

# Heat Related Illness



## Objectives

Students will be able to

- understand the reasons for increased heat risks in urban desert environments.
- differentiate among heat-related health issues (heat stroke, heat exhaustion).
- follow the correct emergency response to scenarios of heat-related health issues.

## Author:

Ecology Explorers  
Education team

## Time:

50-80 minutes

## Grade Level:

6-12

## Standards:

### AZ Science Strands

Inquiry, Nature of Science, Perspectives, Life Science

### NGSS - Core Ideas

Structure and Function; Information Processing; Interdependent relationships in Ecosystems

### Practices

Obtaining, evaluating, and communicating information

### Crosscutting Concepts

Cause and effect, Structure and function, Stability and change

*Specific AZ, Common Core, and NGSS standards on page 3*

## Background:

Warm weather means fun under the sun! It also means we must be careful not to let a heat-related illness spoil the day... especially in Phoenix, where it's only getting hotter!

We can say goodbye to cool desert nights. Did you know that the average nighttime low temperature in

Phoenix has increased by 8° F over the last 30 years! This is due to our urban heat island. Roads can reach

160° F and roof tops can be as hot as 190° F! Summertime heat in the U.S. causes more deaths than any other natural phenomenon.

Normally, the body has ways of keeping itself cool, by letting heat escape through the skin, and by evaporating sweat (perspiration). If the body does not cool properly or does not cool enough, the victim may suffer a heat-related illness.

Phoenix has very little humidity, so evaporative cooling works great around here. That's what causes our pools to lose ½ inch of water every day in the summer. However, since our sweat does evaporate quickly, we don't always realize how hot we are until it's too late.

Anyone can be susceptible to the heat, although the very young and very old are at greater risk. Heat-related illnesses can become serious or even deadly if unattended.

## Preventing Heat-Related Illness

- **Dress for the heat.** Wear lightweight, light-colored clothing and use a hat or umbrella.
- **Drink water.** Drink water or juice continuously even if you do not feel thirsty. Avoid alcohol and caffeine, which dehydrate the body.
- **Eat small meals and eat more often.** Avoid high protein foods.
- **Slow down.** Plan strenuous activities around the coolest part of the day, which is in the morning between 4:00 a.m. and 7:00 a.m.
- **Stay indoors when possible.**
- **Take regular breaks.**

## Know the difference between:

**Heat Wave:** More than 48 hours of high heat (90° F or higher) and high humidity (80 percent relative humidity or higher) are expected.

**Heat Index:** This is how hot it really feels with the heat and humidity. The higher the humidity, the hotter it feels. Full sunshine also can increase the heat index by 15° F. You can find the heat index by checking your local weather in a newspaper, the weather channel, or on the Internet. Any HI value greater than 100 is considered hazardous.

**Vocabulary:**

**heat index** - how hot it really feels with the heat and humidity

**heat illness** - is a spectrum of disorders due to environmental heat exposure.

**urban heat island** - A metropolitan area which is significantly warmer than its surrounding rural areas. A night time phenomenon of increased temperatures in the Phoenix Metropolitan area.

**evaporative cooling** - the process by which evaporation causes cooling

**Advanced Preparation:**

Prepare various stations around the room with different heat illness scenarios provided ( [https://ecologyexplorers.asu.edu/docs/explorers/lesson\\_plans/4a\\_heat\\_illness\\_scenarios.pdf](https://ecologyexplorers.asu.edu/docs/explorers/lesson_plans/4a_heat_illness_scenarios.pdf) ). Scenarios will describe a situation of either heat cramps/exhaustion or heat stroke. Students will need to be able to read the scenario and decide whether the case involves heat cramps, heat exhaustion or heat stroke.

**Materials:**

- clipboards
- heat cramps and heat exhaustion expert information
- heat stroke expert Information
- heat illness scenarios
- student worksheets and answer key

**Recommended Procedure:**

**Engagement:** The Story of Korey Stringer (10 min)

- 1) Read the brief statement about the death of football player Korey Stringer.
- 2) Ask the students what happened to him. Write their responses on the white board. Ask if the students have heard of “heat stroke” or “heat exhaustion”?

**Exploration:** Heat Illness Jigsaw (15 min)

- 3) Form groups of four. (These are the home teams). Explain that students will become an expert on either heat cramps/exhaustion or heat stroke. (These are the expert teams)
- 4) Assign two students from each home team to read and take notes on the information sheet describing “heat stroke” and the other two students the information describing “heat cramps/exhaustion”.
- 5) Pass out expert information sheets and give guiding questions, such as: How do the treatments for your

illness directly address the symptoms?

**Explanation:** Peer Teaching (10 min)

- 6) After completing their individual research, the two members of each expert team will compare notes and make sure they both understand the medical condition.
- 7) Once each expert team is confident in their understanding, have each expert team take turns teaching their home teams about heat cramps/exhaustion and heat stroke.

**Expansion:** Evaluate Heat Illness Scenarios (20 min)

- 8) Separate the groups of four into pairs (one heat stroke expert and one heat cramp/exhaustion expert).
- 9) Students will proceed through the various stations around the room. They will read each scenario and decide if the case involves heat cramps, heat exhaustion or heat stroke, then determine an appropriate course of actions that will help the situation.
- 10) Share the answers with the student teams

**Evaluation:** Journal Prompt (15 min) :

- 11) Read students the short paragraph about heat illness and student athletes.
- 12) Have the students write some procedures for helping student athletes prevent heat-related illnesses at area schools.
- 13) Share some student ideas on the whiteboard.
- 14) Then read Dr. Mueller’s recommendations and discuss.

**Extensions:**

Students can keep a written and/or photo journal of their experiences coping with heat in various environments during their daily routines. They may brainstorm ways to improve their environment with regard to heat risks.

Students may interview family members, neighbors and friends to assess their experiences coping with heat, which can lead to analysis and comparison of interview data and discussions about possible solutions to mitigate urban heat island and climate change.

As a culmination, students may prepare an exhibit of their work. (See the Photovoice lesson in this unit)

**Related Reading**

Have students read the ASU Chain Reaction magazine

article “Thermoregulation: Hot Enough for You?” [http://chainreactionkids.org/files/issues/2/chreact2\\_p30\\_32.pdf](http://chainreactionkids.org/files/issues/2/chreact2_p30_32.pdf). Have students discuss the article in small groups. Are humans “warm-blooded” (endothermic) or “cold-blooded” (ectothermic)? Which parts of our bodies are good conductors? Which are good insulators?

Have the students read the ASU Chain Reaction Magazine article “How Heat Hurts” ([http://chainreactionkids.org/files/issues/7/chreact7\\_master.pdf](http://chainreactionkids.org/files/issues/7/chreact7_master.pdf))

Using vocabulary from the articles, ask students to describe the normal healthy process in which heat from the sun hits their bodies and their body responds to maintain its stable temperature. (This provides an opportunity to demonstrate understanding of thermoregulation, radiation, energy, conduction, heat capacity, conductors, insulators, convection, perspiration etc.).

### **Standards:**

#### **Arizona Science**

S1-C3-GR5-8-P02  
S1-C3-GR8-P05  
S1-C3-GRHS-P01  
S2-C2-GR6-7-P03  
S2-C2-GR8-P01  
S3-C1-GR7-8-P01  
S3-C1-GR7-P03  
S3-C1-GRHS-P01, P02, P04  
S3-C2 GR6-8-P01,P02  
S4-C3-GR7-P05  
S4-C3-GRHS-P02  
S4-C4-GR8- P01, P02  
S4-C4-GRHS-P02

#### **Arizona Social Studies**

S4-C5-GR7-8-P03-7  
S4-C5-GRHS-P03-4

#### **NGSS Core Ideas**

LS1.A: Structure and function  
LS1.D: Information Processing  
LS2.A: Interdependent relationships in ecosystems

#### **NGSS Practices**

Constructing Explanations  
Obtaining, evaluating, and communicating information

#### **NGSS Crosscutting Concepts**

Cause and effect: Mechanism and explanation  
Structure and function  
Stability and change

### **Common Core/ELA Literacy**

RST1: Understand explicit text  
RST2: Summarize key points  
SL1: Participate in collaborations and conversations  
SL2: Integrate oral information

#### References:

- 1) The American National Red Cross. <http://www.redcross.org/services/hss/tips/heat.html>
- 2) Arizona Department of Health Services [http://www.azdhs.gov/phs/oeh/protect\\_from\\_heat.htm](http://www.azdhs.gov/phs/oeh/protect_from_heat.htm)



### Heat Cramps and Heat Exhaustion Experts

Heat illness occurs in stages: heat cramps, heat exhaustion, then heat stroke. Heat stroke is the most severe and can include some symptoms of the other stages.

You will become an expert in understanding heat cramps and heat exhaustion and then you will teach it to your classmates who are becoming experts in heat stroke. To help other students understand, feel free to act out the symptoms or give examples of what a person with heat exhaustion might look like. Read the following carefully:

The first stage of heat illness is...

### Heat Cramps

**What is it?** The loss of water and salt from sweating causes the cramps.

#### Symptoms:

Muscular pains and spasms due to heavy exertion. They're usually in the stomach muscles or legs. They can be quite painful.

#### What should you do?

- Stop activity and rest.
- If the person is fully awake and alert, have him or her drink small amounts of cool water or a commercial sports drink.
- Gently stretch the cramped muscle and hold the stretch for about 20 seconds, then gently massage the muscle.
- Repeat these steps if necessary. If the victim has no other signs of heat-related illness, the person may resume activity after the cramps stop.

The next stage of heat illness is...

### Heat Exhaustion

**What is it?** Heat exhaustion is less dangerous than heat stroke. It typically occurs when people exercise heavily or work in a warm, humid place where body fluids are lost through heavy sweating. Fluid loss causes blood flow to decrease in the vital organs (like the brain). With heat exhaustion, sweat does not evaporate as it should, possibly because of high humidity or too many layers of clothing. As a result, the body is not cooled properly.

#### Symptoms:

Cool, moist, pale, flushed or red skin; heavy sweating; headache; nausea or vomiting; dizziness; and exhaustion. Body temperature will be near normal.

#### What should you do?

- Get to a cooler place and rest in a comfortable position.
- If the person is fully awake and alert, sip a half glass of cool water every 15 minutes. No alcohol or caffeine as they can make conditions worse.
- Remove or loosen clothing and apply cool, wet towels or sheets.
- Call 9-1-1 if the person refuses water, vomits or loses consciousness.

# Student Worksheet

## Heat Related Illness p. 2



### Heat Stroke Experts

Heat illness occurs in stages: heat cramps, heat exhaustion, then heat stroke. Heat stroke is the most severe and can include some symptoms of the other stages.

You will become an expert in understanding heat stroke and then you will teach it to your classmates who are becoming experts in heat cramps and heat exhaustion. To help other students understand, feel free to act out the symptoms or give examples of what a person with heat stroke might look like. Read the following carefully:

### What is it?

Also known as sunstroke, heat stroke is life-threatening. The victim's temperature control system, which produces sweating to cool the body, stops working. The body temperature can rise so high that brain damage and death may result if the body is not cooled quickly.

### Symptoms:

- Vomiting
- Decreased alertness level or complete loss of consciousness
- High body temperature (above 104° F)
- Skin may still be moist from sweating or the person may stop sweating and the skin may be red, hot and dry
- Rapid, weak pulse
- Rapid, shallow breathing

### What should you do?

Heat stroke is a life-threatening situation! Help is needed fast.

- Call 9-1-1.
- Move the person to a cooler place.
- Quickly cool the body. Wrap wet sheets around the body and fan it. If you have ice packs or cold packs, wrap them in a cloth and place them on each of the victim's wrists and ankles, in the armpits and on the neck to cool the large blood vessels. (Do not use rubbing alcohol because it closes the skin's pores and prevents heat loss.)
- Watch for signs of breathing problems and make sure the airway is clear.
- Keep the person lying down.

# Student Worksheet

## Heat Related Illness p. 3



Diagnose each scenario in the spaces below.

### What treatment should you give?

Look at the treatment sheet for a list of possibility, then circle all the letters that apply.

**Soccer Game:** Diagnosis: \_\_\_\_\_

Treatment: A B C D E F G H I J K L

**Visiting Grandma:** Diagnosis: \_\_\_\_\_

Treatment: A B C D E F G H I J K L

**Trip to the Beach:** Diagnosis: \_\_\_\_\_

Treatment: A B C D E F G H I J K L

**Summer Job:** Diagnosis: \_\_\_\_\_

Treatment: A B C D E F G H I J K L

**Good Samaritan:** Diagnosis: \_\_\_\_\_

Treatment: A B C D E F G H I J K L

**Grand Canyon:** Diagnosis: \_\_\_\_\_

Treatment: A B C D E F G H I J K L

**School Dance:** Diagnosis: \_\_\_\_\_

Treatment: A B C D E F G H I J K L

### Bonus

**Poor Perro!:** Diagnosis: \_\_\_\_\_

Treatment:

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# Student Worksheet

## Heat Related Illness p. 4



### Engagement: The Story of Korey Stringer

Have you ever heard of Korey Stringer? He was an offensive tackle for the Minnesota Vikings. On August 1, 2001 he reported to the Vikings training camp. He was 27 years old, 6-foot-4-inches, 335 pounds and starting his 7th season.

He could not complete the first practice in the morning and was carted off the field. He did not practice Monday afternoon but vowed to return on Tuesday. He participated in the Tuesday morning practice session which lasted two and a half hours. The players were all in full pads.

The temperature on the practice field was around 90 degrees with high humidity. The combination of humidity and temperatures made it feel like 110 degrees. Stringer vomited three times during practice and then walked to an air-conditioned shelter. There he became dizzy and weak and began breathing heavily.

Stringer was driven by ambulance to Immanuel St. Joseph's-Mayo Health System, where his body temperature was 108 degrees upon arrival. He was unconscious until he died at 1:50 a.m.

What happened to Korey Stringer?

### Wrap-up activity: Heat Illness and Student Athletes

According to the Centers for Disease Control and Prevention, three hundred Americans, die of heatstroke every year, most of them elderly or infants. There have been over 20 heatstroke deaths of high school and college football players since 1995.

What are some procedures you think might help student athletes prevent heat-related illnesses at school?

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# Student Worksheet

## Heat Related Illness p. 5



<p><b>A</b></p> <p>Place ice packs on wrists, ankles, armpits, and neck.</p> 	<p><b>B</b></p> <p>Call 911.</p> 	<p><b>C</b></p> <p>Cool body by wetting skin and blowing fan, or apply wet sheets.</p> 
<p><b>D</b></p> <p>Remove excess clothing.</p> 	<p><b>E</b></p> <p>Resume normal activity.</p> 	<p><b>F</b></p> <p>Lie down and make sure he/she doesn't choke if they faint.</p> 
<p><b>G</b></p> <p>Stretch sore muscles and hold for 20 sec., then massage. Repeat if needed.</p> 	<p><b>H</b></p> <p>Move to a cooler place.</p> 	<p><b>I</b></p> <p>Check to see if he/she is alert and awake.</p> 
<p><b>J</b></p> <p>Take it easy for several days.</p> 	<p><b>K</b></p> <p>Drink 1/2 glass of water or sports drink every 15 min.</p> 	<p><b>L</b></p> <p>Seek medical attention!</p> 



# Student Worksheet

## Heat Related Illness - Answer Key



### Diagnose each scenario in the spaces below.

What treatment should you give? *Look on attached sheet for a list of possible treatments, then circle all the letters that apply.*

**Soccer Game:** Diagnosis—heat muscle cramps-first sign of heat illness

Treatment: K G E

**Visiting Grandma:** Diagnosis—heat exhaustion

Treatment: H F K D C L

**Trip to the Beach:** Diagnosis—heat stroke

Treatment: B H C A F L

**Summer Job:** Diagnosis—heat stroke

Treatment: B H C A F L

**Good Samaritan:** Diagnosis—heat stroke

Treatment: B H C A F L

**Grand Canyon:** Diagnosis—heat exhaustion

Treatment: H F K D C

**School Dance:** Diagnosis—heat exhaustion

Treatment: H F K D C

### Bonus

**Poor Perro!:** Diagnosis—Heat stroke

Treatment: Immediately cool the dog's body with a hose running the water over his mouth and tongue, belly and between his legs making sure the skin is wet and not just running off the hair. Make sure air is moving across it to allow evaporative cooling. Make sure you stop cooling when the body reaches 103° F as the body will continue to cool down. Smaller dogs will cool down more quickly. Then, head to the nearest animal hospital for possible IV's and medication to stop cell damage. Dogs with shorter faces, like boxers, overheat more quickly as do older or overweight dogs. All dogs overheat faster than people do, because they rely on panting to cool off which is more inefficient than sweating.

### Dr. Mueller's Suggestions for Student Athletes:

Dr. Fred Mueller, a director of sports medicine at the University of North Carolina, has sorted through data back to 1931 to study heatstroke deaths in high school and college football.

“When you have high heat and high humidity and a football team with all of that equipment covering the body, the chances of heatstroke are more likely in this sport than in others,” Mueller said. “Out of this death (of Corey Stringer) the N.F.L. might want to look at three things: 1) change the time of practices or make them shorter when there is high heat and humidity; 2) enforce water breaks, not just make them available; and 3) make sure your players are climatized to the area before practices in pads, allowing a 7-to-10-day period to adjust to weather before full-bore, full-padded practices.”