ABOUT THE SCIENCE

LESSON AND TOPIC	SCIENCE NOTES
PRECOURSE: SWIM GOGGLES	Swim goggles should only be worn for the prerequisite swim for a variety of reasons: ■ Swim goggles are not part of any standard issue lifeguarding equipment protocol used in making a land or water rescue. ■ Swim goggles are designed for preventing water entry and irritation and not to protect from trauma to the eye. Swim goggles present a greatly reduced surface area at the point of contact with tissue around the eye. The potential for serious eye injury is greatly increased by the swim goggle being contacted by an external object (or another participant) during the course. ■ Submerging to a depth of 5 feet or greater has the potential to cause barotraumas to the eye of an individual wearing swim goggles that cannot be pressure equalized.
LESSON 2: THE DROWNING PROCESS	■ During the drowning process, a victim may gasp for air but instead inhales water into the airway causing reflexive shutting of the larynx or water aspirated into the lungs. After a period of time with no air entering the lungs, inadequate oxygenation of body tissues and eventually cardiac arrest may occur. This can happen in as little as 3 minutes after submerging. Brain damage or death can occur in as little as 4 to 6 minutes. The sooner the drowning process is stopped by getting the victim's airway out of the water, opening the airway and providing resuscitation (with ventilations or CPR), the better the chances are for survival without permanent brain damage. Adequate ventilation and CPR can be performed without the need to remove water from the lungs. ■ There are many intervening variables that can affect the outcome of a drowning victim, such as any underlying medical conditions of the victim or the time until advanced medical care intervenes. However, in general, evidence suggests that if the victim is rescued within 1 1/2 to 2 minutes of submerging, giving ventilations may resuscitate the victim.
LESSON 2: EFFECTIVE SURVEILLANCE	**Hyperventilation Preceding Underwater Swimming:** Voluntary hyperventilation dangerously deregulates brain's control of breathing and lowers the blood's carbon dioxide level. Hyperventilation does not increase the oxygen level in the blood. After a person takes a series of rapid and deep breaths and then attempts to swim a long distance, oxygen is quickly used up. The person will then become unconscious before the carbon dioxide level raises to the level that triggers the urge to breath. Drowning then occurs if the person is not rescued.
LESSON 5: PRIMARY ASSESSMENT	■ **Checking for responsiveness:** When checking a person for responsiveness, sometimes a tapping of the shoulder does not provide enough physical stimuli to elicit a response to pain. Therefore, a trained responder could employ a "shout-tap-pinch" approach with a pinch to the muscle between the neck and shoulder in order to provide a stronger physical stimulus to a sensitive area. It is important that "shout-tap-pinch" does not delay patient care by adding extra time to determine a response to verbal or painful stimuli.

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LESSON 5: PRIMARY ASSESSMENT *continued*	■ **Recovery Positions:** Based on the available evidence, it is important to turn a person who is responsive and breathing normally but not fully awake onto their side to lower the risk for choking and aspiration. There is little evidence to suggest an optimal recovery position. However, turning the victim towards the rescuer, rather than away from the rescuer, allows for more control over the movement and facilitates monitoring the victim's airway. ■ **Ventilations for Drowning Victims:** Due to the hypoxic nature of drowning, lifeguards and professional responders should alter the initial treatment for victims with no breathing and no pulse as a result of a drowning and provide two initial ventilations during the primary assessment prior to beginning CPR with chest compressions.
LESSON 5: RECOGNIZING AND CARING FOR BREATHING EMERGENCIES	■ **Respiratory Arrest:** Hyperventilation most commonly occurs when victims are being ventilated in respiratory arrest or when an advanced airway is placed during cardiac arrest. It is critical to avoid hyperventilation of the victim because it leads to increased pressure and a subsequent decrease in cardiac filling and cardiac perfusion pressures by putting pressure on the vena cava (the main chest vein). ■ **Opioid Overdose:** With a growing epidemic of opioid (commonly heroin and oxycodone) overdoses in the United States, local and state departments of health have increased access to the medication naloxone, which can counteract the effects of overdose including respiratory arrest. Naloxone (also referred to by its trade name Narcan™) has few side effects and can be administered intranasally (through the nose). Trained responders should administer the drug when the patient is in respiratory arrest and an opioid overdose is suspected. Lifeguards and professional responders should follow local medical protocols and regulations to determine dosing and timing of naloxone administration.
LESSON 5: GIVING VENTILATIONS USING A BVM	**BVM:** Ventilation with a BVM is reserved for when multiple rescuers are available to treat the victim: One to perform chest compressions and two others to manage the airway and provide ventilations. While a BVM may often be used in some situations by a single responder (advanced medical personnel), the evidence supports the use of a BVM with two responders: One to maintain an adequate seal and one to squeeze the bag to deliver the ventilations.
LESSON 5: AIRWAY OBSTRUCTION	**Choking:** Evidence suggests that it may take more than one technique to clear the airway, and that back blows, abdominal thrusts and chest thrusts are all effective.
LESSON 6: RECOGNIZING AND CARING FOR A HEART ATTACK	There is strong evidence that suggests that when a person is experiencing signs and symptoms of a heart attack, outcomes are improved when cardiac catheterization is performed within 90 minutes of the onset of signs and symptoms and within 60 minutes of arrival to the hospital, which is why advanced life support provided by advanced medical personnel is critical. When cardiac catheterization is not readily available, the administration of certain medications, including aspirin, within the first few hours of the onset of signs and symptoms has also been shown to be of benefit.

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LESSON 6: CPR	■ **Chest Compressions:** Actual depth may be difficult to judge without the use of feedback devices, but it is critical to compress the chest AT LEAST 2 inches for an adult victim. Evidence shows that compression depths greater than 2.4 inches in the average adult lead to a higher incidence of non-life threatening injuries and should be avoided. Compression rates that exceed 120 compressions per minute also affect the quality of compressions. Evidence suggests that higher rates of compressions lead to inadequate compression depths. ■ **High Performance CPR:** Evidence continues to build that the key to successful resuscitations is the delivery of high quality CPR, including uninterrupted chest compressions and ventilations. ■ **CPR Differences–Adult and Child:** The majority of pediatric cardiac arrests are a result of a respiratory cause such as a breathing problem (asthma/anaphylaxis), an obstructed airway, drowning or an injury. As such, ventilations and appropriate oxygenation are important for a successful resuscitation. In these situations, laryngeal spasm may occur, making passive ventilation during chest compressions minimal or non-existent.
LESSON 6: AED	■ For every 1 minute of delayed defibrillation, the rate of survival drops 7 to 10 percent. ■ AEDs allow for compressions post-analysis while the AED is charging. Lifeguards and professional rescuers may perform compressions from the time the shock advised prompt is noted through the time that the prompt to clear occurs, just prior to depressing the shock button. Emphasize the need to follow the manufacturer's recommendations and their local protocols and practices.
LESSON 8: CARING FOR HEAD, NECK AND SPINAL INJURIES IN THE WATER	Reassessment of protocols has shown that packaging a victim can be detrimental. They often will lie on spine boards for hours in the emergency room, which causes anxiety and can cause physical damage. Research indicates that the damage has likely already occurred with the initial injury. The focus for lifeguards should be on safely extricating the person from the water while maintaining stabilization. Studies have shown that the application of cervical collars can cause further injury.