



## Educator's Guide to *Rescue* IMAX 3D





# R Parachutes

## How do rescuers use parachutes for both people and supplies?

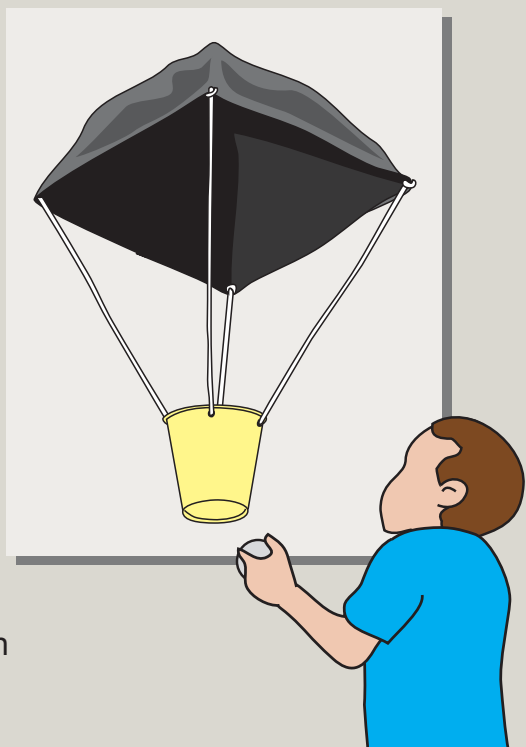
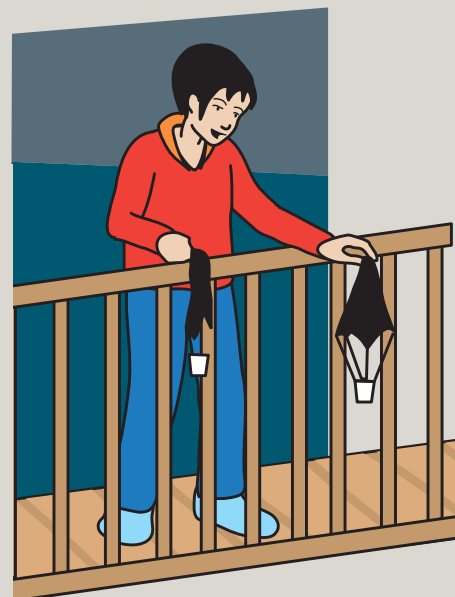
### You Will Need:

plastic garbage bag, scissors, ruler, paper, sharp pencil, 4 pieces of string per parachute, 1 small paper cup per parachute, stopwatch, a partner, pennies

1. Cut different sizes of squares from the plastic garbage bag. Each square will be used to create its own parachute.
2. Measure and record the area of each square.  
Area = Length x Width.
3. Poke holes in the 4 corners of each square. Tie one end of a piece of string to each hole.
4. Poke 4 holes in the edges of the paper cup, equal distances from each other. Tie the other end of each piece of string to one of the holes in the cup.
5. Have your partner get ready with the stopwatch and find a high spot to launch the parachutes.
6. What is your hypothesis? Which will land more quickly, the larger parachutes or the smaller ones? Drop each parachute from the same height and time how long it takes to land. Record your data.
7. Experiment with adding weight to your parachutes by putting pennies in the cups. How would you need to adjust a parachute when it is carrying a heavy load?

### What's Going On?

A parachute works because it creates drag from the air pulling on it, a force that slows down the falling object. The larger the parachute, the more drag it creates. Different sizes of parachutes are carefully designed to match the weight of emergency relief supplies, or a person jumping from a plane. Parachutes are effective because they are lightweight and can be made in large sizes. They can catch a lot of air and create a lot of drag, but they are easy to carry.

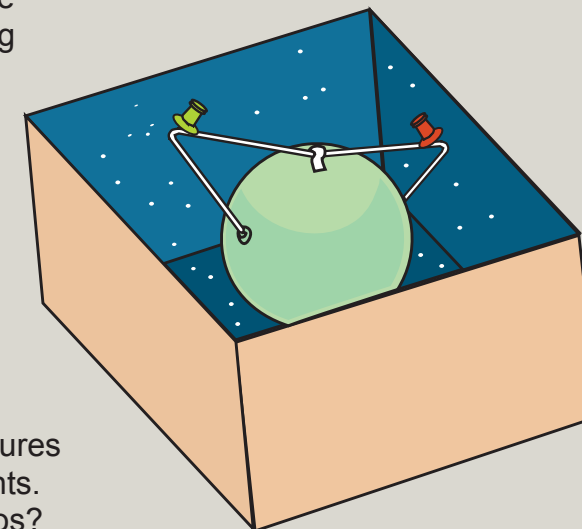
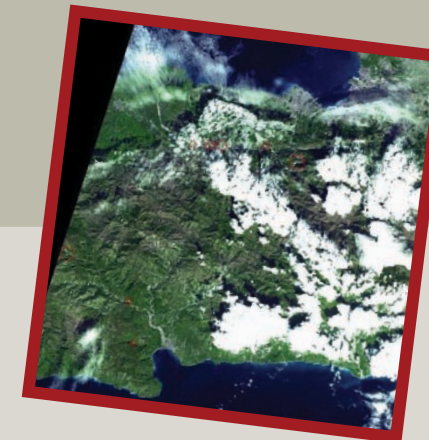


# R Satellite Communications

## How do satellites send messages?

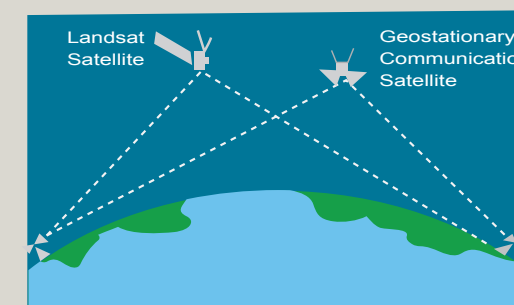
**You will need:** ball, box several inches larger than the ball on all sides, string, scissors, marking pens, label stickers, pushpins, tape, computer with internet

1. The ball represents the Earth. Mark a spot on the ball that represents Haiti and two other faraway locations around the world where people would like to provide help to the Haitians after the earthquake. Everything else that will go inside your box is up to you.
2. Research satellite communication on the internet. Find out how signals travel from one place to another. Why does a signal have to go up into space instead of across the land? You can use the pushpins on the inside walls of the box to represent satellite locations.
3. Study the satellite images at the websites [eros.usgs.gov](http://eros.usgs.gov) and [landsat.gsfc.nasa.gov](http://landsat.gsfc.nasa.gov). Find pictures of extreme weather conditions like floods or droughts. What important details can you identify in the photos?
4. In your box, make a model of how satellite communication helped us respond to the needs in Haiti. You can use the string to show how the signals travel. Write a brief description of your plan and how it works.



### What's Going On?

Before anything was sent to Haiti, first responders were able to determine the need for emergency supplies and housing by looking at satellite photos. Haiti didn't have landlines or cell phones or an air traffic control tower so the U.S. Air Force used their satellite phones to help planes land safely. Satellites play a very important role in global communication and cooperation because they can connect people across the globe by bouncing signals up into space and back down again. A satellite phone must be used outside so that there is a clear view to the satellite in space.



### Find Out More

NASA and the U.S. Geological Survey manage a program called Landsat, a satellite that has been sending pictures of the Earth since the 1970s. Among the many uses of Landsat are: providing information regarding natural resources, geology, population, land use, and environmental monitoring. Landsat data is key in assessing the impact of natural disasters.

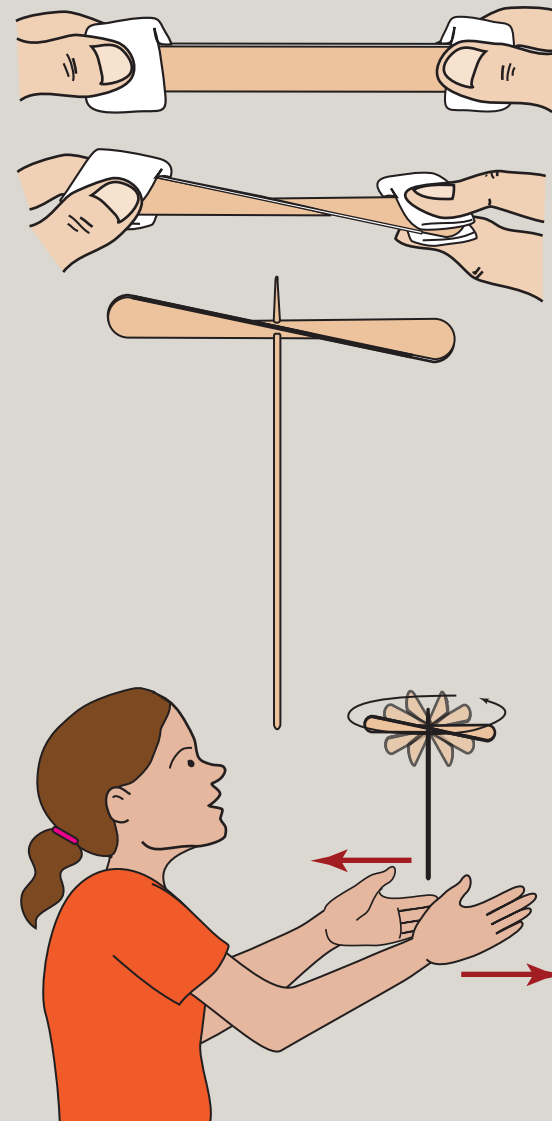


## The Rescue Helicopter

### How does a helicopter take off straight up into the air?

**You will Need:** tongue depressor/craft stick, an adult to help, pan of boiling water, nail, wooden skewer, glue, paper towels, scissors, paper clips

1. Have your adult helper place the craft stick in the boiling water. Let it soak until it is soft, about 30 seconds.
2. Ask your adult helper to take the craft stick out of the water, holding it with the paper towel. After it cools down a little, he or she can hand it to you.
3. Twist the ends of the craft stick so that it is curved like a helicopter blade. Hold the stick in the twisted position long enough so that it keeps its shape when you let go. Let it dry in this new shape.
4. Use the nail to poke a hole in the middle of the craft stick. The hole should be small enough so that the skewer fits inside snugly.
5. Cut the skewer so that it is about six inches long.
6. Stick the skewer into the hole and put glue around it to hold it in place.
7. Roll the skewer back and forth between your hands and let go!
8. Try attaching paper clips to the skewer, one at a time and launching and re-launching. How much weight can your helicopter hold?



#### What's Going On?

Airplanes and helicopters have curved propellers that create lift so that they can take off into the air. Air moves faster over the top of the curved blade. The slower air underneath is at a higher pressure and pushes up on the propeller causing the helicopter to rise. A helicopter takes off vertically using a set of propeller blades rotating at high speed to generate lift, so it doesn't need a runway.



## CH-47F Chinook

The Boeing Chinook is a tandem rotor, medium-lift helicopter that meets tactical and combat support mission requirements for military forces around the world. The Chinook is the world's most reliable and efficient transport helicopter, capable of handling useful loads up to 24,000 lbs. and a maximum gross weight of up to 50,000 lbs. (22,668 kg). Its tandem rotor configuration also provides exceptional handling qualities that enable the CH-47 to operate in climatic, altitude and crosswind conditions that typically keep other helicopters from flying.



#### General Characteristics:

- Length: Fuselage – 52.0 ft. (15.9 m) Incl. Rotors – 99.0 ft. (30.18 m)
- Width: 12.42 ft (3.78 m)
- Rotor Diameter: 60 ft. (18.29 m)
- Height: 18.92 ft. (5.77 m)
- Propulsion: 2 Honeywell 55-GA-714A engines, 4,733 shp (3,529 kW) each
- Speed: 170 kt (315 km/h)
- Fuel: 1,034 gal. (3,914 L)
- Service Ceiling: 20,000 feet
- Useful Load: 24,000 lbs. (10, 886 kg)
- Mission Radius: 200 nm (370.4 km)
- Max Gross Weight: 50,000 lbs. (22,668 kg)
- Mission: Transport of troops, artillery, ammunition, fuel, supplies, water in support of combat operations, and civil and humanitarian relief
- Service Customer: U.S. Army, in service since 1962

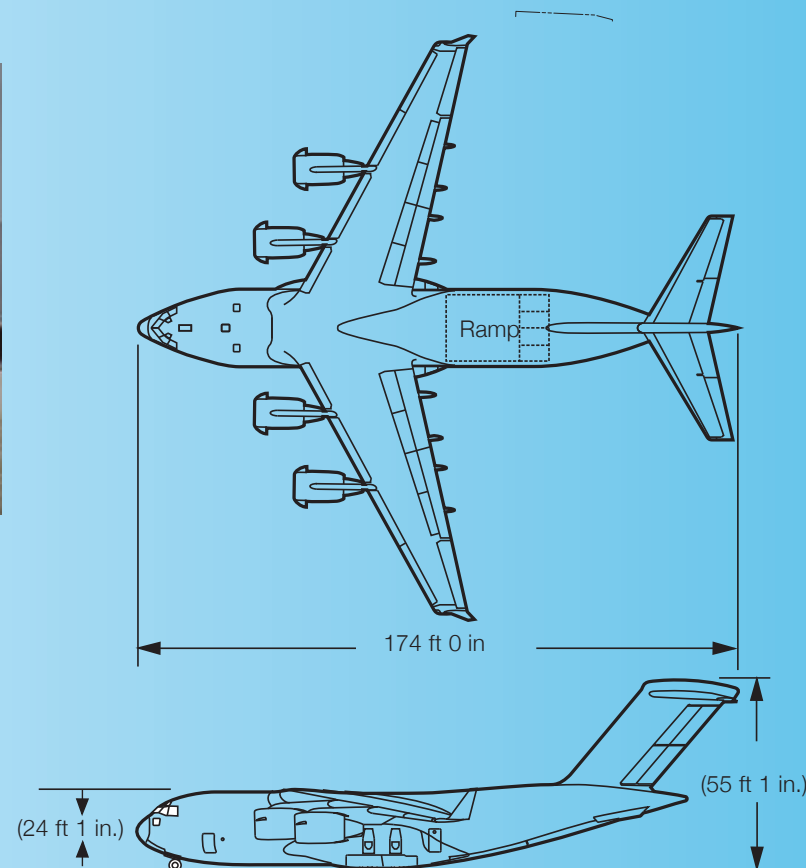
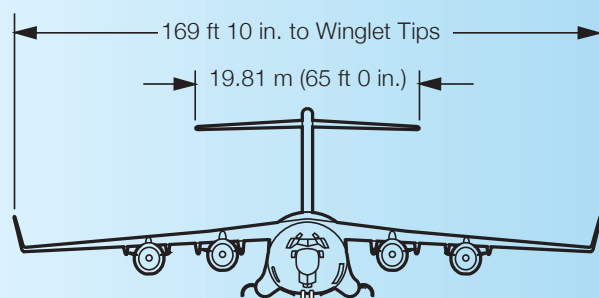




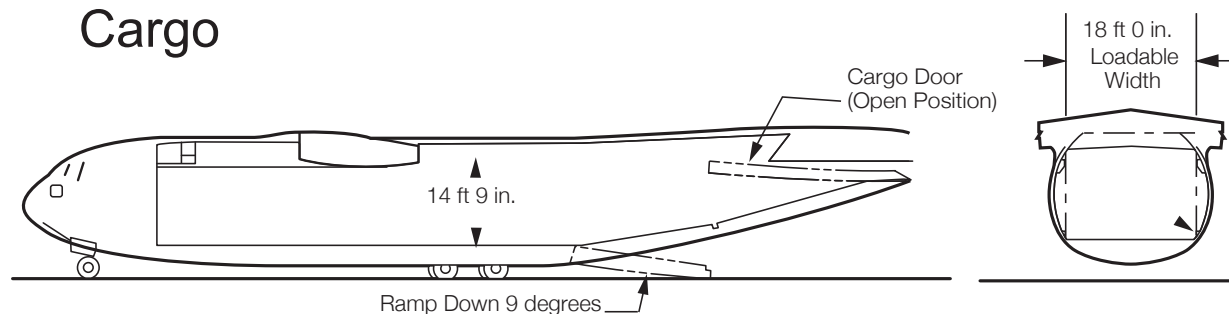


## Boeing C-17 Aircraft

The C-17 is much more than a huge plane. Due to its extraordinary capabilities, it has played a growing role in global disaster relief operations in recent years, bringing rapid aid to such catastrophes as the Haiti quake, Indian Ocean Tsunami, Hurricane Katrina, Pakistan floods and earthquakes in New Zealand and Japan.



### Cargo



## All About the C -17

Use the Fact Sheets on the following pages – and your math skills! – to answer these questions about the C-17.

1. A patient litter is like a stretcher. It's used to transport patients who can't walk or sit on their own. How many patients can travel on the C -17 in this way?
2. The loadmaster is the person in charge of the C-17's cargo. How long and how wide is the cargo compartment floor space he has to load? How many square feet of floor space does he have?
3. How long of a runway does the C-17 need in order to land while carrying 160,000 pounds of cargo?
4. How much does a gallon of fuel for the C-17 weigh?
5. How many gallons of fuel is it carrying if it has 180,806 pounds of fuel?
6. If the C-17 is carrying 160,000 pounds, how far can it fly? How much farther can it fly when it's empty?
7. How far is it from the tip of one winglet to the tip of the other winglet?
8. How much does the C-17 weigh when it's empty?
9. How many permanent seats does the C-17 have?
10. An airdrop is when the C-17 attaches supplies to parachutes and drops them from the air. What does a single load airdrop weigh?
11. Find an interesting fact about the C-17 that isn't already on this worksheet and write it here.





# Boeing C-17 Aircraft Fact Sheet

General Description: The C-17 Globemaster III is a high-wing, four-engine T-tailed military transport.

## EXTERNAL DIMENSIONS

Wingspan to winglet tips 169.8 feet (51.74 m)  
Length 174 feet (53.04 m)  
Height at tail 55.1 feet (16.79 m)  
Fuselage diameter 22.5 feet (270 inches) (6.86 m)

## ENGINES

Four Pratt & Whitney PW2040 (military designation F117-PW-100) 40,440 pounds (179.9 kN) thrust each

## CARGO COMPARTMENT

Cargo compartment crew One loadmaster  
Cargo floor length 68.2 feet (20.78 m)  
Ramp length 21.4 feet (6.52 m) structural length  
Loadable width 18 feet (5.49 m)  
Loadable height (under wing) 12.3 feet (3.76 m)  
Loadable height (aft of wing) 14.8 feet (4.50 m)  
Ramp to ground angle 9 degrees  
Ramp in flight load capacity 40,000 pounds (18,144 kg)  
Aerial delivery system  
    Pallets Eleven 463L pallets (including 2 on ramp)  
    Single load airdrop 60,000 pound platform (27,216 kg)  
    Sequential loads airdrop 110,000 pounds (49,895 kg)  
        (60 feet of platforms) (18.29 m)  
Logistic rail system capacity Eighteen 463L pallets (including 4 on ramp)  
Dual-row airdrop system Up to eight 18 foot platforms or 12 463L pallets  
Combat offload All pallets from ADS or logistic rail systems

## SEATING

Sidewall (permanently installed) 54 (27 each side, 18 inches wide, 24 inch spacing center to center)  
Centerline (stored on board) 48 (in sets of six back-to-back, 8 sets)  
Palletized (10-passenger pallets) 80 on 8 pallets, plus 54 passengers on sidewall seats

## AEROMEDICAL EVACUATION

Litter Stations (onboard) Three (3 litters each)  
Litter Stations (additional kit) Nine  
Total Capability (high density) 36 litters and 54 ambulatory

## PERFORMANCE

Maximum Ramp Weight 586,000 lbs. (265,805 kg)  
Maximum Takeoff Gross Weight 585,000 lbs. (265,352 kg)  
Operating Empty Weight 276,500 lbs. (125,420 kg)  
Usable Fuel (@ 6.7 lbs/gal) 180,806 lbs. (82,013 kg)  
Payload:  
    Maximum 170,900 lbs. (77,520 kg)  
    At 4,000 nautical miles 58,400 lbs. (26,490 kg)  
Range with Payload  
    160,000 pounds 2,500 nautical miles  
    40,000 pounds (paratroops) 4,200 nautical miles  
    Ferry (empty) 4,740 nautical miles  
Service Ceiling 45,000 ft. (13,716 m)  
Cruise Speed 0.74 - 0.77 Mach  
Takeoff Field Length (Max. gross wt.) 7,740 ft (2,359.15 m)  
Landing Field Length  
    (160,000 lbs of Cargo) 3,000 ft. (914.40 m)



## What's your character?

*Character Counts* defines six pillars of good character – Trustworthiness, Respect, Responsibility, Fairness, Caring, and Citizenship. (From [www.charactercounts.org](http://www.charactercounts.org).) When you read the following four stories of the heroes from the film *Rescue*, which of these traits do you see?

What activities do you participate in that show your character? Are you involved in any volunteer work?

Research volunteer and non-profit organizations in your area or online. Choose one to write about and report back to your class. Explain to them what the organization does, why it is important, and how they can get involved.

Talk with your classmates about a group volunteer project that you could do together. What needs does your community have that you could address?

If you aren't volunteering, why not start today?



## Commander Peter R. Crain

Featured in the film *Rescue* is the Captain of the Athabaskan, Commander Peter Crain. Crain spent some of his early years living in France and England with his parents. He joined the Canadian Forces in 1983 and completed his naval training in 1986. His first posting was as a watchkeeper aboard HMCS Ottawa, and he later served as a weapons officer on the ships HMCS Saguenay and Vancouver, and then as combat officer on HMCS Regina, with a variety of other postings.

Commander Crain completed several operational tours, including off Haiti in 1988, then served in support of UN Sanctions against Iraq in 1997 and 1999, and in Operation Apollo in 2002 as the Task Group Combat Officer.

Following graduation in 2004 from Canadian Forces Command and Staff College, Crain was appointed Executive Officer of HMCS Athabaskan and, on the promotion of his present rank, Executive Officer of Sea Training in the Atlantic. From 2006 to 2009, he served in the Directorate of Strategy Co-ordination at National Defence Headquarters.

On the 27th of August 2009, Commander Crain was appointed Commanding Officer of HMCS Athabaskan. He is an accomplished sailor and also races a 33-foot yacht based in Halifax. Amazingly, though he has grown up on the ocean, Commander Crain has never learned to swim.



## Lauren Ross

*It is really hard for people to imagine what it's like as an Air Force pilot. Most people have only experienced commercial airliners, so this movie will give them an amazing opportunity to come fly with me, to see what I see. I have the best job in the world and I am really excited to share it with people, especially children that might have an interest in aviation like I did when I was young. I hope Rescue opens doors for me to talk to school aged children. I love sharing the joy of my job with kids so they can imagine themselves in my shoes...or combat boots. I started out just like them, a little girl with a big dream.*




Captain Lauren Ann Ross was born in Valdosta, Georgia on September 28, 1981, to parents James and Cynthia Baize. As a child, she moved every three years because her father was an Air Force F15 pilot. Her fondest memories of her childhood were with her older brother Jonathan, and their parents, exploring the places they lived. They sled down the White Sand Dunes of Alamogordo, New Mexico, learned to Scuba dive in the reefs and shipwrecks off the coast of Okinawa, Japan and enjoyed the waterfalls and beaches of Oahu, Hawaii. Lauren's family moved to Texas when she was sixteen years old, where she attended Burkburnett High School. She attributes her involvement in volleyball, basketball, Fellowship of Christian Athletes, National Honor Society, Peer Assistant Leadership, and Student Council to helping her earn a Congressional appointment to the United States Air Force Academy (USAFA) in Colorado Springs, Colorado. There, Lauren achieved a Bachelor of Science in Humanities while competing in Division 1 volleyball and club water polo. She was commissioned as a Second Lieutenant in the Air Force in 2005. As a cadet, she met her future husband, Christopher Ross, and they were married shortly after graduation. She attended pilot training at Columbus Air Force Base, Mississippi where she earned her pilot wings in 2007 as the Distinguished Graduate.


Lauren and her husband both currently fly the C-17A Globemaster III as members of the 21st Airlift Squadron, stationed at Travis Air Force Base, California. She is a C-17A Aircraft Commander and Executive Officer with over 700 combat hours. She has been deployed into combat twice, earning four Air Medals as well as Iraq and Afghanistan Campaign Medals. Lauren was selected to play on the 2009 Air Force Volleyball team and they won the silver medal at the All Armed Forces Championship. She is currently working towards a Masters degree in Business Administration. Lauren has coordinated field trips to share the C17 with children and recently flew an American flag into combat in honor of the students of Bethany Lutheran Elementary School.





# The *Rescue* Educator's Guide: An Overview

The *Rescue* Educator's Guide is for teachers, community group leaders, and museum educators who work with upper elementary and middle school-aged students. The Guide addresses these four questions:

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**What is a disaster?** This section includes hands-on activities regarding the earthquake in Haiti, other disasters that happen around the world, and the science behind how disasters happen
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**How is the human body affected by disaster?** This section includes hands-on activities regarding first responder emergency care and the health and science issues that need to be addressed in the days and weeks following a disaster.
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**How do we rescue?** This section includes hands-on activities regarding emergency equipment, vehicles, communication, and planning.
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**Who are the rescuers?** This section includes brief biographies of some of the rescuers featured in the film so that students can get to know these inspirational people and find out about how they might one day pursue similar careers

The activities take an inquiry approach to learning and have flexibility to adapt to younger and older students. They are written with a casual style, addressing students directly. They use only supplies that are easy and inexpensive for teachers to obtain. Ties to the national science and math standards are emphasized throughout. The Guide has been developed by the Saint Louis Science Center and K2 Communications. For further information, please contact [jjovanov@slsc.org](mailto:jjovanov@slsc.org).

## Rescue IMAX 3D: About the Film

*Rescue* is an inspirational and exciting film about international response to humanitarian crises. Through the eyes and reflections of real world rescuers who often risk their lives, or put their lives on hold, to answer the humanitarian call when disaster strikes, we get an insider's look at their training, the assets they use, and their passionate commitment to saving lives. During our real time filming of the international response to the humanitarian crisis caused by the monster earthquake in Haiti, we witness the vital role of the military, and our heroes, in the crucial first response. For more about the film, please visit [www.rescue-film.com](http://www.rescue-film.com).

# National Science and Math Standards

The *Rescue* Guide presents an invaluable opportunity for classroom teachers to address a wide spectrum of science and math content standards. You can choose the activities and themes that best match the subject area you are teaching at the time your students view the film. Here are just a few examples of the science or math standard and a related question addressed by our hands-on activities:

## Physical Science, motions and forces:

Why do buildings fall down during an earthquake?

## Life Science, structure and function in living systems:

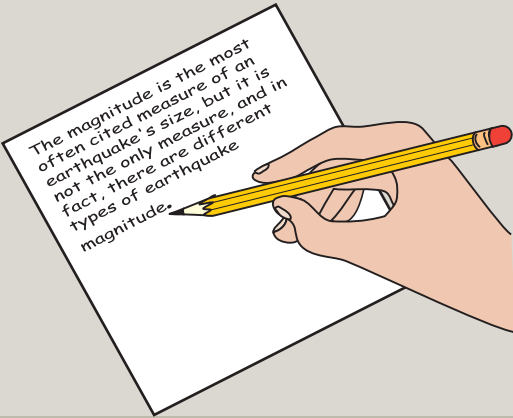
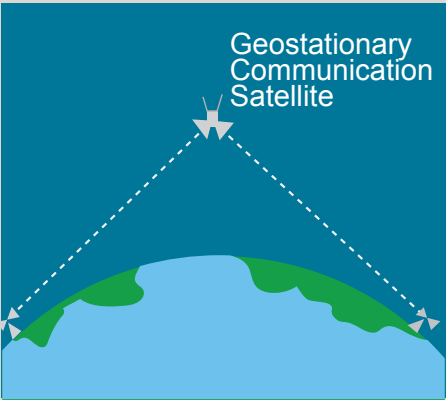
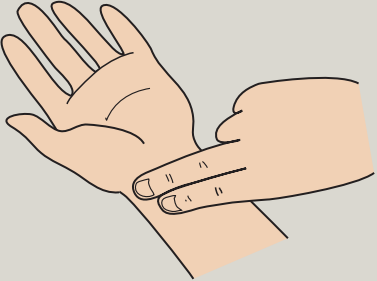
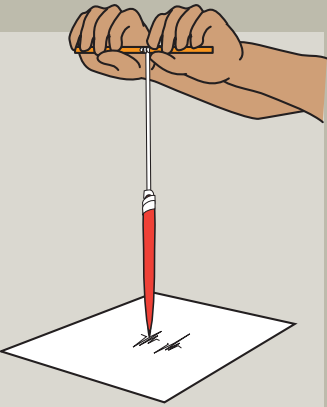
How do rescuers address circulatory and respiratory systems when providing first aid?

## Science and Technology, abilities of technological design:

How has technology enabled us to communicate internationally and to take action swiftly when there is a disaster?

## Data Analysis and Probability, develop and evaluate inferences and predictions:

How do scientists analyze data to study earthquakes?







## Steven Heicklen

Steven Heicklen is a FEMA certified Emergency Manager, a member of a USAR search and rescue team, a firefighter and an Emergency Medical Technician.

Heicklen first became involved in disaster response in 2004 when severe floods ravaged his home town in Southern, New Jersey. Thirteen inches of rain over 6 hours caused catastrophic failures of many dams in the region. Heicklen volunteered his expertise, equipment and staff and orchestrated the cleanup of one of three major roadways through the town. Since that time, Heicklen has been involved with various NGOs in the responses to Hurricane Katrina in New Orleans, Hurricane Gustav in Alabama and Hurricane Ike in Texas where his efforts included debris removal and the setting up of PODs (Points of Distribution) to service the needs of up to 50,000 people in surrounding population centers. In 2010, Heicklen was involved in responding to the earthquake disaster in Haiti.

Through his pool installation and maintenance business, Heicklen has developed expertise with heavy excavation equipment, debris removal and inspecting and working with concrete—skills that have served well in his work in disaster response and search and rescue. Heicklen credits his experience as an entrepreneur for helping him recognize that he has a talent for getting things done and for taming chaos that is handy in disaster situations.

Responding to the Haiti earthquake, Heicklen served as Disaster Coordinator for a team of medical professionals that flew into Haiti and took over a hospital in the southern part of the stricken nation. Team Ange (“Angel”) performed hundreds of surgeries, treated thousands of patients and secured treatment for 8 critically injured Haitians in America.

Since returning from the Haiti mission, Heicklen formed his own NGO, Americas Disaster Reaction Team. Staying busy, he has settled back into his role as a business owner and family man to wife, Jen and his four kids. Unfortunately, awaiting the next disaster.



## Major Matthew Jonkey

Jonkey was born in Las Vegas in 1973 and raised in Carson City, Nevada. Before Matt realized his dream of becoming a helicopter pilot he studied Criminal Justice at the University of Nevada. His father, now a retired FBI agent, was one of the reasons Matt was drawn this field. Matt didn't end up working for the FBI, but he still credits his father as his main career inspiration: “Probably my biggest role model is my father, just instilling the sense of work ethic and pride and integrity into what I do. The fundamentals that he gave me for dealing with life's challenges have certainly helped me throughout my career.” Matt took a break from his Criminal Justice studies to attend flight school; once he was working as a helicopter pilot for the U.S. Army he returned to university and finished his degree. His job with the military has brought him around the world for humanitarian missions, training and war efforts; he has been to Antigua, Iceland, Afghanistan and Haiti.

His work with the National Guard has been diverse. While deployed to Afghanistan, he was a Maintenance Officer and Maintenance Test Pilot. For this job, he was responsible for recovering aircraft downed by small arms fire or mechanical problems; he performed quick repairs so the aircraft could make it back to base. In Haiti, his unit's mission was primarily to resupply medical facilities, move troops, offer hurricane evacuation support, and provide personnel with Medical Evacuation to Guantanamo Bay or the Dominican Republic.

On being one of four main characters in the IMAX film Rescue, he says: “It's been a lot of fun. The reason I've enjoyed doing it is because it's something I can show my kids someday and something I can be proud of doing.”

Jonkey is currently working as a Supervisory Instructor Pilot/Operations Officer with the Nevada National Guard. When asked about being a helicopter pilot, he says he “can't imagine doing anything else”.





# Organizations that Help

People all over the world are helping the Haitians, the Japanese and other victims of disaster wherever it strikes. Here are just a few groups, with quotes from their websites, to start you thinking about how you might get involved.

## [www.redcross.org](http://www.redcross.org)

Since its founding in 1881 by visionary leader Clara Barton, the **American Red Cross** has been the nation's premier emergency response organization. As part of a worldwide movement that offers neutral humanitarian care to the victims of war, the American Red Cross distinguishes itself by also aiding victims of devastating natural disasters.

## [www.pih.org](http://www.pih.org)

**Partners in Health** works in twelve countries around the world to provide quality health care to people and communities devastated by joint burdens of poverty and disease. PIH has been providing vital health care services in Haiti for more than twenty years and is the largest health care provider in the country.

## [www.unicefusa.org](http://www.unicefusa.org)

Working in over 150 countries, **UNICEF** is a global humanitarian relief organization providing children with health care, clean water, nutrition, education, emergency relief and more. The U.S. Fund for UNICEF supports UNICEF's humanitarian relief work through fundraising, advocacy and education in the United States.

## [www.mfkhaiti.org](http://www.mfkhaiti.org)

Dr. Patricia B. Wolff, Professor of Clinical Pediatrics at Washington University's School of Medicine, founded **Meds & Food for Kids** in response to her frustration of watching malnourished Haitian children needlessly die. MFK's approach is to use local labor and local resources to manufacture Medika Mamba, a treatment for malnutrition, which in turn develops the local economy.

## [www.usaid.gov](http://www.usaid.gov)

**USAID** is an independent federal government agency that receives overall foreign policy guidance from the Secretary of State. Our work supports long-term and equitable economic growth and advances U.S. foreign policy objectives by supporting: economic growth, agriculture and trade; global health; and, democracy, conflict prevention and humanitarian assistance. We work in close partnership with private voluntary organizations, indigenous organizations, universities, American businesses, international agencies, other governments, and other U.S. government agencies.

# All About the C -17

## Answer Sheet

1. A patient litter is like a stretcher. It's used to transport patients who can't walk or sit on their own. How many patients can travel on the C -17 in this way?  
**36 patients**
2. The loadmaster is the person in charge of the C-17's cargo. How long and how wide is the cargo compartment floor space he has to load? How many square feet of floor space does he have?  
**68.2 x 18 = 1,227.6 sq. ft.**
3. How long of a runway does the C-17 need in order to land while carrying 160,000 pounds of cargo?  
**3,000 ft.**
4. How much does a gallon of fuel for the C-17 weigh?  
**6.7 lbs.**
5. How many gallons of fuel is it carrying if it has 180,806 pounds of fuel?  
**180,806 ÷ 6.7 = 26,985.97 gallons**
6. If the C-17 is carrying 160,000 pounds, how far can it fly? How much farther can it fly when it's empty?  
**2,500 nautical miles with cargo**  
**4,740 – 2,500 = 2,240 more nautical miles when empty**
7. How far is it from the tip of one winglet to the tip of the other winglet?  
**169.8 feet**
8. How much does the C-17 weigh when it's empty?  
**276,500 lbs.**
9. How many permanent seats does the C-17 have?  
**54**
10. An airdrop is when the C-17 attaches supplies to parachutes and drops them from the air. What does a single load airdrop weigh?  
**60,000 lbs.**
11. Find an interesting fact about the C-17 that isn't already on this worksheet and write it here.



## Measuring Earthquakes

### How can scientists tell how strong an earthquake is?

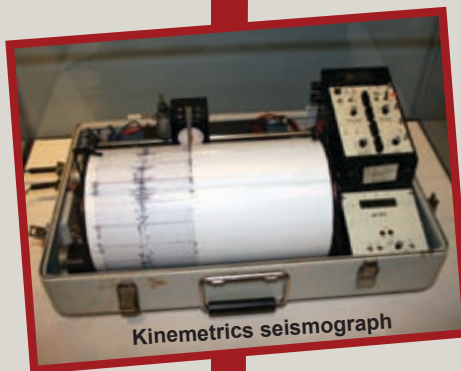
**You Will Need:** paper, marker, pencil, string, tape, table, a partner

1. A seismograph measures earthquakes. You can make a very simple one by tying a string around the center of a pencil and taping a marker to the other end so that its point faces straight down.
2. Tape a sheet of paper to the table. Hold the pendulum just above the paper so that the marker is barely touching.
3. Have your partner shake the table to simulate an earthquake. Make sure that the marker is only moving due to the shaking, not from you moving it.
4. Repeat the activity with a different sheet of paper and a different strength of "earthquake". How does the marking on the paper change? What do the different readings tell you about the earthquakes?



### +/- Math and Magnitude

Even though scientists now use a more accurate "moment magnitude scale", you still need to know one very important math concept to understand what these measurements mean: An earthquake that has a magnitude of 6 is 10 times more powerful than one with a magnitude of 5. That means that the 8.9 magnitude earthquake in Japan was how many times more powerful than the 7.2 Haiti earthquake?



### What's Going On?

Seismographs have been used for over 100 years to measure earthquakes. They work pretty much the same way a pendulum works – a heavy weight tends to remain in the same position, even when the ground below it is moving. Scientists measure the changes in size of earthquake seismograph waves – like the wavy lines you produced – to figure out the magnitude of (or measure the energy released by) an earthquake. You've probably heard something like "the earthquake measured a 5 on the Richter Scale" on the news. That scale is named after Charles Richter who developed it in the 1930s to measure the strength of earthquakes.

### Find Out More

Visit [earthquake.usgs.gov](http://earthquake.usgs.gov) and click on "Learn" to find out all about earthquakes and their impact. We measure earthquakes not just by magnitude but by intensity too – the earthquake's effect on people.

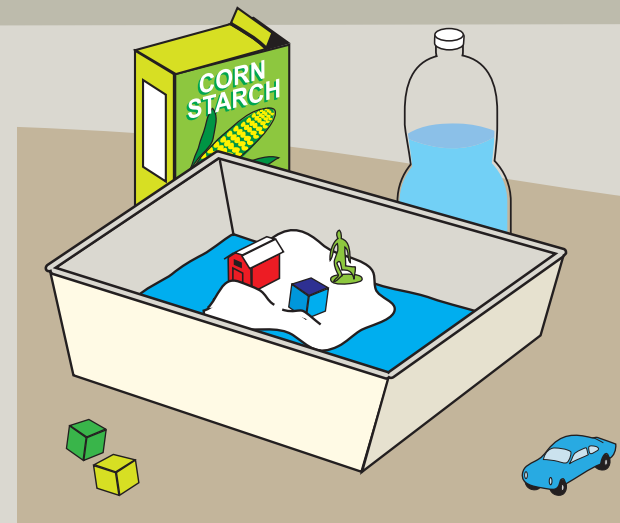


## Landslides

### Why do some places have landslides and others don't?

**You Will Need:** corn starch, water, cake pan, your choice of small blocks, toy buildings, cars, action figures, etc.

1. Build a cornstarch hill in the middle of the pan, about 2 inches tall.
2. Arrange the blocks, etc. on the hill to create a town.
3. Gradually pour water into the pan so that it surrounds your hill.
4. Gently rock the pan from side to side. What happens to the cornstarch when it's mixed with the water?
5. Observe what happens to your town as you add more water and continue rocking the pan.

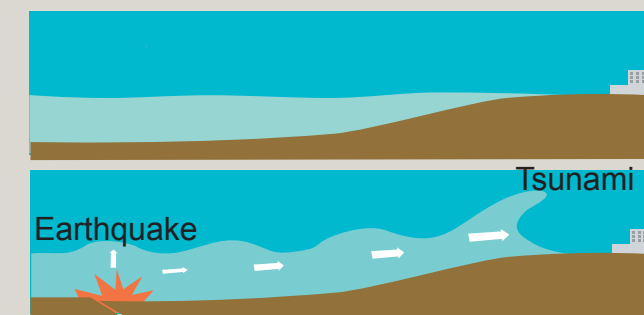


### What's Going On?

When the cornstarch and water mix, your town experiences a landslide caused by soil liquefaction. This can occur when ground water mixes with what used to be solid ground, causing it to become fluid. Buildings in sandy areas are vulnerable because sand that is firmly packed down may appear to be solid enough to build on, but can easily become unsteady due to rain or earthquakes. Soil liquefaction results in landslides and quicksand conditions.

### Earthquake and Tsunami in Japan

On March 11, 2011, while we were writing this guide, a devastating earthquake measuring 8.9 on the Richter scale struck Japan. We don't know yet how many lives have been lost. But we do know, just as with the Haiti earthquake, that rescuers from around the world headed for Japan to help. The earthquake was followed by a tsunami. A tsunami, meaning "harbor wave" in Japanese, begins under the ocean. The energy from the shaking ground below is transferred into the ocean water above. The movement of the land pushes the water to move too, away from the epicenter of the earthquake, causing a series of huge, powerful waves traveling at about 500 miles per hour. The results of the Japanese tsunami were felt as far away as the coast of California.







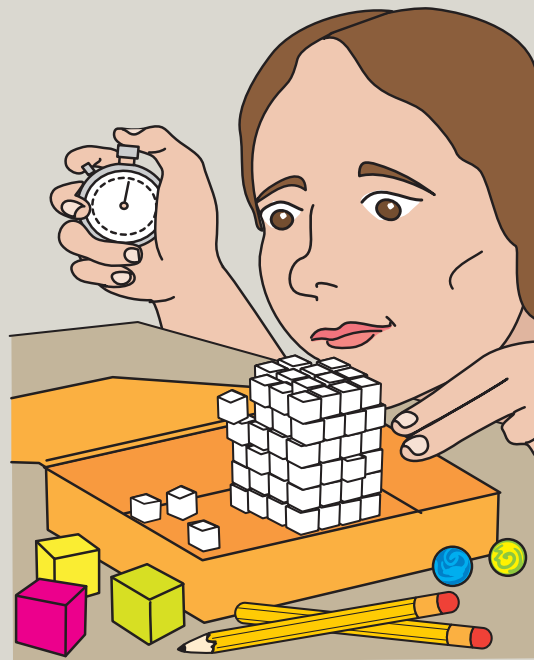
## Buildings that Crumble



Can you design a building that doesn't fall down in an earthquake?

**You Will Need:** sugar cubes, small building blocks, pencils, dish sponge, marbles, pencil box, stopwatch

1. Using the sugar cubes or blocks, build a skyscraper, whatever design you choose, in the middle of the pencil box.
2. Test the skyscraper's ability to withstand an earthquake by carefully shaking the pencil box from side to side. Use the stopwatch to time how long you need to shake before your skyscraper falls down.
3. Don't give up! You still haven't used the pencils, the sponge or the marbles. How can you add these to your skyscraper to help it stand up to the shaking? Try different designs inside the pencil box and retest your building. Can you increase the time before it falls down? Or can you keep it from falling at all?
4. After you experiment with different designs, draw a diagram of the one that works best. Label the parts of the building and explain why your design works. If you email it to [jjovanov@slsc.org](mailto:jjovanov@slsc.org), we'll post it on our Science Beyond the Boundaries website and share it with science centers around the world!



### What's Going On?

Engineers know that to survive an earthquake, a building, no matter how sturdy it looks, has to be able to move when the ground underneath it is moving. Many earthquake-resistant structures are built using a design called "base isolation." That means that the base of the building rests on the ground, but the building itself does not. Between the isolated base and the building are rollers or flexible pads that move when the earth moves so that the building doesn't. A "fixed base" building rests directly on the ground, so, when the ground moves, the building does too.

### Find Out More

Visit [discoveryeducation.com/teachers](http://discoveryeducation.com/teachers) and enter the word "earthquakes" in the search box in the upper right corner for a variety of classroom activities about measuring, tracking and preparing for earthquakes.



## Clean Water

How do we get safe drinking water into an area affected by disaster?

**You Will Need:** coffee filters, cotton balls, charcoal (from the pet store), water, salt, dirt, gravel, clear plastic cups, nail

1. In one of the plastic cups, mix water, salt and dirt so that it looks like something you'd never want to drink.
2. Use the nail to poke a hole in the bottom of several of the other cups so that when you pour the dirty water in, it will flow out the bottom. (Don't forget to have a cup without a hole in it to collect the water after it flows through.)
3. Use the coffee filters, cotton balls, charcoal and gravel to build a system of filters in the cups to clean the water. Experiment with different combinations of materials to see what works best. Record your results.

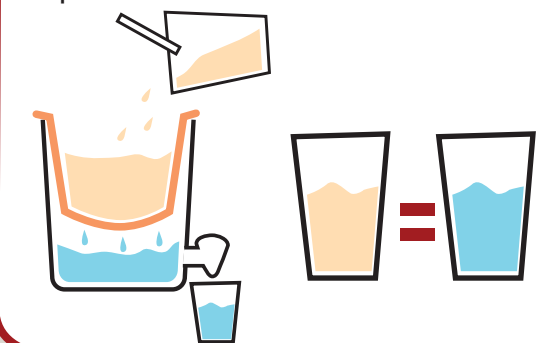


### What's Going On?

After a disaster, sanitation systems may not be working properly, making the water unsafe to drink. Bottled water is one of the first emergency items sent to areas affected by disaster so that people won't get sick from drinking contaminated water. Water purification systems use a series of filters that remove most impurities. Portable water purification systems have been sent to Haiti and other countries in need. Filters alone are not enough to protect people from some waterborne diseases, so additional chemical treatments, such as chlorine are also used.

### Find Out More

These drawings show how one type of ceramic water filter is made. It resembles a flowerpot, but rounded at the bottom. The filter uses colloidal silver to fight bacteria and charcoal to improve taste and color.





## Fight or Flight

### How does your body react when you're in danger?

**You Will Need:** paper, pencil, bowl, six or more people

1. Divide into teams of 3 - 4 people each. Study the chart below and talk to your group about a dangerous situation that might cause the "fight or flight" response or a relaxing situation that would cause "rest and digest". The Fight or Flight response happens when you are afraid. This can be anything from being surprised by a bear in the woods to your teacher asking you to stay after class. Write your idea for the situation on a piece of paper, fold it up, and put it in the bowl without any of the other teams seeing it.

2. Pass the bowl around and have each team pick a situation to act out for the rest of the group. (Don't worry. This isn't charades. You can talk.) Make sure your skit includes the physical changes in the human body involved with each response.

	Fight or Flight	Rest and Digest
Heart Rate	faster	slower
Blood Pressure	higher	lower
Skin	sweating	normal/cool
Breathing	faster	slower
Digestion	decreased	increased

3. Discuss "fight or flight" and the skits with your whole group. Why do you think the human brain has an automatic reaction like this?

#### What's Going On?

An autonomic nervous system response is something your brain does automatically. (You don't have time to think: "Hmm, that stove is hot, maybe I should take my hand off the burner." Your brain does it for you.) The sympathetic nervous system (fight or flight) prepares your body for emergencies. It sends your blood to your muscles and increases your blood pressure, heart rate and breathing rate, so you are stronger and can run faster. The parasympathetic nervous system (rest and digest) maintains and restores your energy and also sends blood to your digestive tract. It helps your body recover from "fight or flight".

NOTE: This activity is especially designed for groups attending both the *Goosebumps! The Science of Fear* exhibit and the *Rescue* film. For more on *Goosebumps* and related activities, visit [fearexhibit.org](http://fearexhibit.org).

#### Find Out More

Visit [learn.genetics.utah.edu](http://learn.genetics.utah.edu) and click on "Amazing Cells" for a video about how cellular communication works during the Fight or Flight response.



## Know Your A,B,Cs

### What does a rescuer do first to help someone who might be injured?

**You Will Need:** stopwatch, a partner

1. A, B, C. That's what "first responders" have to remember for emergency first aid. A is for Airway. First, they check to see if the person can talk, or if there's something stuck in his or her throat. Once that's taken care of, they move on to B.
2. B is for Breathing. They check to make sure the person's breathing is normal. To check your respiration rate, set your stopwatch for 60 seconds, lie quietly on the floor, push the start button and count how many times you breathe in and out. Try it again after running in place and it will be higher. Now for C.
3. C is for Circulation. They check to make sure blood is circulating normally through the person's body by feeling for his or her pulse. To check your own pulse, put your index and middle finger on the inside of your wrist. When you can feel the beat, ask your partner to time you with the stopwatch.
4. When your partner says "go," start counting every time you feel a beat. Ask your partner to say "stop" after 15 seconds.
5. To find out your beats per minute, multiply your number by 4. Athletes have such strong hearts that their pulse can be as low as 40 beats per minute. How was yours?
6. Now, run in place for one minute. When time is up, sit back down and take your pulse again. What is your number this time?
7. The heart is a hard-working muscle. Don't believe it? Try squeezing your hand as many times per minute as your pulse rate. Your heart muscle has to do that all the time, without taking any breaks!



#### What's Going On?

**A is for Airway.** The Heimlich Maneuver is commonly used to squeeze someone's diaphragm muscle and push out whatever is choking him or her. You will need to take a CPR class to learn how to do this. Visit [heart.org](http://heart.org) to find out more.

**B is for Breathing.** In respiration, the lungs give your body the oxygen it needs for any activity, even lying around. The number of breaths you take in a minute is your respiration or breathing rate. The average respiration rate, if your age is 7 years or older, is 12 to 24 breaths per minute.

**C is for Circulation.** Your pulse is the sound of your heart muscle pumping blood through your body. If your age is 10 years or older, the average pulse rate is in the range of 60 to 100 beats per minute.