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Marine Science Lesson 1.2 - Solubility (Outline)

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Subject: science **Grade Level:** 11th **Format:** quiz **Generated:** September 11, 2025

AICE Marine Science Quiz: Lesson

1.2 - Water Solubility

🎯 LEARNING OBJECTIVES
By completing this quiz, you should be able to:
- 🔴 **ESSENTIAL:** Define solubility and identify factors affecting water's solvent properties
- 🔴 **ESSENTIAL:** Explain the relationship between temperature, pressure, and gas solubility in seawater
- 🟡 **IMPORTANT:** Analyze how salinity affects the solubility of different substances in marine environments
- 🟡 **IMPORTANT:** Apply solubility principles to real marine science scenarios

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PART A: MULTIPLE CHOICE (20 points)
Choose the best answer for each question.

1. Water is known as the "universal solvent" primarily because:
a) It can dissolve any substance
b) Its polar nature allows it to dissolve many ionic and polar substances
c) It has a neutral pH
d) It exists in three states of matter

2. 🔴 ESSENTIAL: As temperature increases, the solubility of gases in seawater:
a) Increases significantly
b) Remains constant
c) Decreases
d) First increases, then decreases

3. The solubility of oxygen in seawater is HIGHEST in:
a) Warm tropical waters
b) Cold polar waters
c) Deep ocean trenches
d) Areas with high salinity

4. 🟡 IMPORTANT: Henry's Law states that:
a) Solubility is independent of pressure
b) Gas solubility is directly proportional to partial pressure
c) Temperature has no effect on gas solubility
d) Salinity decreases gas solubility

5. Which factor does NOT significantly affect the solubility of substances in seawater:
a) Temperature
b) Pressure
c) Salinity
d) Ocean current direction

6. 🔴 ESSENTIAL: The "salting out" effect refers to:
a) Salt crystallizing from solution
b) Decreased gas solubility in saltwater compared to freshwater
c) Increased evaporation in salty water
d) Salt settling to the ocean floor

7. At which ocean depth would you expect the HIGHEST concentration of dissolved CO_2:
a) Surface waters (0-10m)
b) Shallow waters (10-100m)
c) Deep waters (1000m+)
d) Mid-water zone (200-500m)

8. 🟡 IMPORTANT: Upwelling zones are often rich in marine life because:
a) They have warmer temperatures
b) They bring nutrient-rich, oxygen-poor water to the surface
c) They have lower salinity
d) They create stronger ocean currents

PART B: TRUE/FALSE (16 points)
Mark T for True or F for False. Correct any false statements.

9. 🔴 ESSENTIAL: Polar substances generally dissolve well in water due to water's polar nature.
T / F _____

10. Increasing pressure always increases the solubility of all substances in water.
T / F _____
Correction if false: _____

11. 🟡 IMPORTANT: Cold water can hold more dissolved oxygen than warm water.
T / F _____

12. The Dead Sea has low salinity, which is why few organisms can survive there.
T / F _____
Correction if false: _____

13. 🔴 ESSENTIAL: Gas solubility decreases as water temperature increases.
T / F _____

14. Dissolved nutrients in seawater are more concentrated in surface waters than deep waters.
T / F _____
Correction if false: _____

15. The solubility of most solid substances increases with increasing temperature.
T / F _____

16. 🟡 IMPORTANT: Fish kills in summer are often related to decreased oxygen solubility in warm water.
T / F _____

PART C: SHORT ANSWER (24 points)
Provide complete answers in 2-4 sentences.

17. 🔴 ESSENTIAL: Explain why polar water molecules are effective at dissolving ionic compounds like salt. Include the role of water's molecular structure in your answer. (6 points)

_____
_____
_____

18. 🟡 IMPORTANT: A marine biologist notices that fish are dying in a coastal area during a summer heat wave. Using your knowledge of gas solubility, explain what might be causing this die-off and why it's more common in summer. (6 points)

_____
_____
_____

19. Compare and contrast the solubility of oxygen in: (a) cold Arctic seawater vs. warm tropical seawater, and (b) freshwater vs. saltwater at the same temperature. Explain the reasons for any differences. (6 points)

_____
_____
_____

20. 🟡 IMPORTANT: Deep-sea organisms often have adaptations for low-oxygen environments, while surface organisms rely on high dissolved oxygen levels. Using solubility principles, explain why oxygen levels differ at these depths and how this affects marine ecosystems. (6 points)

_____
_____
_____

📚 KEY TERMS BOX
Quick Reference:
- **Solubility:** The ability of a substance to dissolve in a solvent
- **Henry's Law:** Gas solubility ∝ partial pressure
- **Salting Out Effect:** Reduced gas solubility in saltwater
- **Polar vs. Nonpolar:** "Like dissolves like" principle
- **Upwelling:** Deep, cold, nutrient-rich water rising to surface

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🔗 CONNECTION POINTS
- **Remember:** This connects to ocean circulation patterns (Lesson

1.1)
- **Think Ahead:** These principles will be important for understanding marine food webs
- **Real World:** Consider how climate change (warming oceans) affects marine oxygen levels

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ANSWER KEY

Part A: Multiple Choice

1. **b** - Water's polar nature allows it to dissolve ionic and polar substances

2. **c** - Gas solubility decreases as temperature increases

3. **b** - Cold polar waters hold more dissolved oxygen

4. **b** - Henry's Law: gas solubility directly proportional to pressure

5. **d** - Current direction doesn't significantly affect solubility

6. **b** - Salting out = decreased gas solubility in saltwater

7. **c** - Deep waters are cold and under high pressure

8. **b** - Upwelling brings nutrient-rich water to surface

Part B: True/False

9. **T** - Polar dissolves polar

10. **F** - *Correction: Pressure mainly affects gas solubility, not all substances*

11. **T** - Cold water holds more dissolved gases

12. **F** - *Correction: Dead Sea has extremely HIGH salinity*

13. **T** - Inverse relationship between temperature and gas solubility

14. **F** - *Correction: Deep waters are more nutrient-rich due to decomposition*

15. **T** - Most solids are more soluble at higher temperatures

16. **T** - Summer heat reduces oxygen solubility

Part C: Short Answer Sample Responses

17. Water molecules have a bent shape with partial positive (H) and negative (O) charges. When ionic compounds dissolve, water molecules surround ions - negative ends attract positive ions, positive ends attract negative ions. This hydration process breaks apart the ionic crystal structure and keeps ions dissolved in solution.

18. The fish kill is likely caused by decreased dissolved oxygen levels. As water temperature increases during heat waves, the solubility of oxygen decreases significantly. Fish require dissolved oxygen to breathe, so when levels drop below critical thresholds, they suffocate. This is more common in summer because warm water simply cannot hold as much dissolved oxygen as cold water.

19. (a) Cold Arctic water holds much more dissolved oxygen than warm tropical water due to the inverse relationship between temperature and gas solubility. (b) At the same temperature, freshwater holds more dissolved oxygen than saltwater due to the "salting out" effect - dissolved salts reduce the water's ability to hold gases. Both effects are important in marine ecosystems.

20. Deep waters are cold and under high pressure, which increases gas solubility, but they're often oxygen-poor because organisms consume oxygen through respiration and decomposition. Surface waters are warm (lower gas solubility) but constantly replenished with oxygen from the atmosphere and photosynthesis. This creates distinct ecological zones - oxygen-rich surface communities vs. adapted deep-sea organisms that survive in low-oxygen conditions.

📊 SCORING GUIDE
- **54-60 points:** Excellent understanding of water solubility principles
- **48-53 points:** Good grasp with minor gaps
- **42-47 points:** Adequate understanding, review key concepts
- **Below 42 points:** Review lesson materials and seek additional help

🔴 **Focus Review Areas if Struggling:**
- Temperature-gas solubility relationship
- Polar nature of water and dissolving process
- Henry's Law applications in marine systems