LESSON PLAN

The Design of the Traditional Hawaiian Canoe

Grade Level: 7–12
Time: 60–90 minutes (adaptable for 45 min class or extended block)

Lesson Overview

Students explore the **primary and secondary design features** of the traditional Hawaiian canoe (waʻa), analyze how environment shaped hull design, and evaluate how design tradeoffs determined canoe use (fishing, racing, war, cargo, surfing).

Students will understand that Hawaiian canoe design was not random — it was the result of environmental adaptation, material knowledge, and deep cultural understanding of ocean conditions.

Essential Questions

1. How did Hawaiian canoe design reflect environmental realities?
2. What primary features defined all traditional Hawaiian canoes?
3. How did secondary design features determine canoe performance?
4. Why was the rounded “U”-shaped hull critical in Hawaiian waters?

Learning Objectives

Students will be able to:

- Identify and describe primary design features of traditional Hawaiian canoes.
- Explain how hull shape affects speed, tracking, maneuverability, and carrying capacity.
- Compare rounded hulls to “V” hulls and evaluate performance tradeoffs.
- Use correct Hawaiian vocabulary related to canoe structure.
- Analyze how environmental conditions influence engineering design.

Key Vocabulary

Hawaiian Term	English Meaning
Waʻa	Canoe
Waʻa kaukahi	Single-hull outrigger canoe
Waʻa kaulua	Double-hull canoe
ʻIako	Outrigger booms
Ama	Outrigger float
Wae	Thwart (crosspiece inside hull)
Manu	Bow and stern covers
Kaupoʻi	Weatherboard
Moʻo	Gunnels
Kino / Kaʻele	Hull
Rocker	Fore-and-aft curve of hull bottom
Sheer	Curve of gunnel line
Calabash hull	Bulging lower hull shape
Medial ridge	Subtle central ridge on hull bottom
Tracking	Ability to hold straight course

Part 1 – Introduction (10–15 min)

Hook Question

“If you were building a canoe for rough Hawaiian waters, what shape would the bottom be?”

Have students sketch a quick hull cross-section.

Introduce idea:

- The sea dictated survival.
- Design = adaptation to conditions.

Part 2 – Primary Design Features (Core Content)

Explain that **Primary Features** are found in ALL traditional Hawaiian canoes.

The Six Essential Features

1. **One-piece dugout hull**
    - Primarily made from *Acacia koa*
    - Not plank-built
2. **Two canoe types**
    - Waʻa kaukahi (single hull + ama)
    - Waʻa kaulua (double hull)
3. **Rounded “U”-shaped hull bottom**
    - Never sharply “V” shaped

    - Rounded in transverse section

4. **Convex wetted surfaces**
    - No hard chines
    - Smooth curves reduce drag and prevent broaching
5. **Continuous rocker**
    - Banana-like curvature
    - Helps canoe rise over waves
6. **Narrow, tapered bow and stern**
    - Efficient entry and exit
    - Reduces resistance

Why No “V” Hull?

Discuss:

- A V-hull “tracks” aggressively
- In Hawaiian swells, it would broach and flip
- Rounded hull allows canoe to “give ground” and slide through swell
- Better for surfing and rough seas

Engineering concept:
Tradeoff between tracking and maneuverability

Part 3 – Secondary Design Features (Adaptation for Purpose)

Secondary features varied depending on canoe function.

Examples

1. Medial Ridge (Subtle Keel)

- Rare, very slight
- Improved tracking
- Reduced maneuverability

2. Calabash Hull

- Bulging lower hull
- Increased carrying capacity
- Higher freeboard when loaded
- Ideal for freight or fishing

3. Rocker Variation

- Heavy rocker = good for rough water & surfing
- Minimal rocker = better cargo stability

4. Bow and Stern Shape

- Fine entry = faster, less drag
- Full blunt bow = more cargo capacity

Design Tradeoffs Discussion

Use board chart:

Feature	Advantage	Disadvantage
Rounded hull	Maneuverable, safe in swell	Less straight-line tracking
Medial ridge	Tracks better	Less responsive
Heavy rocker	Rises over waves	Less speed on flat water
Full bow	Carries more	More drag

Activity Options

Option A – Hull Comparison Exercise (20 min)

Provide three drawn hull profiles:

- Racing canoe
- ‘Opelu fishing canoe
- Freight canoe

Students identify:

- Rocker amount
- Entry shape
- Likely use
- Carrying capacity

Option B – Engineering Analysis (High School Level)

Students evaluate:

“If you were designing a canoe for:

1. Surfing
2. Deep-sea fishing
3. War transport
4. Racing

Which features would you emphasize?”

Students must justify using:

- Drag
- Displacement
- Wetted surface
- Tracking
- Stability

Option C – Outdoor Instruction (Beside Canoe)

Have students:

- Trace rocker visually
- Examine hull cross-section
- Identify:
    - Manu

    - ‘Iako
    - Wae
    - Mo‘o
    - Kaupo‘i
- Estimate where the canoe is widest and deepest

Assessment Options

Quick Exit Ticket

1. Why were Hawaiian hulls rounded?
2. What is rocker?
3. What is one tradeoff between speed and carrying capacity?

Short Written Reflection

“How did Hawaiian canoe design reflect both environment and worldview?”

Engineering Extension

Calculate:

- Length-to-beam ratio
- Discuss impact on speed

Cross-Curricular Connections

History

- Pre-contact vs post-contact influence
- European boatbuilding influence

Physics

- Drag
- Buoyancy
- Center of gravity
- Stability vs maneuverability

Cultural Studies

- Canoe as expression of worldview
- Design as cultural knowledge

Teacher Notes

Key Teaching Emphasis:

- Hawaiian canoe design was not primitive — it was highly adapted engineering.
- Survival in Hawaiian waters demanded specific hull characteristics.
- Each canoe was unique — no molds or templates.
- Environmental adaptation drove form.
