STEM SPORTS EDUCATION

FUNDAMENTAL CONCEPTS

Skill Unit

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ASD SPORT COMPASS
GYMNASIO ATHION 1991
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Environment and Physical Education: Exploring STEM through Sports

Fundamental STEM Concepts

Learning goals

	In this Unit I will learn how to
Learning goal 1	Recall key scientific concepts relevant to Core Unit 1 and 2.
Learning goal 2	Explain relationships between the human body, natural surfaces, and performance.
Learning goal 3	Recognize factors (e.g., temperature, terrain, friction) that influence sports in ecological and health contexts.
Learning goal 4	Use terminology and reasoning from physics, chemistry, and physiology in interpreting sports and environment interactions.
Learning goal 5	Build a reference base that supports their participation in inquiry-based tasks in the Core Units.

Overview

This unit is designed as a comprehensive revision to refresh your core science and mathematics knowledge, bridging the gap between previous learning and the sports- and environment-focused Core Units. Each lesson focuses on one subject, provides a knowledge organizer, details learning outcomes, lists key learning tools, and makes explicit connections to upcoming Core Units.

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Lesson 1: Chemistry – Understanding Water in Sports & the Environment

Knowledge Organizer

Concept	Brief Explanation
Water states	Water can be liquid, solid, or gas
pH scale	Measures acidity/alkalinity (0-14, 7 = neutral)
Chlorine	Used to disinfect pools for safe swimming
Temperature	Affects health, performance, muscle use

Learning Outcome

- Explain basic water chemistry and its importance for swimming and physical performance.
- Recognize safe water conditions for sports and links to personal health.

Learning Tools

- pH scale diagram and safe pool range chart
- Case study: How temperature affects swimming stamina
- Interactive matching: chemical concept → swimming scenario
- Label the molecule worksheet

Connection to Core Units

Preparation for Core Unit 1: Chemistry & Swimming
Understanding water chemistry is critical for safely measuring pool water quality, explaining why swimmers perform differently in certain conditions, and discussing how the environment affects sporting outcomes.

Before we test real water samples and analyze how chemistry affects your performance in the pool, let's make sure everyone is on the same page with some key basics. These ideas might feel familiar from science class or PE, but we're reviewing them here like a quick "swim warm-up." Think of this as your safety briefing and science refresher – read carefully, try the quick checks, and you'll be ready to explore water chemistry like a pro.

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Basic Water Safety Rules – Your First Line of Defense

Water is fun, but it can be dangerous if you're not prepared. These rules aren't just for this unit – they're lifesavers every time you're near water, whether it's a pool, lake, or beach. Swimmers who know and follow them stay safe and can focus on learning science instead of worrying.

The Top 5 Water Safety Rules (Memorize These!):

- Never Swim Alone. Always have a buddy or adult supervision. Why? If you get a cramp or tired, someone can help fast. In science terms, water resistance + fatigue = trouble quickly.
- Check the Depth First. Look for depth markers (numbers on the pool wall or bottom). Never dive into shallow water (<1.5m/5ft). Why? Your head or neck could hit the bottom – a serious injury called a spinal cord risk.

- Follow All Signs and Instructions. "No Diving," "Walk Don't Run," "Lifeguard Rules." Pool chemicals + wet floors = slippery danger. Signs tell you where chlorine levels or hazards are controlled.
- Walk, Don't Run Near Water. Wet tiles or decks are super slippery (low friction from water + soap residue). One slip = broken bones or concussion.

Know Your Limits and Exit Plan. If you're cold, tired, or the water smells funny (too much chlorine?), get out. Have a clear path to stairs or ladder.

Real-Life Connection: In this unit, when we test pool water, bad pH or chlorine could make eyes sting or skin itch. Safety rules let you notice "something feels wrong" and get help.

Swim Science Link: Bad pH + chlorine imbalance = red eyes, coughs, or rashes. Good pH = happy swim!

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Simple pH Concept – The "Acidity Alarm" for Water

pH is like a traffic light for liquids. It tells you if water is safe for your body, equipment, and even germs. Imagine pH as a scale from 0 (super acidic, like battery acid – DANGER) to 14 (super basic/alkaline, like drain cleaner – also DANGER). The middle, pH 7, is neutral like pure rainwater.

VIDEO ON WHAT IS pH Scale

Concentration of Hydrogen ions compared to distilled water				Examples of solutions and their respective pH
	1/10,000,000	14	Liquid drain cleaner, Caustic soda	
	1/1,000,000	13	bleaches, oven cleaner	
	1/100,000	12	Soapy water	
	1/10,000	11	Household Ammonia (11.9)	
	1/1,000	10	Milk of magnesium (10.5)	
	1/100	9	Toothpaste (9.9)	
	1/10	8	Baking soda (8.4), Seawater, Eggs	
	0	7	"Pure" water (7)	
	10	6	Urine (6) Milk (6.6)	
	100	5	Acid rain (5.6) Black coffee (5)	
	1,000	4	Tomato juice (4.1)	
	10,000	3	Grapefruit & Orange juice, Soft drink	
	100,000	2	Lemon juice (2.3) Vinegar (2.9)	
	1,000,000	1	Hydrochloric acid secreted from the stomach lining (1)	
	10,000,000	0	Battery Acid	

Why Pools Aim for pH 7.2-7.6 (Not Exactly 7):

- Too Low (<7.0, Acidic): Stings eyes (like lemon juice), corrodes pool ladders/pumps, makes chlorine "hyperactive" (wastes it fast).
- Just Right (7.2-7.6): Eyes/skin comfortable, chlorine kills germs effectively without irritation.
- Too High (>7.8, Basic): Cloudy water, chlorine weak (germs survive), itchy skin/dry hair (like soap residue).

How We Measure It: Dip a pH strip (looks like litmus paper) in water – it changes color. Match to a chart: yellow/orange = acidic, green/blue = neutral/basic.

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Water States – Solid, Liquid, Gas (And Why Temperature Rules Them)

Water is special – it's the only substance on Earth that naturally exists as solid (ice), liquid (water), and gas (steam/vapor) at temperatures we experience. Temperature is the boss: it decides the state.

The Water Cycle Basics (For Swimmers):

Cold Temps (<0°C) → Ice (Solid): Slippery pool deck, frozen lake = NO SWIMMING!

Room/Body Temp (0-100°C) → Liquid: Your everyday swim water.

Hot Temps (>100°C) → Steam (Gas): Not for pools, but hot tubs can have steam + mineral buildup.

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Key for Pools (20-35°C Range):

- Cold Liquid (15-22°C): Feels "shocking." Muscles tighten (vasoconstriction – blood vessels narrow to save heat), heart rate jumps 20-30%, swimming speed drops 5-10%. Cramps risk ↑.
- Warm Liquid (28-32°C): Muscles relax, but sweat can't cool you (you're already wet). Overheat risk ↑ after 20+ minutes.
- Perfect (24-28°C): Body maintains ~37°C core temp. Muscles work smoothly, focus on technique.

Observation Skills – Train Your "Water Detective" Eyes

Good scientists (and swimmers) observe first, test second. Water tells stories through sight, smell, touch.

What to Notice (The "CLear" Checklist):

- Color: Crystal clear = good. Green/brown = algae/contaminants. Milky = chemicals off.
- Layering: Oil/skimmer film on top = poor circulation.
- ear Smell: Slight chlorine scent OK. Strong bleach = too much. No smell/rotten = too little.
- ripples/Waves: Steady = good circulation. Still/flat = dead spots (germs hide).

Touch Test (Mentally): Cold/hot feel, silky/slimy texture.

Basic Measurement – Reading Scales Like a Scientist

No fancy lab needed – simple tools give big insights.

Thermometer (Temperature):

- Alcohol/mercury/digital: Insert, wait 30 sec, read to nearest °C.
- Example: Red line at 26 = 26°C ✓ (shake down first if old-style).

pH Strips: (*VIDEO on how to use it*)

1. Dip 2 sec in water.
2. Wait 10-15 sec (don't shake).
3. Match wet strip color to chart box.
    a. Yellow = 6.0-6.5 (acidic).
    b. Green = 7.2-7.6 (perfect).
    c. Blue = 8.0+ (basic).

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Lesson 2 - Tech and Orienting

Knowledge Organizer

Concept	Brief Explanation
Map Symbols	Universal icons: Green = trees/plants, Black lines = paths, Gray boxes = buildings, Blue = water
Cardinal Directions	N↑ (top), S↓ (bottom), E→ (right), W← (left) when facing north; use sun for backup
Map Scale	1cm on map = X meters real distance (e.g., 1:10,000 = 1cm=100m); measure lines to calculate
Outdoor Hazards	Roots/rocks, mud/slippery slopes, drop-offs, weather changes; scan 10m ahead
Stride Length	Your walking pace ≈0.7m/step; 10 steps ≈7m for distance estimation
GPS Triangulation	Phone receives signals from 3+ satellites to pinpoint location (latitude/longitude) within 5-10m
Eco-Impact	Foot traffic causes soil erosion, plant trampling; stay on paths to "leave no trace"

Learning Outcomes

- Read and interpret basic maps using symbols, scale, and cardinal directions to follow simple routes accurately.
- Apply outdoor safety protocols by scanning surroundings, respecting nature, and moving safely in groups during navigation.
- Estimate distances and time using personal stride length, pacing, and basic speed calculations (distance/time). Observe environmental features systematically (plants, ground, structures, hazards) to collect meaningful eco-data.
- Collaborate effectively in navigation teams by rotating roles (leader, pacer, scribe, scout) and using clear communication phrases.

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Learning Tools

- Printed School Map (A4 size with legend, scale bar, compass rose, 3-4 checkpoints marked)
- Smartphone/Tablet with Free Mapping App (Google Maps, OsmAnd, or Maps.me with GPS/location enabled)
- Physical Compass (simple magnetic needle type for backup direction checks)
- Stopwatch/Timer App (for pacing and speed calculations)
- Observation Checklist Worksheet (PEST method: Plants, Earth, Structures, Things; plus eco-impact notes)
- Stride Measurement Tape (2m tape or string to measure personal pace length)
- Safety Whistles (one per team for emergency regrouping)
- Cones/Flags (3-4 colored markers for outdoor checkpoints)
- Poster Paper & Markers (for route redesign and green path presentation)

Before You Head Outdoors – Essential Skills for Safe and Smart Navigation

Welcome to the Technology & Orienteering unit! Before we hit the trails with maps, apps, and GPS, let's make sure you're equipped with the basics. Orienteering combines brainpower, physical movement, and tech smarts – like being a real-life explorer with a smartphone. These skills might ring a bell from PE class, science labs, or even video games, but we're breaking them down here step-by-step, like your personal navigator's handbook. Read, try the checks, and visualize yourself leading a team through a park without getting lost. Ready? Let's gear up!

Basic Map Reading – Your "Bird's Eye View" Superpower

A map isn't just pretty lines – it's the world shrunk down so you can plan like a pro. Think of it as a photo taken straight down from a drone.

Core Map Skills You Need:

- Recognizing Symbols: Maps use universal icons (like emojis for the real world).
    - Green blob/dot = tree or bushes.
    - Black squiggly line = path or trail.
    - Gray rectangle = building (gym, classroom).
    - Blue wavy line = water (stream, puddle).
      Example: Spot a tree symbol? That's real vegetation blocking your path – don't run through!

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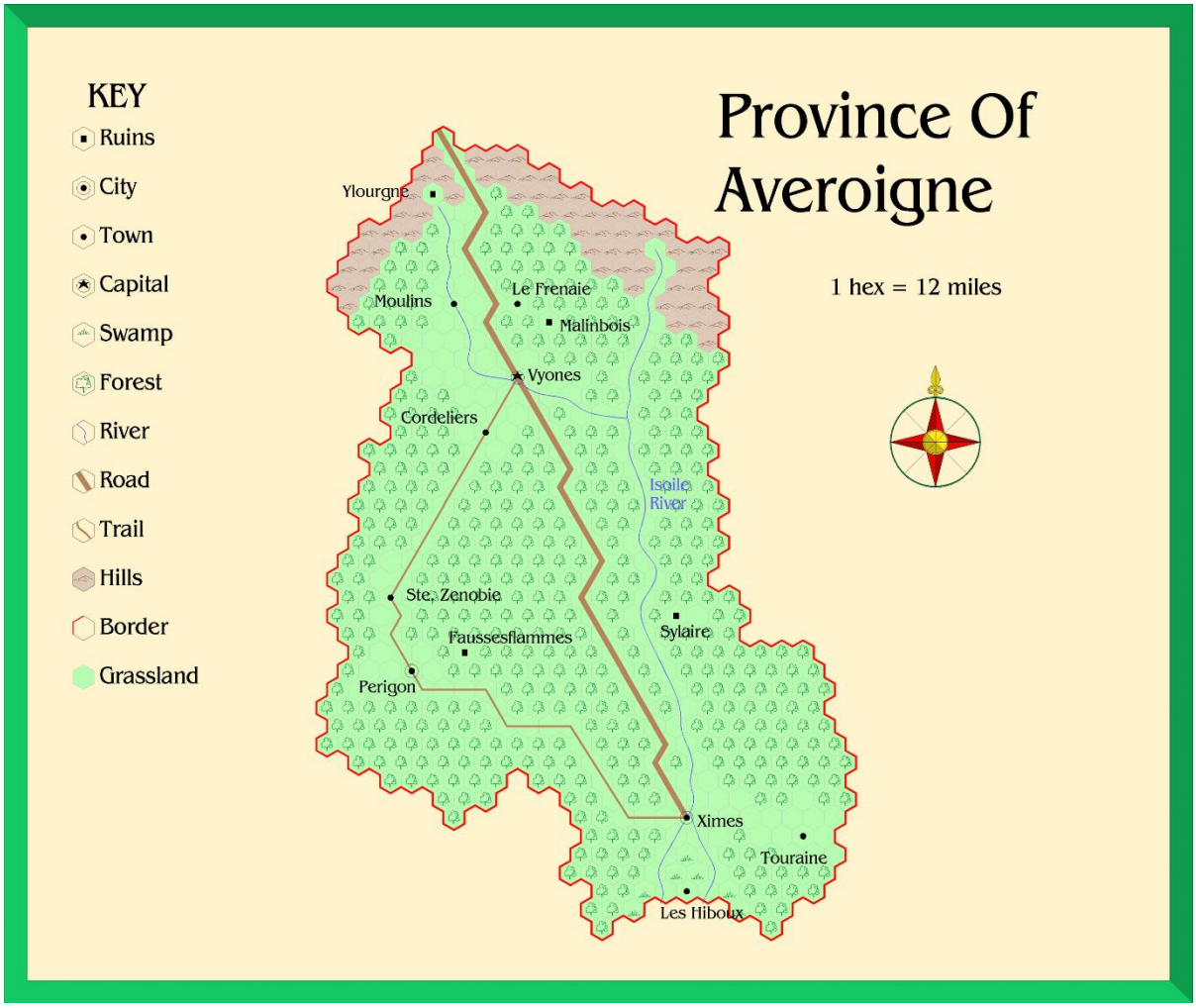
- North/South/East/West Directions: Maps have a "compass rose" (little N-S-E-W arrow).
  - North ↑ = top of map (usually).
  - Hold map with north pointing away from you (like holding a photo of the land).
  - East → = right when facing north. West ← = left. South ↓ = behind you. Pro Tip: Sun rises in east, sets in west – use it if lost!
- Following a Short Route on Paper: Start at "You Are Here" (star/dot). Follow line/arrow to next symbol. Count paces (your foot length ≈0.7m).
  Example Route: "From classroom (gray box), go 50 steps north to tree (green dot), turn east 20 steps to path (black line)."



Orienteering Link: Paper maps build "spatial thinking" before apps take over.

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Outdoor Safety Awareness – Eyes Open, Stay Smart

Discover the Basics of Tracking a Person in the Wilderness VIDEO LINK

Outdoors = unpredictable adventure. Safety isn't "no fun" – it's what lets you explore longer.

Key Rules (The "SMART" Check):

- Scan Surroundings: Look 10m ahead + sides. Hazards? People/animals? Weather change?
- Respect Nature: Stay on paths (no cutting corners – causes erosion). Leave no trace (pack out trash).
- Move Safely in Groups: Single file on narrow paths. No pushing/running near drops. Announce "Rock!" or "Mud ahead!"
- Buddy System: Always know where your team is. Lost? Stop, regroup, use whistle 3x.
- Weather/Body Check: Hot? Drink water. Rain? Slow down (slippery). Tired? Rest.

Real Connection: Tech shows your exact spot, but eyes spot roots/rocks first.

Simple Measurement – Numbers Make Navigation Precise

Guessing distance = getting lost. Measure = arrive on time.

Distance (Steps/Meters):

- Your pace ≈70cm walking, 1m running.
- 10 steps = 7m. Practice: Pace 10 steps, measure with tape = your stride length.

Timing Short Movements:

- Stopwatch: Start → mark point → stop. Speed = distance/time (e.g., 100m/20sec = 5m/s).
- "Pace Rate": Orienteers aim 5min/km walking briskly.

Observation Skills – Notice Like a Detective

Orienteering = 50% navigation, 50% noticing details for clues/eco-data.

What to Scan (The "PEST" Method):

- Plants: Thick bushes? Open grass? Trampled areas?

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- Earth/Ground: Mud? Rocks? Erosion ruts?
- Structures: Fence? Bench? Power lines?
- Things: Litter? Animals? People?

Practice: Walk 10m, list 5 observations. Sharp eyes = faster routes + safer steps.

Teamwork Basics – Lead, Follow, Communicate

Solo orienteering = slow. Teams = unstoppable. Roles (Rotate Every Checkpoint):

- Leader: Holds map/app, calls directions ("20m north!").
- Pacer: Counts steps/time.
- Scribe: Notes observations (litter, slope).
- Safety Scout: Watches surroundings, signals hazards.

Communication Phrases:

- "Checkpoint sighted!"
- "Wrong turn – recalculate."
- "Stop for observation."
- "All good? Moving!"

By mastering this skill unit, you'll be set to explore sports, the environment, and STEM together—with confidence and curiosity!

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