technologies (Version 8.4)
Mathematics (Version 8.4)

Feedback

We would love to hear your feedback on the resources and how you embedded the series teachings into your subject curriculum and classrooms, as well as learning outcomes and initiatives that the series and resources may have inspired. This helps us to better what we design and offer for you as teachers and for your students. Please contact us at info@cultureislife.org.

Before Viewing



Discussion Questions

Before viewing any of the episodes or short clips, ask your students to respond to the following questions:

- What does the title of the series tell us?
- What might we be learning from studying a series called ‘First Weapons’?
- What group of people’s knowledge might this series teach us about?
- How might this relate to the subject or area of study we are doing now?
- What is one thing that you would like to know more about from watching this series?
- Do you know of any Australian Aboriginal Weapons?

Viewing The Series



How To Watch

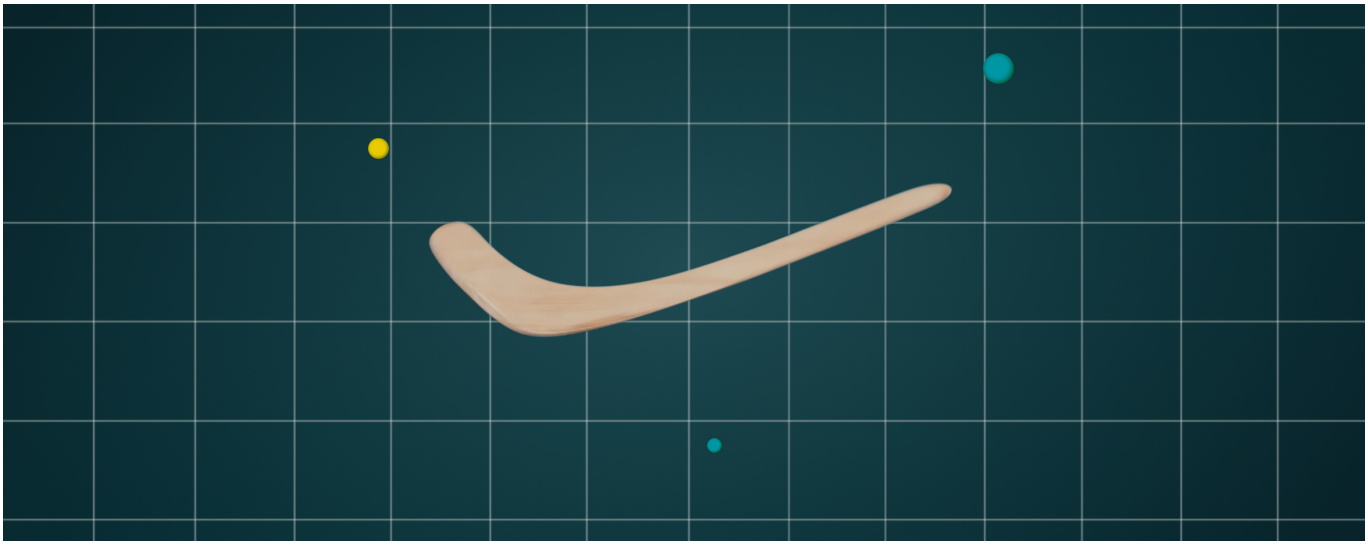
1. First Weapons on ABC iView
https://iview.abc.net.au/show/first-weapons

2. First Weapons Collection by ABC Education
https://www.abc.net.au/education/digibooks/first-weapons/102398250

3. First Weapons Resources by Culture is Life
https://www.cultureislife.org/education/first-weapons

Episode 1: **Returning Boomerang**

Quick Start Guide



Returning Boomerang

The Returning Boomerang is a strategic hunting weapon, designed to deceive and frighten its prey. Its winged edges and distrinctive shape create complex aerodynamics. The unique design and airflow propsel the weapon back to the thrower.

Synopsis

Host Phil Breslin visits South Australia to investigate Australia's most iconic and scientifically complex weapon - the Returning Boomerang. After sourcing the hard rubbish for weapon maker Moogy Sumner to upcycle into the famous weapon, Phil learns the ancient techniques of design and crafting passed down through generations.

Phil is given a crash course in throwing ... and catching before he and Moogy travel to Brisbane to unpack the ingenious design and flight of the Returning Boomerang and reveal how the user and weapon interact.

In an ultimate challenge the world's original flying craft is put through its paces by the newest flying aircraft in the ultimate race of Returning Boomerang V Drone. Phil and Moogy go head-to-head with FAI Drone Racing World Champion Rudi Browning.



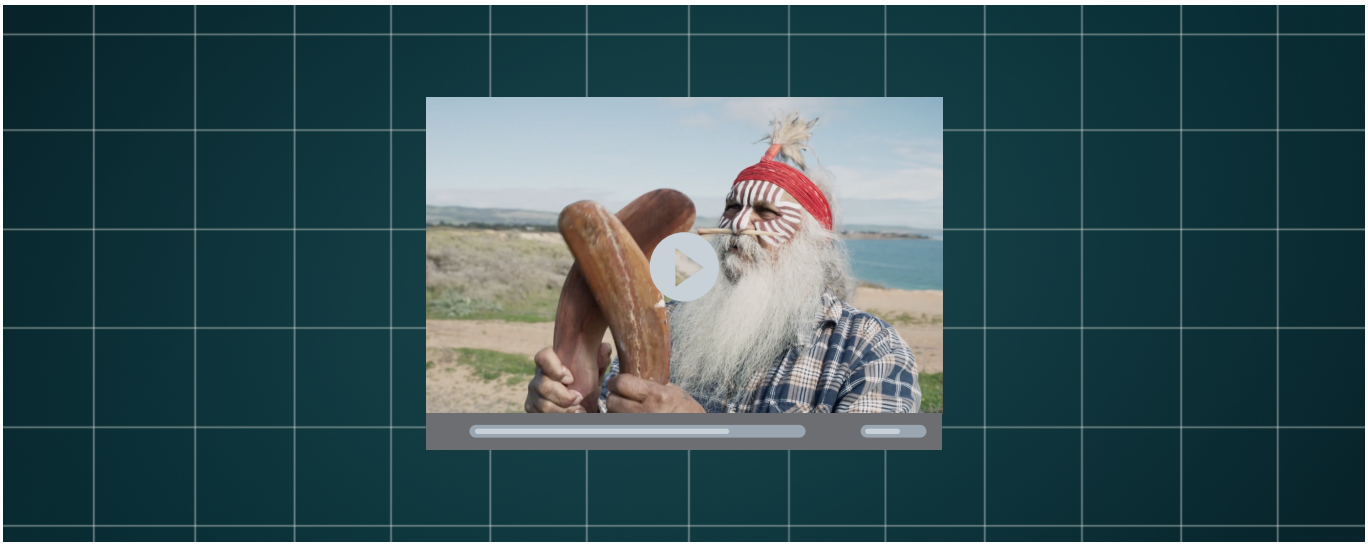
Before Viewing

Discussion Questions

Discuss what the class knows about the returning boomerang. Where have they seen one used and what is its purpose?

List and define aerodynamic principles including:

- Turbulence
- Drag
- Lift
- Average Centre of Lift
- Centre of Mass
- Gyroscope
- Velocity
- Biomechanics
- Velocity
- Degrees of Motion



Uncle Moogy & Phill want to learn what makes the returning boomerang so unique and why it comes back. In the lab we test the boomerang in a wind tunnel, where the effects of lift, drag & turbulence are explained. We then go onto the oval where the gyroscope and the boomerang throw is explained using boomerang animation.

Testing Aerodynamics

Discussion Questions:

- How does mechanical engineer, Dr Conrad Stacey, explain the focus of his PhD?
- What does the wind tunnel look like in the lab?

Describe what the aeroplane wing looks like compared to a boomerang wing.

- How does this demonstrate a difference in the aerodynamics?
- What do the curved streamlines over the top of the wing and curved streamlines underneath the wing do?

Explain this principle in a diagram annotating the flow on the top versus flow underneath and what this means.

- What difference do we see, and does Dr Conrad explain, about the smoke around the boomerang wing?
- What does this turbulence cause?
- Why is it important that we have a drag on the trailing edge of the boomerang wing?
- Why is it safer for the thrower?

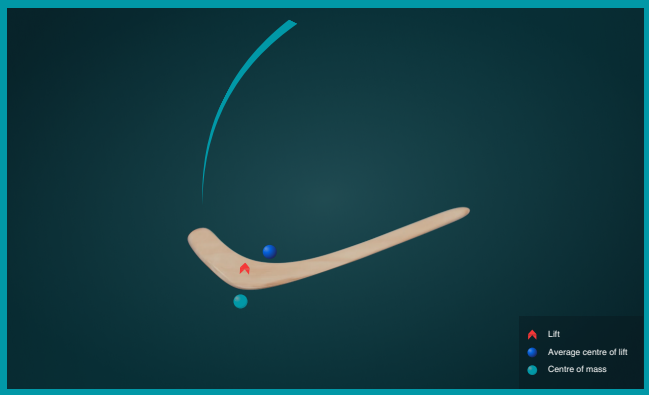


Putting It To Practice

Discussion Questions:

- What do we learn about why this particular boomerang comes back if thrown correctly?
- What is a gyroscope and what are examples of these in your world?
- What is the bicycle wheel used to explain?
- What happens when the wheel isn't spinning?
- Where is the center of mass?







Research Activity: Types of Boomerangs

Research the different types of boomerangs and their unique shapes and purposes.

Draw the different types of boomerangs researched and label the significant characteristics of the boomerang on your drawings.

Based on your findings, what boomerang do you believe to be the most useful for survival and explain your response.

When you throw the boomerang, one arm of the boomerang is advancing and one arm is almost still. One arm has twice the velocity of the boomerang.

- How do we see this in Phill's throw with the leading edge highlighted?
- How is the difference in life explained from the top arm to the bottom as it rotates?

Describe aerodynamic drag in relation to the throwing of the returning boomerang.

- What three components are measured in the Boomerang Animation?
- What about the center of lift and the center of mass makes the boomerang lie down as it's turning?
- What do we see in the flight path of the boomerang?

Extended Curriculum

Activity: Local Weapons

Explain to students that the weapons in this series are found in different places throughout Australia and that some places may have a different variation of a similar weapon shown in the series. It is also important to express why connecting, learning from and sharing with your local Aboriginal and community is so important, as this is the Country that looks after them and the people who have cared for it for millennia!

Instruct students on how to research online or in person utilising services and people in their local community. Students will research weapons traditionally and/or currently made in their local area that your school is located, where students live or they're family are from.

This research activity can be completed after watching one or all 6 episodes, and students' can be given the choice of the local weapons they would like to research.

Discussion Questions

The below can be used as a guide for student research to present in any creative way possible.

- What is the local language word for the weapon?
- What trees in their area would be used to make weapons and/or artifacts?
- What other materials are needed to make this weapon? How can they be sourced?
- What can the weapon or tool be used for?
- How might these uses differ today?
- What might have replaced the use of this weapon?

Any other exciting and interesting local knowledge they have discovered related to their research!



Sourcing the Raw Materials

Discussion Questions:

- What Country is Phil visiting and what do we learn about Uncle Moogy and where he is from?
- What tree do we learn about here?

‘Nothing will go to waste.’

Discuss this as Aboriginal lore. What does this mean, what is this teaching us and how might we practice this resourcefulness and appreciation of Country in our everyday life?

• What parts of a tree might we find the appropriate curve for a boomerang?

‘People don’t realise what they are putting out, someone else can use.’

Explain this concept in relation to what Uncle Moogy is teaching here. Why is this important for the sustainability of Country for generations to come?



Making the Boomerang

Discussion Questions:

- What is the first step in making the boomerang from plywood?

Continue to add each step as a flow chart of the list to create instructions on how to make the boomerang the way Uncle Moogy teaches it.

Here we see stencils drawn close together to maximize the amount of boomerangs that can be made from the wood from the cupboard.

- What tools would have First Nations peoples have traditionally used to make boomerangs?
- How does Uncle Moogy explain cutting the flight pattern into the boomerang?
- What are the two names of the edges on the boomerang?
- What would happen to the flight path of the boomerang without these edges cut?



Activity: David Unaipon

Overview:

The Boomerang Principle was very much a helicopter. Developing concepts for the helicopter, further research David Unaipon, Ngarrindjeri Man, and The Boomerang Principle. Write a report explaining what was significant about the time of Australian history for Aboriginal people like David Unaipon. Write your reflections in learning about this story and the principle Unaipon discovered.



Episode 2: **Amerr**

Quick Start Guide



Amerr

The Amerr is the spear thrower, also known as woomera. It is an extroadinarily versatile weapon, but its primary purpose is for hunting. A spear is loaded onto its peg and then acting as an extension of the arm, it propels the spear further, faster and with greater precision.

Synopsis

Host Phil Breslin visits Alyawarr country in the Northern Territory to discover a weapon that was once one of the fastest weapons on earth - the Amerr. Spending time with weapon makers Donald Thompson, John Duggie, Casey Holmes and Frank Holmes, Phil learns how to source, craft, and throw the Amerr.

In Brisbane they unpack the scientific principles that make this weapon so special, revealing how the ingenious design supercharges the spear's distance, speed, and accuracy. The expert team reveals how Phil interacts with the weapon before Dr Adam Griffin demonstrates just how lethal the combination of spear and Amerr can be.

The challenge tests historian Eric Wilmott's statement "that until the invention of the self-loading rifle, the woomera and spear were the fastest weapons on earth".



Before Viewing

Discussion Questions

Have you heard of a Spear Thrower or Amerr - sometimes called a Woomera? If so, where have you heard these names and what do you know about them?

Define the below terms:

- Engineering
- Distance
- Leverage



Here we are introduced to the Amerr (pronounced Ah-mud-da), an extraordinarily versatile weapon, before collecting materials on Country; the spinifex grass for resin and the Mulga tree and the Emu bush. The men then melt the spinifex to make the resin, bush glue, before beginning to carve the wood collected.

Collecting Materials

Discussion Questions:

The first job after collecting the materials is to separate the sticky resin that coats the spinifex. This gives us the glue to create the Amerr.

- What does the spinifex look like?
- How does Phill explain that it feels and smells?
- How is its taste described?
- What are the next steps after the grass is collected?
- What do we see the men do?
- What is the purpose of this process?
- What's another way Phil describes the sticky resin?



Research Activity: Spinifex

Research where the grass known as spinifex is grown and its traditional and modern uses. Reflect on why this is so significant to Aboriginal people and their practices and consider any alternatives to spinifex's uses traditionally and in modern times.

Discussion Questions:

- After the bush glue is sauced, we go to find the wood.
- What do the Mulga trees look like?
- Why does Frank think this is a good tree for the Amerr?
- What does Frank teach us about selecting the tree?
- What does this teach us about cultural practices and Aboriginal lore?
- How is this different from European ways of doing?
- How is the tree cut? Observe the angles and how the tree falls. Draw a diagram of this teaching, labeling the approach and its purpose.
- How might this hard and heavy wood benefit the weapon we are making?





The Right Wood

Discussion Questions:

- What is the English name for the tree we are shown to make the peg?

The next process takes concentration and skill. We need to make the resin fine by crushing it up. The resin is like carrying around a repair kit for your tools!

- What modern equipment is John using to sift the resin?

Discuss the sustainability behind repurposing used materials and how this is beneficial to the environment. Describe the next step in turning the resin into bush glue.

- What is used for heat in this process?
- How does the resin look after being heated?

Episode 2: **Amerr (Woomera)**

Extended Curriculum



Theory of Motion

In Meanjin, Brisbane we meet Renee Wootton, aerospace engineer and pilot. Here we want to discover what is actually happening when this spear is being launched into the air! As a class, discuss the biomechanical principle of motion and how it relates to linear motion, velocity, speed, acceleration, and momentum.

Discussion Questions:

- What does distance and leverage mean?
- What is the difference in the starting position if you were to throw a spear without a woomera?
- How many centimetres does Phill move his arm from the starting point to the release point?

Now when we add the Amerr.

- What changes in the distance travelled from the starting point to the release point?
- How could you describe this difference?



Speed and Velocity

Discussion Questions:

- What is speed and how do we measure it?
- What is velocity and how do we measure it?
- How does this double in length traveled from starting point to release point affect the velocity?
- The Amerr gives you a longer arm so the spear can travel further!







Activity: Making the Amerr

Create an instruction guide to teach the steps of making the Amerr taught in this episode. You can include photos and diagrams and improve on your memory of these steps by preparing and teaching it to your classmates with little to no looking at the steps. The below is written as a guide to start you off.

The Steps:

1. Collect the spinifex
2. Collect the Mulga tree wood for the spear
3. Collect the wood for the peg.
4. Crush the resin and heat it on the fire to make glue.
5. Dig a round hole to place the wood in to split the wood in half with an axe.
6. Cut down the wood with the axe and carve the wood with an axe, file and car spring.
7. Heat the resin and glue the pointy tip
8. Tie the emu tendon to the tip like a rope on top of the resin and cover in dirt.
9. Dig a round hole to dig the wood in standing up to split the wood in half.
10. Test the shape and balance



Activity: Your Local Elders and People

What traditional lands is your school located on? Research or discuss your relationships and knowledge of your local Aboriginal groups in your school community and who are their Elders. Discuss these relationships as a class and protocol and ways you can contact the local Aboriginal land council or build relationships with traditional custodians that the school can invest in to come share local knowledge and stories with your class.

Episode 3: **Leangle and Parrying Shield**

Quick Start Guide



Leangle and Parrying Shield

The leangle and parrying shield are combat weapons designed for engaging the enemy at close quarters. The leangle is used to strike the body and can hook the shield, exposing the opponent. Its companian, the parrying shield, can strike as well as defend. Together, they are a lethal combination.

Synopsis

On Wadi Wadi Country in Victoria host Phil Breslin meets weapon makers Brendan Kennedy and Trevor Kirby to learn more about formidable hand combat weapons - the Leangle and Parrying Shield. On the bank of the Wakool River, Phil observes the knowledge, skill and craftmanship as the weapons are made, before enjoying a masterclass in the art of combat.

To unpack the science behind the Leangle and Parrying Shields ingenious design, Phil, Brendan and Trevor join a crack team of experts to test and reveal the science that makes them so deadly. In a challenge of courage and to celebrate Aboriginal Cricketer Dick-a-Dick's 1868 crowd-pleasing and fun demonstration, Phil faces down cricket balls traveling at more than 100 kilometres an hour.



Before Viewing

Discussion Questions

Reflect on how science has changed throughout history?

Discuss what scientific knowledge might have gained throughout the years and what knowledge might have been lost?

What are some modern weapons you know of that are used today? Discuss some of their uses.

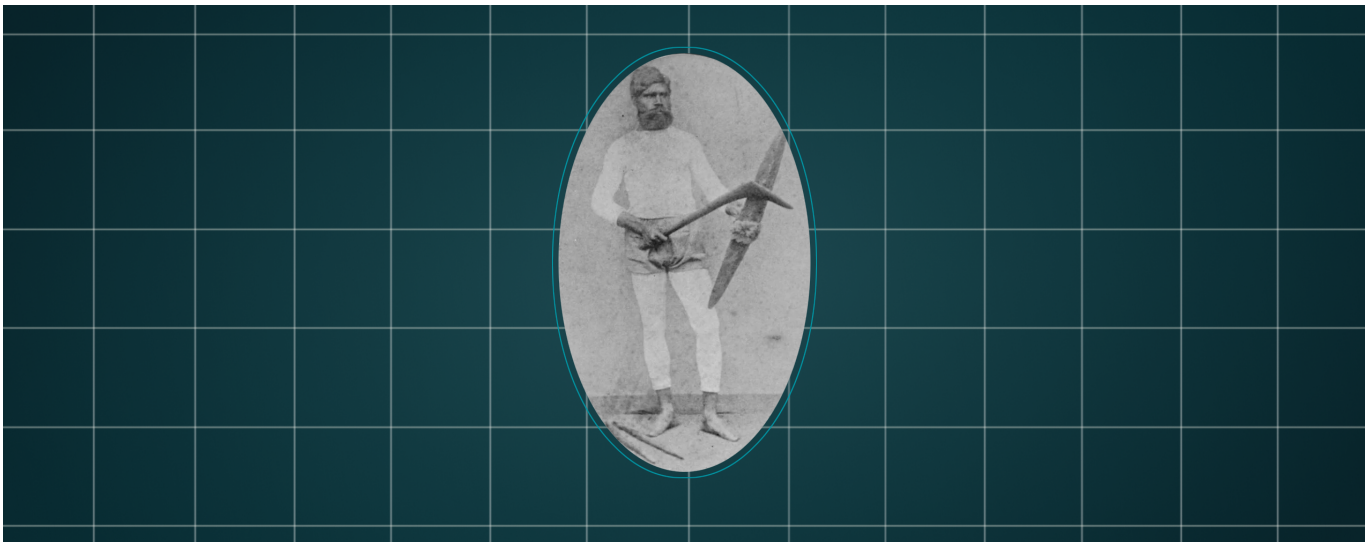
What traditional Australian First Nations weapons do you know about? Discuss some of their uses.



Here the Leangle (pronounced lea-ung-gal) and Parrying Shield that Trevor Kirby and Brendan Kennedy made on Wadi Wadi Country are put to test, measuring Phil's strike speed and range of motion using a neuro muscular skeletal model. We then learn about Wotjobaluk man, Dick-a-Dick, and put the weapons to test at the national cricket centre with Trevor deflecting professional bowler, Josh Lalor's fast balls as Dick-a-Dick was famous for.

Discussion Questions:

- What traditional lands are we on at Griffith University?
- What does Laura and David research and what does the neuro muscular skeletal model provide us?
- What was the maximum velocity of his fastest swing?
- How is the Leangle range of motion explained and what joint do we expect to see a large range of motion in?
- How do the angles of the parrying shield reflect the cricket bat?
- What was Wotjobaluk man Dick-a-Dick famous for and how did Brendan test his skills he inspired?



Activity: Dick-a-Dick (Yanggendyinanyuk)

Research Dick-a-Dick (Yanggendyinanyuk), the first Aboriginal team to compete in England and present your finding to the class, reflecting on the following:

Discussion Questions:

- Why is his story so significant?
- What was happening to Aboriginal people at the time that Dick-a-Dick and the cricket team competed overseas, making his experience so unique for Aboriginal people?

Further research your local Aboriginal or Torres Strait Islanders heroes stories and how these stories have an impact today.

Episode 3: **Leangle and Parrying Shield**

Extended Curriculum



A Formidable Pair of Weapons

Host Phil Breslin and weapon makers Brendan Kennedy and Trevor Kirby unpack the Leangle and Parrying Shield before honouring an Aboriginal Cricketer's crowd-pleasing demonstrations from 1868.

Discussion Questions:

- What is the Leangle used for?
- What is the purpose for the design of the Leangle?
- What does its companion, the parrying shield do as well as defend?
- What is the importance of a handle on the Parrying Shield? And how does Trevor work out the sizes?
- What skills do we witness the men needing to fight with these weapons?
- Why might the shield come in handy?



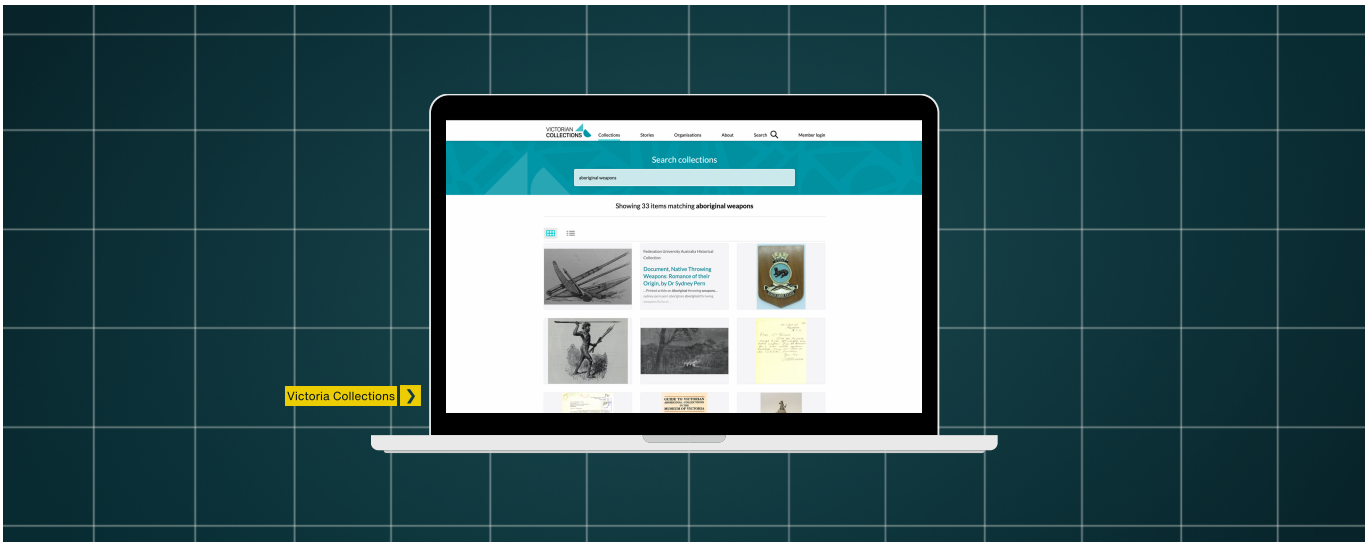
Force Rating

Consider the force rates on the object below.

Force Rating Flat Plate (body) - 64 kgs
Force Rating Angle Plate (shield) - 16 kgs

Discussion Questions:

- Describe the difference between hitting a flat plate and hitting a shield with curved edges.
- What is the potential force of the Leangle and how might you deal with handling this force?
- What did we see the board do when the force is exerted onto it?
- Where did the force go?
- How might this knowledge help the person hitting the shield?
- How many times more force is placed on the flat wood?
- What might this mean in a fight scenario?
- What is Newton's second Law?
- What is the Formula for Force?
- What does this teach us in relation to the Leangle and Parrying Shield?
- How might you test force in your classroom?



Activity: Victorian Aboriginal Weapons

Search the Victoria Collections for ‘Aboriginal Weapons’ and research one of the 33 items that appear in the collections on the website. This might include correspondence, books or artefacts. Record any information available about where the weapons were from, who made them, what they were used for and where they are now, where known, and share this with your class.



Activity: First Warriors

There are many Aboriginal and Torres Strait Islander Warriors throughout history. One of the first known stories from the Frontier Wars being the stories of Pemulwuy and Bennelong. You can learn more about these heroes and the resistance that they lead, including their weapons used to fight the invasion and protect their people and Country in Episode 1 of The Australian Wars.

Research who are the Aboriginal and Torres Strait Islander Warriors from local Aboriginal groups, how did they protect their people and Country.

Episode 3: **Leangle and Parrying Shield**

Quick Start Guide



Kodj

The Kodj is multi-functional. The head features two edges. One is sharp for slicing and chopping. The other is blunt for pounding. The pointed handle can be used for climbing or combat. At approximately 45cm in length and 2.5kgs in weight, this little weapon packs a punch.

Synopsis

Southwest of West Australia in Kinjarling - Albany on Menang country, Phil learns about the Kodj. A hafted axe well known and widely used by the Noongar people. Weapon maker Larry Blight teaches Phil how to source, construct and use the multipurpose weapon.

To discover more, Larry and Phil traverse the continent to meet with our crack team of scientific experts uncovering the scientific secrets of this ancient weapon.

But Phil's not done yet.

Upping the ante, he invites Champion Axeman Mitch Argent to take part in a unique challenge of speed and skill.



Before Viewing

Discussion Questions

- How would you describe the weapon just looking at the image?
- How long is this weapon and how much does it weigh?
- How does this length compare in size to the other weapons in the series?

Activity: Dolerite

Here we not only measure how strong the Kodj is, but how it breaks.

Discussion Questions:

- What happens when the edge is touched after the first break?
- What does this teach us about the dolerite and its benefits?

Continue watching the full episode to see the results of the force test with small grains with no porous.

Extended Curriculum



Grass Tree

Here we learn that the Grass Tree (Xanthorrhoea preissii) grows about 3-5 mm in a year. How tall must the tree be if it is predicted to be around 800 years old?!

Discussion Questions:

- What is another name for the grass tree?
- What does the tree bleed out when burned under 400 degree temperatures?
- How much resin does Larry say we are going to need for an axe or a Kodj?



Discussion Questions:

Now we crush the resin bulbs with a stone hammer. ‘This is where the chemistry starts!’

- Define chemistry? How is this an example of chemistry?
- What is carbon and what does it look like?
- Can you think of modern uses for carbon?
- Next step is to mix the crushed resin with the crushed rock, carbon.
- What colour is the carbon and what colour is the resin?

The third ingredient looks like poo! And it is.

- What native animal’s poo is this?
- What does the grinded poo act as?







Measuring Force

Veronica explains the impact of the Kodj in a targeted area, not distributed. Therefore, the full 1700 newtons landed in one area is a very deadly weapon!

Discussion Questions:

- How do we measure force?
- What is the average amount of force from a strike with a hammer?
- Compare the force from the Kodj to the average hammer. How many newtons was Phil's strike?





The First Inventors

After seeing the process of making the Kodj, seeing the transform from powder to melted tar like substance to solid rock! Write a reflective piece or research paper imagining the first time this process was discovered.

Discussion Questions:

- How did this happen?
- What may have they been trying to achieve?
- What could have gone wrong?
- What are the incredible uses of this resin?



Episode 5: **Longspear**

Quick Start Guide



Longspear

The Longspear or Allener us unique to Lutruwita, Tasmania. Ranging from 2.5 to 5 metres in length, the longspear is crafted from a sapling. The sharp point is at the thickest end of the spear with the thin end at the tail. Weighing as little as 850 grams, this weapon is designed for maximum flight distance, precision and lethal impact.

Synopsis

Lutruwita - Tasmania. Host Phil Breslin meets weapon maker Dave mangenner Gough to learn about the Allener - the Longspear.

Heading to the mountains they source the perfect saplings to craft these ancient hunting weapons. Phil discovers the stripping and straightening process before learning how to throw this outsized weapon.

Next Phil and Dave travel to Brisbane to unlock the science behind the Longspear. Meeting our team of experts, they discover that this seemingly simple weapon contains complex scientific principles propelling it extraordinary distances.

Next Phil invites Paralympian Corey Anderson and three-time National U18's Women's Javelin champion Alexandra Roberts to put this weapon into action.



Before Viewing

Discussion Questions

Research and discuss as a class the European colonial history of Lutruwita (loot-tru-weet-ta)/ Tasmania and its current impacts. Explain to students that despite attempts of genocide, Aboriginal poeple and culture in Lutruwita/Tasmania is still alive and strong today.

- Have you heard of the long spear?

Discuss cultures around the world that use spears for hunting and how they may still be used today.



Here we are introduced to the Allenar (Ull (like null but no ‘n’) -en-na) and how it is unique to Lutruwita, Tasmania, its measurements, and what it is designed for. Dave teaches Phil how to source the wood, shave it down and heat and mould the spears pointing edge.

Discussion Questions:

- How many metres in length does the Allenar typically range from?
- What is the long spear crafted from and how much does it weigh?
- What is the Allenar designed for? Discuss the shape, size and weight and how this is fit for purpose.
- How does Dave explain the characteristics of the saplings, dogwood tree’s, to be sourced for the allenar?







The Process

Discussion Questions:

What industries and modern practices affect our amount and quality of resources such as native woods today? How can we protect our natural resources and what practices and policies are you aware of designed to protect Country?

This can be discussed as a class or further research activity.

- What is used to shave the sapling tree down?
- What do we see coming out of the tree and it's shaven down?
- Explain the purpose of heating the wood and rubbing the point in this next process over the fire? What are we trying to achieve here?

Watch the full episode to learn the next steps and see them put the Allener to the test!

Extended Curriculum



The Design

Discussion Questions:

- What are the 3 axis that enable and lock flight?
- Explain how these three axis are described in relation to the spear?
- What is the importance of finding the centre of gravity?
- How does this affect the flight path?
- What are the three physical features of the spear described?
- What does this contribute to?



The Impact

Discussion Questions:

- What impact do we see the spear having on the gel torso?
- What damage might be caused from this spear tip penetrating through the lungs?
- What is the primary motion of the spear throw?
- What are the revolutions per second and what does this culminate in?







The Javelin

Discussion Questions:

- What is the difference in centrementeres between the long spear and the javelin?
- What are the athletes' personal best at throwing a javelin? How does this compare to their long spear throw?
- How does the extra metre of the long spear affect their throw in their angle of release and range of motion?

Alex throws 49 metres! Imagine this being thrown as a weapon and it's advantageous. Definitely a unique and formidable first weapon!





Episode 6: **Wartilykirri**

Quick Start Guide



Wartilykirri

The Wartilykirri is a non-returning boomerang, often referred to as the Number 7 because of its distrinctive shape. Designed for hunting and killing, it's carved from hardwood, and is heavier andlarger than its cousin, the Returning Boomerang. The Wartilykirri can be used in hand-to-hand combat or thrown at its target, reaching extroadinary distances around 100 metres.

Synopsis

At Tennant Creek, 500 kms north of Alice Springs, host Phil Breslin meets master carver and craftsman Joseph Williams to learn about the Wartilykirri, a non-returning boomerang, often referred to as the Number 7.

Phil sources the wood, witnesses the crafting and puts this weapon into action. He gets a crash course in throwing and manoeuvring this hefty weapon. Keen to unpack the science that makes this hunting boomerang unique, Phil and Joseph meet our experts who are ready and waiting to investigate the wonder of the Wartilykirri.

It's been quite the journey, but they're not done yet. Phil wants to see the Wartilykirri in full fight mode, and so in a battle royale - medieval combat fighters put down their swords and pick up the Wartilykirri.



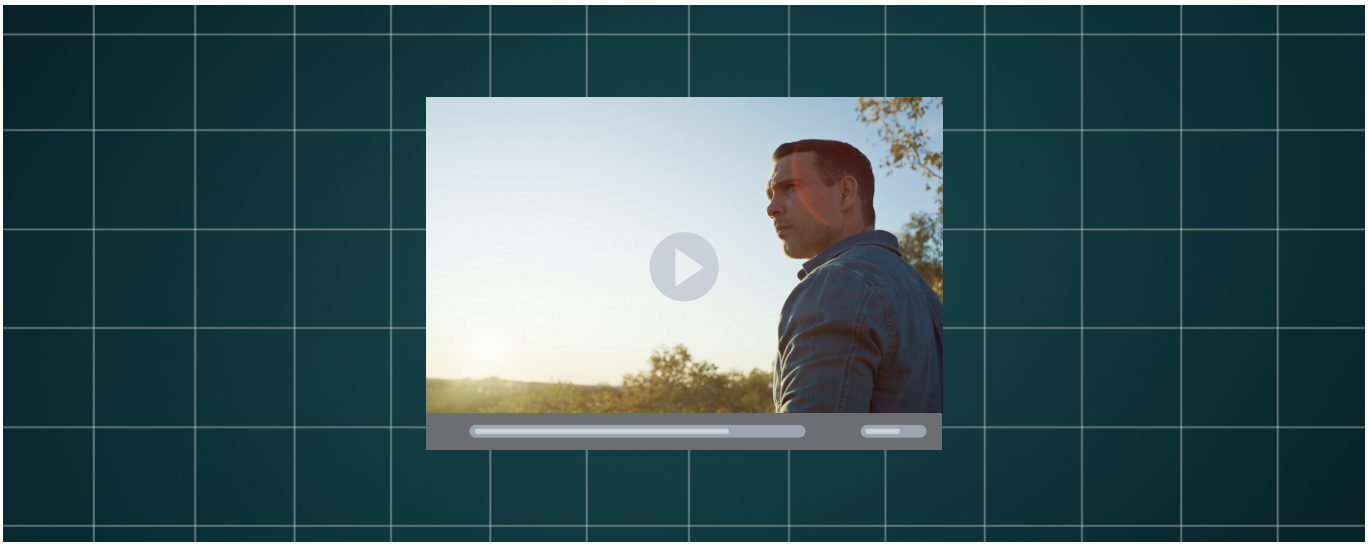
Before Viewing

Discussion Questions

‘For thousands of years knowledge has been passed down through generations.’

Discuss this line from the opening with your students.

- Why might this be called the Number 7 Boomerang?



Phil can't wait to use the Wartilykirri (pronounced wah-til-gear-re), the Number 7 Boomerang he sourced and carved with Joseph, a Warrumungu man from Tennant Creek NT. After Phil and Joseph use it out bush, they take it to Meanjin where Dr Conrad makes a model of the boomerang to test in the wind tunnel.

Number 7

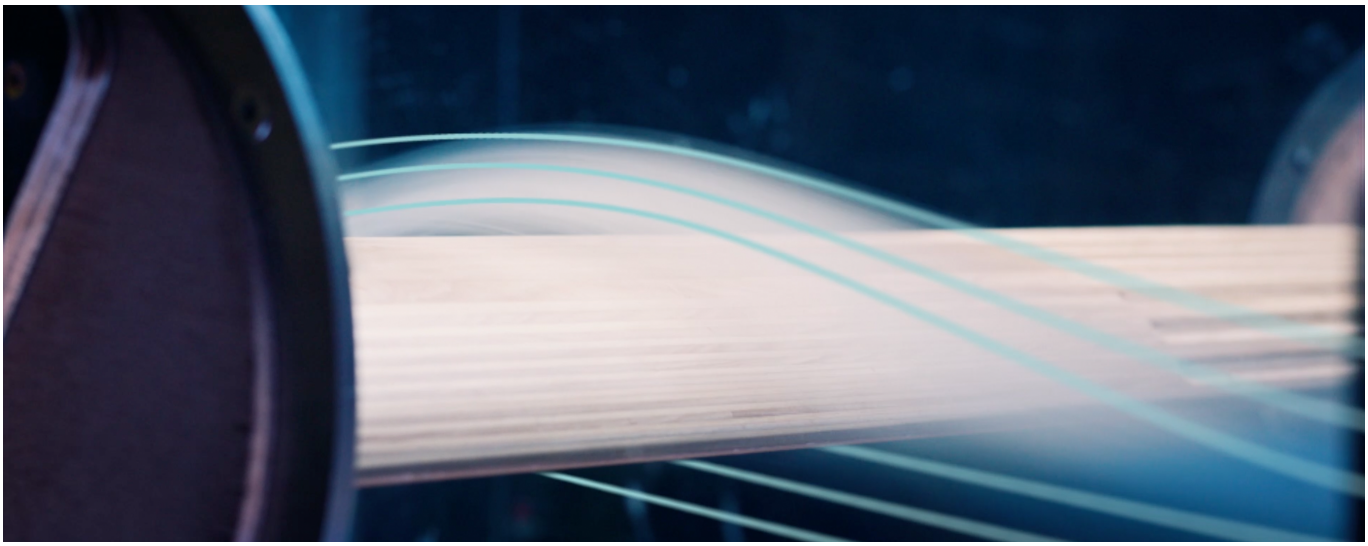
Discussion Questions:

- Who are the owners of the Traditional Lands are we visiting here in Tennant Creek, Northern Territory?

Grandpa Walter taught Joseph how to make the Wartilykirri.

- What tools do we see him use to make the weapon?
- How does Phil explain the feel of the weapon?
- What can the hook be used for?



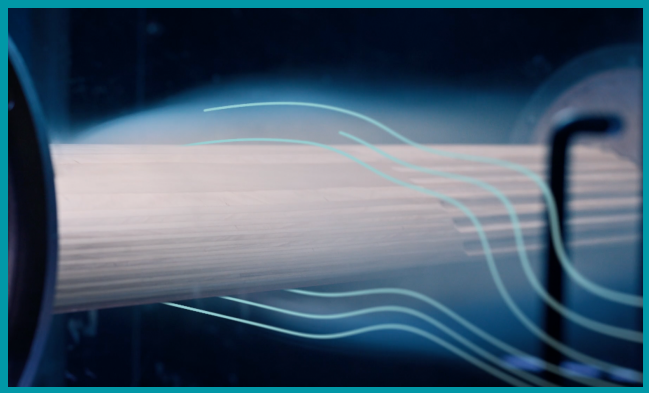


Flight Path

Discussion Questions:

- What helps the boomerang generate lift in the air?
- How does low drag and reasonable lift support the flight path?
- Why do we want to reduce drag? Discuss accuracy, speed and flight.
- What does Conrad explain happens to the turbulence if you increase the angle of attack?
- What would happen to the boomerang in this case?





Extended Curriculum



Drag and Lift

Draw a diagram of the boomerang in the wind tunnel and annotate the following elements and principles to explain the effects of drag and lift. Explain how the structure of the weapon is carefully designed to support its purpose.

- Drag
- Lift
- Flight Path
- Wind
- Angle of Attack
- Accuracy
- Speed
- Flight

Alternatively, draw a picture or the Wartilykirri and label these angles and other significant characteristics. Add descriptions to the labels to explain their purposes.



Angle of Attack

Discussion Questions:

- Who are the owners of the Traditional Lands are we visiting here in Tennant Creek, Northern Territory?
- Grandpa Walter taught Joseph how to make the Wartilykirri. What tools do we see him use to make the weapon?
- How does Phil explain the feel of the weapon? What can the hook be used for?
- What helps the boomerang generate lift in the air?
- How does low drag and reasonable lift support the flight path?
- Why do we want to reduce drag? Discuss accuracy, speed and flight.
- What does Conrad explain happens to the turbulence if you increase the angle of attack? What would happen to the boomerang in this case?



Injury Index

Senior Forensic Doctor Adam Griffin sets up an experiment to measure the impact of the Wartilykirri on soft tissue structure.

Discussion Questions:

- What major organ sits under the ribs on the right side?
- Why is this so dangerous to the human body if it strikes the right side?
- What could this result in?
- What organs sit underneath the clavicle?
- What could result in this bone being fractured?
- What is the name of the flat bone that shields the heart?
- What can a strike to this bone structure result in?

Here we measure how the human body and the Wartilykirri work in tandem. Laura and David measure Phil's body movements when throwing and striking with the Wartilykirri.

- What speed does Phill throw the weapon at?

Further Reading

Resources and References

1. Map of Indigenous Australia | AIATSIS
2. Human-factors engineering | Definition, Ergonomics, & Examples | Britannica
3. Acknowledgement of Country and Welcome to Country | Reconciliation.org.au
4. DeadlyScience
5. David Ngunaitponi (Unaipon) | AIATSIS
6. Aboriginal Stone Artifacts, F.S. Colliver | AIATSIS
7. A Record in Stone: A study of Australia's flaked stone artefacts | AIATSIS
8. Earliest evidence of the boomerang in Australia | National Museum of Australia
9. 5 Indigenous engineering feats you should know about | SBS NITV

Feedback

We would love to hear your feedback on the resources and how you embedded the series teachings into your subject curriculum and classrooms, as well as learning outcomes and initiatives that the series and resources may have inspired. This helps us to better what we design and offer for you as teachers and for your students. Please contact us at info@cultureislife.org.

Answers

Teacher Resources

Before Viewing

Answers:Discussion Questions

Before viewing any of the episodes or short clips, ask your students to respond to the following questions:

• What does the title of the series tell us?

That this show is about Aboriginal and Torres Strait Islander weapons, the use of 'First' in the title alludes to First Nations and/or First Peoples and also the 60,000+ years of continued culture, making their weapons the 'First Weapons'.

• What might we be learning from studying a series called 'First Weapons'?

Learning about the different weapons traditionally used by Aboriginal and Torres Strait Islander people.

• What group of people's knowledge might this series teach us about?

Aboriginal and Torres Strait Islander people.

• How might this relate to the subject or area of study we are doing now?

The science and technology used in these weapons.

• What is one thing that you would like to know more about from watching this series?

• Do you know of any Australian Aboriginal Weapons?

Some examples are the boomerang, spear, axe and shield.

Quick Start Guide

Answers: Before Viewing

List and define aerodynamic principles including:

Turbulence
Turbulence is unstable air movement that is caused by changes in wind speed and direction.

Drag
A force acting opposite to the relative motion of any object moving.

Lift
A fluid flowing around an object exerts a force on it. Lift is the component of this force that is perpendicular to the oncoming flow direction.

Average Centre of Lift
The mean of all the centres of pressure on an airfoil.

Centre of Mass
The centre of mass is defined as a position on an object which represents the average (or mean) mass of that object.

Gyroscope
A device used for measuring or maintaining orientation and angular velocity.

Velocity
The speed and the direction of motion of an object.

Biomechanics
The study of human movement including the interaction between the participant and equipment.

Testing Aerodynamicss

Answers: Discussion Questions

• How does mechanical engineer, Dr Conrad Stacey, explain the focus of his PhD?
High speed space dynamics, space travel and scramjets. Honours thesis on boomerang aerodynamics.

• What does the wind tunnel look like in the lab?

Describe what the aeroplane wing looks like compared to a boomerang wing.
Boomerang wings are not symmetrical like those of birds or aircraft. This results in right-handed and left-handed boomerangs. When thrown vertically into the wind, the upper wing's leading edge is positioned on the inner concave part of the boomerang.

• How does this demonstrate a difference in the aerodynamics?
The boomerang's wings generate lift as it flies, but this alone is not sufficient to keep it in the air. To maintain stable flight, the boomerang must be thrown with a spin, similar to a discus. Without spin, it wobbles and falls. The rotational spin of the boomerang stabilises its flight and causes it to follow a curved path. This spinning effect is also seen in other objects like toy tops and bicycle wheels.

• What do the curved streamlines over the top of the wing and curved streamlines underneath the wing do?
Gives it the lift, means no turbulence.

Explain this principle in a diagram annotating the flow on the top versus flow underneath and what this means.

• What difference do we see, and does Dr Conrad explain, about the smoke around the boomerang wing? ***Trailing and a lot of turbulence.***

• What does this turbulence cause?
The drag. Caused in sudden change of section at the trailing edge. Causes the flow to separate.

• Why is it important that we have a drag on the trailing edge of the boomerang wing?
So it doesn't return as fast as you throw it.

• Why is it safer for the thrower?
Need it to slow it down.

Putting It To Practice

Answers: Discussion Questions

• What do we learn here about why this particular design of boomerang comes back if thrown correctly?
Read about the unique designs of the 3 types of boomerangs here:
https://murruppi.com/boomerang-information

• What is a gyroscope and what are examples of these in your world?
Any spinning object will act to some extent as a gyroscope' as Dr Conrad explains.

• What is the bicycle wheel used to explain?
The returning trajectory of a boomerang involves the aerodynamic lift of its airfoil shape plus the gyroscopic precession associated with its rapid spin. The precession redirects the airfoil so that it "flies" around the returning path. Much like the centre of a bicycle wheel.

• What happens when the wheel isn't spinning?
The wheel falls to the ground.

• Where is the centre of mass?
Outside the material of the body. In a symmetrical boomerang, this is in the middle space in between the two edges.

Types of Boomerangs

Answers: Activity

Research the different types of boomerangs and their unique shapes and purposes. Draw the different types of boomerangs researched and label the significant characteristics of the boomerang on your drawings. Based off your findings, what boomerang do you believe to be the most useful for survival and explain your response.

When you throw the boomerang, one arm of the boomerang is advancing and one arm is almost still. One arm has twice the velocity of the boomerang.

• How do we see this in Phill's throw with the leading edge highlighted?
The leading edge switches wings every time the boomerang spins.

• How is the difference in life explained from the top arm to the bottom as it rotates?
The boomerang wing that's advancing gets more lift.

• Describe aerodynamic drag in relation to the throwing of the returning boomerang.
Consider the angle of attack when thrown, this has a large effect on the drag. The magnitude of the drag generated by an object depends on the shape of the object and how it moves through the air.

• What three components are measured in the Boomerang Animation?
Lift, Average Centre of Lift, & Centre of Mass.

• What about the center of lift and the center of mass makes the boomerang lie down as it's turning?
The centre of lift being slightly forward to the centre of mass.

• What do we see in the flight path of the boomerang?
Circular spin.

Quick Start Guide

Answers: Research Activity

• What Country is Phil visiting and what do we learn about Uncle Moogy and where he is from?
Kaurna Country.

• What tree do we learn about here?
She oak.

'Nothing will go to waste.' Discuss this as Aboriginal lore. What does this mean, what is this teaching us and how might we practice this resourcefulness and appreciation of Country in our everyday life?

• What parts of a tree might we find the appropriate curve for a boomerang?
The roots.

'People don't realise what they are putting out, someone else can use.'

Explain this concept in relation to what Uncle Moogy is teaching here.

• Why is this important for the sustainability of Country for generations to come?
Reusing & Reducing, helps sustain the environment for future generations. Reduces the amount of waste sent to landfill. Reducing means more resources remain on the land ie. making less furniture and reusing current, keeps the trees untouched.

Making the Boomerang

Answers: Discussion Questions

• What is the first step in making the boomerang from plywood?
Stencilling the shapes to cut.

Continue to add each step as a flow chart of the list to create instructions on how to make the boomerang the way Uncle Moogy teaches it.

Here we see stencils drawn close together to maximise the amount of boomerangs that can be made from the wood from the cupboard.

What tools would have First Nations peoples have traditionally used to make boomerangs?
Stone tools (such as a sandstone axe), fire, etc.

• How does Uncle Moogy explain cutting the flight pattern into the boomerang?
Trimming the edges into the boomerang, so it doesn't go straight.

• What are the two names of the edges on the boomerang?
Trailing and leading edge.

• What would happen to the flight path of the boomerang without these edges cut?
The boomerang's curve prevents it from rolling, maximises its speed of rotation and ensures that its central point of rotation stays fixed in one place. Without these edges it would not spin and return.

Quick Start Guide

Answers: Before Viewing

Define the below terms:

• Engineering

The study of using scientific principles to design and build machines, structures, and other things.

• Distance

The amount of space between two places.

• Leverage

The exertion of force by means of a lever.

Collecting the Materials

Answers: Discussion Questions

• What does the spinifex look like?

Dry grass with leaves that grow to approximately 50 cm high with a pointed tip.

• How does Phill explain that it feels and smells?

Feels hard and spiky, smells like Orange peel and raspberry, cranberry and chalk, floral elements.

• How is its taste described?

Bitter.

• What are the next steps after the grass is collected?

Collect the resin.

• What do we see the men do?

Beat the spinifex down.

• What is the purpose of this process?

Knock the resin off the spinifex.

• What's another way Phil describes the sticky resin?

Bush glue.

Spinifex

Answers: Discussion Questions

• What do the Mulga trees look like?

Tall with high branches.

• Why does Frank think this is a good tree for the Amerr?

It's straight.

• What does Frank teach us about selecting the right tree?

A dreamtime tree is a sacred tree. If it's a dreamtime tree then we can't cut it.

• What does this teach us about cultural practices and Aboriginal lore?

Deep knowledge systems learnt over tens of thousands of years, tells us what can and can't be taken and used.

• How is this different from European ways of doing?

Generally the environment is seen as resources for human use.

• How is the tree cut?

With an axe.

Observe the angles and how the tree falls. Draw a diagram of this teaching, labelling the approach and its purpose.

• How might this hard and heavy wood benefit the weapon we are making?

Tough and durable. Won't snap with pressure.

The Right Wood

Answers: Discussion Questions

• What is the English name for the tree we are shown to make the peg?

Therrpeyt (Mulga tree) is the name of the plant where the men get the wood. Ikalharr is the language name for the hook attached to the woomera.

• What modern equipment is John using to sift the resin?

Car filter.

Discuss the sustainability behind repurposing used materials and how this is beneficial to the environment.

• Describe the next step in turning the resin into bush glue.

Read more about the proces here: https://www.survivalandbushcrafts.com/indigenous-australian-glue-and-how-to-make-it/

• What is used for heat in this process?

Fire.

• How does the resin look after being heated?

Like tar.

Theory of Motion

Answers: Discussion Questions

As a class, discuss The biomechanical principle of Motion and how it relates to linear motion, velocity, speed, acceleration, and momentum.

Motion is a movement that results from a force. For example, if an opposition player pushes you to the ground, the force has come from them, and not your own muscles. Motion can be linear, angular or general.

• What does distance and leverage mean?

Distance: the length of the space between two points.
Leverage: the action of a lever or the mechanical advantage gained by it.

• What is the difference in the starting position if you were to throw a spear without a woomera?

Roughly an arm's length.

• Looking at the image below, how many centimetres does Phill move his arm from the starting point to the release point?

60cm.

Now when we add the Amerr, what changes in the distance travelled from the starting point to the release point? How could you describe this difference?

Double.

Speed and Velocity

Answers: Discussion Questions

• What is speed and how do we measure it?
Speed (ms-1) = Distance (m) / Time (s)

• What is velocity and how do we measure it?

Velocity (m/s) = Displacement (m) / Time (s)

• How does this double in length travelled from starting point to release point affect the velocity?

Doubling the initial velocity would increase the range by 4 times. Horizontal velocity would double as well as the time in the air.

Testing Velocity

Answers: Activity

• How did their velocity compare?

More than double.

Leangle and Parrying Shield

Answers: Before Viewing

• What traditional lands are we on at Griffith University, Gold Coast QLD?

Yugambeh

What does Laura and David research and what does the neuro muscular skeletal model provide us?

Biomechanics and digital print.

• What was the maximum velocity of his fastest swing?

4.28 m/s

• How is the Leangle range of motion explained and what joint do we expect to see a large range of motion in?

Large range of motion in the elbow.

• How do the angles of the parrying shield reflect the cricket bat?

Flat v angle side use.

• What was Wotjobaluk man Dick-a-Dick famous for and how did Brendan test his skills he inspired?

His skill blocking cricket balls he learnt with the shield, tested block cricket balls in the net.

Dick-a-Dick (Jungunjinanuke)

Answers: Activity

• Why is his story so significant?

Read about his story here:
https://monumentaustralia.org.au/themes/people/sport/display/93143-jungunjinanuke-dick-a-dick
https://meanjin.com.au/essays/his-walking-feet/

• What was happening to Aboriginal people at the time that Dick-a-Dick and the cricket team competed overseas, making his experience so unique for Aboriginal people?

Read about Aboriginal poeples treatment in the mid to late 1800's here
http://www.workingwithindigenousaustralians.info/content/History_3_Colonisation.html

Leangle and Parrying Shield

Answers: Before Viewing

• What is the Leangle used for?

The leangle, paired with the Mulga shield, formed a deadly weapon combination. Its striking point could swiftly change, making it highly unpredictable and dangerous in combat.

• What is the purpose for the design of the Leangle?

Wooden club with long straight handle curving to a 90 degree angle at the top forming a sharp pointed head.

• What does its companion, the parrying shield do as well as defend?

It can strike.

• What is the importance of a handle on the Parrying Shield?

To grip and hold force.

• And how does Trevor work out the sizes?

It needs to be the same size as a hand.

• What skills do we witness the men needing to fight with these weapons?

Blocking (defending) and striking (attacking).

• Why might the shield come in handy?

To block attacks.

Force Rating

Answers: Discussion Questions

• Describe the difference between hitting a flat plate and hitting a shield with curved edges.

The curved sides change the angle of the strike, resulting in a distribution of force.

• What is the potential force of the Leangle and how might you deal with handling this force?

64 force rating (kg). Use a shield.

• What did we see the straight board do when the force is exerted onto it?

A hole is punctured into the board.

• Where did the force go when hitting the curved board?

To the side.

• How might this knowledge help the person hitting the shield?

Try to avoid hitting the shield.

• How many times more force is placed on the flat wood?

4 times.

• What might this mean in a fight scenario?

You'll be much happier with a shield protecting you.

• What is Newton's second Law?

The acceleration of an object is dependent upon two variables - the net force acting upon the object and the mass of the object.

• What is the Formula for Force?

F = m • a
F = Force
M = Mass of an object
A = Acceleration

Quick Start Guide

Answers: Before Viewing

• How would you describe the weapon just looking at the above image?

A club or axe.

• How long is this weapon and how much does it weigh?

45cm and 2.5kg

• How does this length compare in size to the other weapons in the series?

It's smaller.

Kodj

Answers: Discussion Questions

• What does the Kodj look like when we first see it here in Larry's shed?

A stick or branch.

Earlier in the episode we learn that there are two edges of the Kodj, one sharp edge for slicing and chopping, and the other blunt for pounding.

• What end of the Kodj does Phil use to cut the Peppermint Tree?

The sharp edge.

• And what end of the Kodj does Phill use to crush the Marri nut?

The blunt edge.

• Describe how the edges look and might feel and how this is such a versatile weapon or tool.

The edges look like rocks and might feel hard and/or sharp. It's versatile due to the two edges and the pointed tip, which can be used for climbing or as a weapon.

What does the compression test measure and in what units?

Force, weight applied in kgs.

Dolerite

Answers: Discussion Questions

What happens when the edge is touched after the first break?

Crumbles, breaks off.

• What does this teach us about the dolerite and its benefits?

It's a good balance of smooth and porous.

Grass Tree

Answers: Before Viewing

• What is another name for the grass tree?

Fire Tree, Xanthorrhoea preissii.

• What does the tree bleed out when burned under 400 degree temperatures?

Resin.

• How much resin does Larry say we are going to need for an axe or a Kodj?

About a kilo.

• Define chemistry.

The scientific study of the properties and behaviour of matter.

• How is this an example of chemistry?

It is bonding material together to form new substances.

• What is carbon and what does it look like?

Carbon is charcoal, it looks like a chunk of charcoal.

• Can you think of modern uses for carbon?

An ink, in diamonds, carbon dioxide used to make carbonated drinks, etc.

Grass Tree

Answers: Discussion Questions

Next step is to mix the crushed resin with the crushed rock, carbon.

• What colour is the carbon and what colour is the resin?

The carbon is black and resin is red.

• The third ingredient looks like poo! And it is. What native animal's poo is this?

The language name is 'Yonga Goomp' meaning Kangaroo Poo (Kangaroo 'Yonga' Poo 'Goomp')

• What does the grinded poo act as?

A binding agent.

Measuring Force

Answers: Discussion Questions

• How do we measure force? (Newtons) What is the average amount of force from a strike with a hammer?

Around 1000 newtons, 100 kg.

• Compare the force from the Kodj to the average hammer. How many newtons was Phil's strike?

1700 newtons, 170kgs.

The Long Spear

Answers: Discussion Questions

• How many metres in length does the Allenar typically range from?
2.5-5 metres

• What is the long spear crafted from and how much does it weigh?
It is crafted from a sapling and weighs 850 grams.

• What is the Allenar designed for? Discuss the shape, size and weight and how this is fit for purpose.
It's long, thicker at the point and thinner at the tail, and doesn't weigh too much. It is designed for maximum flight distance, precision and lethal impact.

• How does Dave explain the characteristics of the saplings?
Approx 2.5 metres of straight wood and young shoots.

• What industries and modern practices affect our amount and quality of resources such as native woods today? ***Deforestation and mining.***

The Process

Answers: Discussion Questions

• What is used to shave the sapling tree down?
Hornfelds rock.

• What do we see coming out of the tree as it's shaven down?
A milky white colour of the wood underneath the bark.

• Explain the purpose of heating the wood and rubbing the point in this next process over the fire?
To take out the moisture and harden the wood.

• What are we trying to achieve here?
Hardening and sharpening the tip of the spear.

The Design

Answers: Discussion Questions

• What are the 3 axis that enable and lock flight?
Vertical, horizontal and lateral.

• Explain how these three axis are described in relation to the spear?
It has a longitudinal axis roll, a lateral axis pitch and a vertical axis yaw.

• What is the importance of finding the centre of gravity?
It's a point of equilibrium.

• How does this affect the flight path?
It allows it to be self-propelling.

• What are the three physical features of the spear described?
A combination of diameter length and material.

• What does this contribute to?
It's overall mass.

The Impact

Answers: Discussion Questions

• What impact do we see the spear having on the gel torso?
A lethal injury.

• What damage might be caused from this spear tip penetrating through the lungs?
Loss of function and possibly a collapsed lung.

• What is the primary motion of the spear throw?
A dart throwing motion, with the flick of the wrist.

• What are the revolutions per minute and what does this culminate in?
7.5 revolutions per minute.

Javellin

Answers: Discussion Questions

• What is the difference between the long spear and the javelin?
The long spear is longer.

• What are the athletes personal best at throwing a javelin?
Corey PB 58.18m
Alex PB 57.68m

• How does this compare to their long spear throw?
Their long spear throw is shorter.

• How does the extra metre of the long spear affect their throw in their angle of release and range of motion? ***The angle of release and range of motion are reduced.***

Quick Start Guide

Answers: Before Viewing

'For thousands of years knowledge has been passed down through generations.'

Discuss this line from the opening.

• Why might this be called the Number 7 Boomerang?
Its shape.

Number 7

Answers: Discussion Questions

• What helps the boomerang generate lift in the air?
The shape of the arm and air pressure.

• How does low drag and reasonable lift support the flight path?
It keeps the boomerang in the air.

• Why do we want to reduce drag? Discuss accuracy, speed and flight.
It makes it go faster and further with more accuracy.

• What does Conrad explain happens to the turbulence if you increase the angle of attack?
It increases.

• What would happen to the boomerang in this case?
It will fall to the ground.

Flight Path

Answers: Discussion Questions

• What helps the boomerang generate lift in the air?
The shape of the arm and air pressure.

• How does low drag and reasonable lift support the flight path?
It keeps the boomerang in the air.

• Why do we want to reduce drag? Discuss accuracy, speed and flight.
It makes it go faster and further with more accuracy.

• What does Conrad explain happens to the turbulence if you increase the angle of attack?
It increases.

• What would happen to the boomerang in this case?
It will fall to the ground.

Angle of Attack

Answers: Discussion Questions

• What helps the boomerang generate lift in the air?
The shape of the wing and air pressure.

• How does low drag and reasonable lift support the flight path?
It keeps it flying for longer.

• Why do we want to reduce drag? Discuss accuracy, speed and flight.
Make it more aerodynamic, so it goes faster and is more accurate.

• What does Conrad explain happens to the turbulence if you increase the angle of attack? What would happen to the boomerang in this case? ***Turbulence increases, which creates more drag and would slow it down or make it not able to fly.***

Injury Index

Answers: Discussion Questions

Senior Forensic Doctor Adam Griffin sets up an experiment to measure the impact of the Wartilykirri on soft tissue structure.

• What major organ sits under the ribs on the right side? ***The liver.***

• Why is this so dangerous to the human body if it strikes the right side? ***The liver can split.***

• What could this result in? ***Internal bleeding.***

• What organs sit underneath the clavicle? ***The lung.***

• What could result in this bone being fractured? ***Damage to the blood vessels.***

• What is the name of the flat bone that shields the heart? ***The sternum.***

• What can a strike to this bone structure result in?
Bruising to tissues including the heart muscle, which can result in death.

Here we measure how the human body and the Wartilykirri work in tandem. Laura and David measure Phil's body movements when throwing and striking with the Wartilykirri.

• What speed does Phill throw the weapon at?
10.8 m/s



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