Inhale, Exhale, Repeat

Print:

How ratios, proportions and rates are used by respiratory therapists to measure breathing and lung function and plan respiratory treatments

Industry Sector: Healthcare
Content Area: Mathematics
Core Topic: Ratios, rates and proportions

Expand All | Collapse All

Common Core State Standards

Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

High School—Number & Quantity: Quantities

N-Q.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

High School—Geometry: Modeling with Geometry

G-MG.1: Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
G-MG.3: Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Adult Basic Education Standards

Geometry and Measurement

4G-4: Understand measurable attributes of objects and the units, systems, and processes of measurement and apply appropriate techniques, tools and formulas to determine measurements.
4G-4.1: Convert units of measure in different systems by using own informal methods.

4G-4.1.3: Know how to solve ratio and proportion problems.

Industry Overview

Healthcare in America

From neonatal nurses to radiology technologists, medical coders to medical office assistants, health educators to home care aides, the healthcare industry provides a vast and diverse array of services to individuals at every stage of life. Providing nearly 17 million jobs and accounting for an estimated $18 million of the U.S. GDP in 2009, healthcare is the nation's largest industry. In Massachusetts, in particular, healthcare accounts for more than 15% of employment (compared with 12% nationally), accounting for approximately one in six jobs. With an aging baby boomer population that is living longer, there is greater demand for more and higher quality preventative and long-term healthcare across the United States. With eight of the 30 fastest growing occupations, healthcare is predicted to be one of the fastest growing industries both nationwide and in Massachusetts between now and 2020.

Careers in Healthcare

The healthcare industry includes a vast array of jobs related to planning, managing, and providing therapeutic services, diagnostic services, health informatics, support services, and biotechnology research and development. This industry includes five career pathways:

- therapeutic services, which includes professionals who work directly with patients to improve their health by providing direct care and treatment for patients (for example, a nurse or a physical therapist assistant);
- diagnostic services, which includes professionals who plan and conduct tests to detect and diagnose diseases and injuries, and use test results to plan treatment (for example, a radiologic technologist or a sonographer, who perform diagnostic imaging examinations, such as X-rays or ultrasounds);
- health informatics, which includes professionals who compile and manage health information and records (for example, a medical records and health information technician, who organizes and manages patient databases; higher-level positions, such as administrators of healthcare facilities or departments, are also included in this pathway);
- support services, which includes professionals who provide assistance to other medical professionals, allowing them to do their jobs in diagnosing and treating patients or supporting therapies (for example, food service workers and nutritionists ensure that patients' meals are healthy and meet dietary guidelines); and
- biotechnology research and development, which include careers that involve bioscience research; while many of these professions require doctoral or medical degrees, some entry-level opportunities in the field require only an associate degree (for example, food and agricultural science technicians).

Mathematics and Communication Skills Needed in Healthcare

The growing complexity of the healthcare industry, including changing technologies, requires workers to continuously upgrade their skills. In addition to technical skills specific to their job, mathematics and literacy skills are crucial for success in all occupations across the healthcare industry.

Communication: First and foremost, no matter the job, good healthcare practitioners are committed to giving patients the best care available and keeping abreast of health research and developments in the field. All workers need to be able to read medical journals and understand medical terminology and vocabulary, as well as read and write literate emails to co-workers/supervisors. Many healthcare jobs also require the ability to read and interpret charts and access and interpret electronic medical records in order to provide quality care.

Many health careers, especially—but not exclusively—those in therapeutic services—involve interacting with patients and their families, in some cases working with people who may be sick, disabled, or dying. Even support staff in a medical office or hospital require effective oral communication skills as well as compassionate interpersonal skills such as the ability to listen and talk to patients to assess needs. Effective communication with colleagues as well as patients is crucial. Healthcare is increasingly a group activity, in which a patient's recovery depends on how well all members of a healthcare team perform specific function, and how well they communicate and collaborate with one another.

Mathematics: From reading charts to interpreting data to measuring and administering correct medicine, basic mathematics skills are essential for providing quality care across most healthcare occupations. Nurses, for example, use mathematics for calculations in all areas of their duties. They use mathematics to calculate dosages, caloric requirements for individual patients, calibrate equipment, and interpret lab results. Charts and patient data are often presented as decimals or percentages, and a nurse must be able to convert between the two, thus requiring competency in understanding and using ratios, proportions and percentages.

Much of modern medicine is based on statistics, and all workers in the industry should have a basic understanding of how statistics are used to influence medical trends. Nurses, for example, need to be aware of the statistics behind prescribing medications and possible side effects or complications. They might use statistics to counsel patients on diagnoses or prognoses, or in gathering patient histories.

Career Opportunities in Healthcare with Education from Community Colleges

Massachusetts Community Colleges play a crucial role in preparing students for careers in health sciences across all sectors of the industry—therapeutic services, diagnostic services, informatics, and support services. All 15 community colleges offer pathways to nursing careers, the largest occupation in the healthcare industry. Additionally, Massachusetts Community Colleges offers associate degree and certificate programs that prepare students to enter occupations across all sectors of the industry, for example:

- *Therapeutic services:* registered nurse, practical nurse, nursing assistant, certified nurse's aide, massage therapist, fitness trainer and instructor, dental hygienist, dental assistant, pharmacy technician, physical therapist assistant, occupation therapy assistant, respiratory assistant, medical assistant
- *Diagnostic services:* radiologic technologist and technician, radiographer, surgical technologist, sonographer, phlebotomist, paramedic, polysomnographic technologist and technician, medical and clinical laboratory technician, magnetic resonance imaging technologist, nuclear medicine technologist, veterinary technologist
- *Informatics:* Medical record and health information technician, medical coder, medical interpreter, medical biller, medical transcriptionist, health educator

Recent Career Opportunities in Massachusetts

The following is a sample of healthcare job listings in Massachusetts that require an associate's degree or certificate:

- Registered Nurse (RN), AmeriCare At Home, Boston, MA [show]
- Medical Technologist, Emerson Hospital, Concord, MA [show]
- Ultrasound Technologist, Brockton, MA [show]
- Licensed Practical Nurse, Hologic, East Watertown, MA [show]

Employment Outlook for Healthcare

America's aging population is now nearing or entering retirement (opening new jobs), and will continue to require more services and the increased use of innovative medical technology for diagnosis and treatment. As a result, healthcare is one of the fastest growing industries both nationwide and in Massachusetts, where growth is even higher than nationally. For example, in 2010, Baystate Health of Springfield, which employs more than 10,000 across its Western Massachusetts system, said that it would likely need to hire about 15,000 people between 2010 and 2020 to replace retiring workers and meet increased demand.

One important factor in the healthcare industry is the financial pressure on hospitals to focus on efficiency and profitability, which results in discharging patients as soon as possible. These financial pressures, along with increased healthcare coverage under federal law, will likely result in a growth in out-patient services in the healthcare industry, such as rehabilitation clinics, long-term care facilities, and home care programs. As a result, occupations experiencing the largest growth include home care aides, physical and occupation therapist assistants, dental hygienists, and medical assistants.

Emerging careers in Health/Information Technology (HIT): Estimates based on data from the Bureau of Labor Statistics (BLS), Department of Education, and independent studies indicate a shortfall of approximately 51,000 qualified Health IT (HIT) workers who will be required over the next five years to meet the needs of hospitals and physicians as they move to adopting an electronic healthcare system, facilitated by the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009. The HITECH Act is a key component of healthcare reform. The Act encompasses interoperable electronic health records (EHRs) including computerized systems to order tests and medications, and support systems to aid clinical decision making and the development of a national health information network to permit the secure exchange of electronic health information among providers. The Congressional Budget Office estimates that the incentive mechanisms in the HITECH Act will increase HIT adoption rates from 45 percent to about 70 percent for hospitals and from 65 percent to approximately 90 percent for physicians. To support job growth in this emerging career field and ensure the adoption of EHRs, new types of workers are needed to facilitate information exchange across healthcare providers and public health authorities, and assist in redesigning workflows within healthcare settings to maximize the quality and efficiency benefits of EHRs, while maintaining privacy and security of health information and records. To that end, the Department of Health and Human Services has embarked on an initiative to build the HIT workforce with community colleges as the primary training ground for these new workers: (1) Practice workflow and information management redesign specialists; (2) Clinician/practitioner consultants; (3) Implementation support specialists; (4) Implementation managers; (5) Technical/software support staff; and (6) Trainers. The average hourly earnings for community college program graduates are expected to be in the target range of between $12.46/hour to $20.25/hour.

Resources:

Healthcare Employment Outlook:

- Massachusetts Career Information System: Massachusetts-specific information on careers which can be used to look at different industries, occupations within those industries, and the skills and education needed to work in these jobs
- WorkKeys Occupational Profiles
- Bureau of Labor Statistics

Healthcare Career Information:

- Top 5 Reasons to Work in the Healthcare Field, About.com
- Break Into a Healthcare Career, About.com
- Healthcare Initiatives, US Department of Labor
- Six Healthcare Careers that are Booming, Yahoo! Education
- Career Clusters in Health Sciences, National Association of State Directors of Career Technical Education Consortium
- Explore Health Careers, American Dental Education Association

Massachusetts Healthcare Job Listings:

- Massachusetts Healthcare Jobs, Jobs.net
- Healthcare Jobsite, Beyond.com

Workplace Scenario (8th Grade Level)

This scenario is based on the work of a respiratory therapist. For more information, view this video.

You are a respiratory therapist. You work at a small regional hospital in Western Massachusetts. Most of your work is focused on treating patients with chronic conditions. An example of a chronic condition

is asthma. You are also sometimes called to the emergency room. There you may assist with patients who are suffering from a heart attack or shock. You also sometimes assist with a pediatric patient. For example, you might treat a premature baby. Another typical case would be helping a child with cystic fibrosis.

Communicating with patients and other medical staff is very important. A large focus of your work is to relieve some of their patients' symptoms. This requires a great deal of problem solving. The solution is rarely routine. You must rely on your strong math skills in evaluating and treating patients. For example, you need to calculate changes in lung function. This will help you understand how patients are responding to treatment. You may use algebra to calculate the volumes and densities of gases. (Air is a gas. Many of the treatments used in respiratory therapy also involve gases). You regularly calculate dosages of medications for patients. You need to ensure that the dosage given is in proportion with the patient's size. You are very dedicated to your job and to helping your patients. It is very challenging to watch them suffer when they breathe. You hope to bring them comfort.

Workplace Scenario (High School Level)

This scenario is based on the work of a respiratory therapist. For more information, view this video.

You are a respiratory therapist working at a small regional hospital in Western Massachusetts. Most of your work is focused on diagnosing and treating patients with chronic cardiopulmonary conditions such as asthma. You are also sometimes called to the emergency room to assist with patients who are suffering from a heart attack or shock. Other times you assist with a pediatric patient such as a premature birth or someone with cystic fibrosis. You spend much of your time at work communicating with patients and other medical staff as you try to alleviate some of their patients' symptoms and discomfort. This requires a great deal of problem solving, since the solution is rarely routine. You also find that you rely on your strong mathematics skills in evaluating and treating patients. For example, you need to calculate changes in lung function to understand how patients are responding to treatment. You also use algebra to calculate the volumes and densities of gases (since air is a gas and many of the treatments used in respiratory therapy also involve gases). You are constantly calculating dosages of medications for patients. Since people come in all different sizes, you need to ensure that the amount of medication given to a patient is in proportion with the patient's size. Depending on whether you are helping an obese male patient or a premature infant, the amount of medication you will use in treating the patient will vary hugely. You are very dedicated to your job and to helping your patients. It is very challenging to watch them suffer through the basic function of breathing and you hope to bring them comfort.

Core instructional context

Ratios, rates and proportions are used when making comparisons between different quantities. A ratio is a comparison between two quantities, and a rate is a special kind of ratio that compares the change in one measurement to the change in another measurement. Proportions are two ratios that have been set equal. These mathematical comparisons allow people to understand and communicate about how quantities are related to each other, such as how long it takes to perform certain tasks (for example, extruding one mold takes 1.25 minutes on average if 48 molds are produced each hour), or the cost per unit for an item (for example, $7.99 per pound for one brand of sterile gauze pads versus $5.99 per pound for another brand). Proportional reasoning and understanding the relative way quantities change (for every 5 units up we move 3 units over), is an important building block of algebraic thinking. Developing students' proportional reasoning skills, will help students differentiate between processes that are additive and multiplicative, interpret graphs that represent proportional relationships, and open pathways to further mathematical understandings.

Ratios and rates are important in many industries—to monitor how efficiently work is done, to control machinery, or to determine the quantity of medication to administer. In healthcare, heart rates and pulse rates can be early indicators of serious issues, and nurses monitor the drip rate of an IV to provide medication and fluids to patients. Nurses also use ratios when calculating how much medication to prescribe based on body weight.

Respiratory therapists care for patients who have trouble breathing—from infants born prematurely to accident victims to the elderly; they perform diagnostic tests, treat patients, and monitor and record the progress of treatment. Respiratory therapists most often work in hospitals, but may also work in doctors' offices and nursing homes. Due to the aging population in the United States, employment in this occupation will continue to grow as respiratory therapists often treat elderly patients with diseased lungs.

Many of the diagnostic tests that respiratory therapists conduct involve ratios and proportions, such as measurements of:

- respiratory rate which is usually measured as breaths per minute;
- tidal volume: the amount of air inhaled per one breathing cycle;
- oxygen saturation: the proportion of arterial blood that is saturated with oxygen;
- vital capacity: the maximum volume of air expelled after maximal inspiration (can be reached only during strenuous exercise);
- residual volume: the volume of air remaining in the lungs after maximal expiration;
- total lung capacity: the sum (adding together) of the vital capacity and the residual volume; and
- minute ventilation, the total lung ventilation per minute, the product of tidal volume and respiration rate. It is measured by expired gas collection for a period of 1 to 3 minutes. The normal rate is 5 to 10 liters per minute.

Worked Examples

1. How much oxygen do we normally take in one breath?

Tidal volume is the amount of air that passes in and out of the lungs during normal breathing. In an average healthy adult, the tidal volume is about 500 milliliters. If the air we inhale is approximately 21% oxygen and 78% nitrogen, how much of one inhalation is oxygen in liters?

- Find proportion of oxygen:
  - 0.21 * 500 mL = 105 mL
- Convert to liters:
  - 105 mL * (1 L / 1000 mL) = 0.105 liters

2. Total lung capacity (TLC) can be found by adding the vital capacity and the residual volume. The residual volume is usually 25% of the TLC while vital capacity makes up the other 75%. If a person's vital capacity is 3.2 liters, calculate their TLC and residual volume.

- Calculate the TLC using the 75% proportion:
  - 3.2 L / (0.75) = 4.267 L
- Calculate the residual volume—25% of the TLC:
  - 4.267 L * (0.25) = 1.067 L

Contextualized learning activities

Pre-Reading

Tell students that they are going to conduct a short experiment in which they count their breaths. Let students know that they will be timed for 20 seconds—during that time they will count then number of **inhalations** that they take. Have students place their hands on their belly and tell students to count one inhale each time their chest or belly rises as one inhale.

After 20 seconds, ask for a volunteer to share the number of breaths he or she took. For example, a student may have recorded 5 breaths in 20 seconds. Ask students to find this student's breathing **rate**

per minute based on how many times he or she breathed in 20 seconds. Ask students: How many breaths might this student take in an hour? A day? A year? Approximately how many breaths have you taken since you were born?

Use this example to introduce proportions, ratios and rates. Ask students: What factors might affect a person's **respiratory rate**?

Introduction to the Scenario

Tell students that **respiratory therapists** take care of people who have health conditions that affect their breathing. Have students read the scenario in this module, circling or highlighting the mathematics-related concepts and terminology.

Ask students to think about the last time they went to a doctor's office for a health check-up or, if they have children, ask students to think about when they took their children to the doctor. Ask students to think about which of their health functions and conditions were examined. Ask students to identify which health conditions or functions might be expressed as ratios, proportions or rates.

Possible Answers: pulse rate, respiratory rate, blood level concentrations (of oxygen or different nutrients), ratios and proportions related to body weight and composition, body mass index (ratio of weight to height), body fat percentage (proportion of body fat and lean muscle), and hip-to-waist ratio.

If time permits, have students watch one of the videos (included in the resources section of this module) that shows what a respiratory therapist does. Ask students to identify the mathematics that might be used to diagnose and treat respiratory conditions, according to the scenario in this module and the video(s). Highlight some of the proportions, ratios and rates that they will calculate, including respiratory rate, oxygen concentration in blood, and ratios of medication dosages by weight.

Calculating Respiratory Rates

Divide the class into groups of 5-6 students. *(Note: Tell students ahead of time that this activity requires them to engage in physical activity (jumping jacks) for two minutes. If there are students who are unable or uncomfortable doing that, they can take on the role of recorders or timers within their groups.)*

Have groups conduct the same experiment they conducted in the Pre-Reading activity, where each student within the group calculates their respiration rate at rest. Time it for everyone (timing for either 20 or 30 seconds and have students multiply accordingly to find the respiration rate per minute).

Have each group create a table where they record everyone's respiration rate "at rest."

Note: Self-measuring of breathing frequency is not very accurate, since it is normal to change breathing patterns once a person pays attention to their own breathing while measuring (usually breathing slower and deeper). Suggest conducting three trials of respiration rates at rest and then take the average of the three.

Then have students do two minutes of jumping jacks or other aerobic activity. After two minutes of jumping jacks, have students calculate their respiratory rate after exercise. Have students record the rate in their table, as well as calculate the change of rate for each individual. For example, their table might look like:

Student	Respiratory Rate at Rest (per minute)	Respiratory Rate Post-Exercise (per minute)
Amy	Trial 1: 15 / min	30 / 1 min
	Trial 2: 14 / min	
	Trial 3: 16 / min	
	Average Rate at Rest: 15 / min	

Ben	Trial 1: 12 / min	30 / 1 min
	Trial 2: 12 / min	
	Trial 3: 15 / min	
	Average Rate at Rest: 13 / min	

Ask groups to conduct the following analyses of their data:

- What was the average respiratory rate at rest for your whole group?
- What was the average respiratory rate after exercise?
- What was each individual's change in respiratory rate from rest to post-exercise? Find different ways to express this change in rate. Create graphs or charts that show the change in respiratory rate for each individual from rest to post-exercise.
- What was the average change in breathing rate for the group?
- What are some observations your group makes of the data? For example, did anything surprise you? Identify a research question you could pose regarding respiratory rate. For example, which of the following factors do you think might affect breathing rate: age, gender, and/or level of fitness? Why do you think they might affect breathing? What kind of research or experiments would you conduct to answer or test your theories?

Case Study: Obesity and Asthma

Have students read the following scenario and work in pairs to complete the problems.

You have been working to treat Marc, a 25-year-old man who has been suffering from asthma since he was a child. Recently, his asthma has become worse and he has been hospitalized for severe asthma attacks. ***Asthma*** *is a chronic disease in which the airways of the lungs become inflamed and swollen. Asthmatics are sensitive to "triggers," such as smoke or dust, which cause their airways to narrow, and lead to such symptoms as coughing, wheezing, chest tightness, and shortness of breath. Marc is clinically* ***obese****, and some studies suggest that there is a connection between obesity and asthma. Marc's physician has recommended that he lose weight, which he hopes will improve Marc's asthma symptoms, and lessen his medication needs, hospitalizations, and promote better lung function.*

1. Marc has gone on extreme diets in the past and lost a lot of weight very quickly. The doctor would like him to lose weight at a healthy rate—approximately 1 to 2 pounds per week. About how long will it take Marc to lose 20 pounds?
    - **Answer:** 10 to 20 weeks
2. Marc weighed 240 pounds on June 1st. Eight weeks later, he weighed in at 228 pounds. Is he losing weight at the rate suggested by his doctor? At this rate, approximately how much weight would he lose in a year?
    - **Answer:** He is losing approximately 1.5 pounds per week, which is within the healthy range suggested by his doctor. If he continues to lose at this rate, he would lose 78 pounds in a year.
3. Body Mass Index (BMI) is number calculated from a person's weight and height, that can be used to classify obesity.

    The standard weight status categories associated with BMI ranges for adults are shown in the following table:

BMI	**Weight Status**
Below 18.5	Underweight
18.5–24.9	Normal

25.0–29.9	Overweight
30.0 and Above	Obese

The formula for calculating BMI is:
(Weight in pounds / (Height in inches x Height in inches)) x 703

a. Marc is 6 feet tall. At his starting weight of 240 pounds, what is his BMI? (Use an online BMI calculator to check your results.)

- **Answer:** 32.5

b. What weight would Marc need to attain in order to get his BMI under 30?

- **Answer:** 220 lbs. (his BMI would be 29.8)

4. If Marc successfully follows the weight loss rate suggested by his physician (1-2 pounds per week), how long will it take Marc to get his BMI under 30?

   - **Answer:** 10 to 20 weeks

5. In addition to weight and BMI, many doctors suggest that body fat percentage is a significant indicator of health. While a certain amount of fat is essential to bodily functions (protects organs, stores energy and regulates body temperature), too much fat storage is dangerous. Body fat percentage is the proportion of your total weight that is fat, as opposed to lean body mass (bone, muscle, organ tissue, blood and everything else). If you are 150 pounds and 10% fat, your body consists of 15 pounds fat and 135 pounds of lean body mass (bone, muscle, organ tissue, blood and everything else).

   a. At 240 pounds, Marc is 32% fat. Express his body composition as a ratio of body fat to lean body mass.

   - **Answer:** 76.8 : 163.2 (76.8 pounds of fat to 163.2 pounds of lean body mass)

   b. If Marc lost 20 pounds of fat and maintained the same amount of lean body mass that he currently has, what would his body fat percentage be (at his new weight of 220 pounds)?

   - **Answer:** 25.8% body fat

6. Waist-to-hip ratio (WHR) is another indicator a person's health, with research showing that people with "apple-shaped" bodies (with more weight around the waist) face more health risks than those with "pear-shaped" bodies, who carry more weight around their hips.

   So a person with a 30-inch waist and 40 inch hips would have a WHR of 30 / 40 = 0.75. The World Health Organization (WHO) states that a waist-hip ratio above 0.95 for males and above 0.80 for females is an indicator of obesity.

   Marc has a 38 inch waist and 39 inch hips. Calculate his WHR.

   - **Answer:** 0.97

7. Create a six-month plan for Marc, with weekly goals for weight loss, body fat and/or inches reduction.

Contextualized test items

1. The average resting respiratory rate for a newborn baby (birth to 6 weeks) is 30-60 breaths per minute. Respiratory rates higher than that could signify a health problem. You counted the breaths for four different babies, for different lengths of time. (For example, for one baby you counted breaths for 20 seconds, for another you counted breaths for 30 seconds.)

Baby	Number of Breaths	Time Counted
Alma	15	10 seconds
Bea	20	30 seconds
Cameron	30	20 seconds
Damion	15	30 seconds

Which of the babies have a respiratory rate that falls outside the range of a healthy baby?

A. Only Cameron
B. **Alma and Cameron**
C. None of them
D. Cameron and Bea

2. A person with a 30-inch waist and 40-inch hips would have a waist-to-hip (WHY) ratio of 30/40, which equals 0.75. The World Health Organization (WHO) states that a waist-hip ratio above 0.95 for males and above 0.80 for females is an indicator of obesity. Which of the following females has the highest WHR, and thus faces the greatest health risk?

A. 28 inch waist, 36 inch hips
B. **32 inch waist, 39 inch hips**
(0.82 WHR)
C. 32 inch waist, 41 inch hips
D. 30 inch waist, 43 inch hips

3. One of your patients was prescribed the following simple breathing exercise to help him slow down his breath and help him to relieve stress:

- inhale slowly for three seconds;
- hold the breath for four seconds; and
- exhale for three seconds.

a. If your patient follows this plan, what will his ratio of inhale time to exhale time be?

- **Answer:** 1:1

b. How many breaths will he take in one minute if he follows this plan (count one cycle as the time it takes to inhale, hold and exhale)?

- **Answer:** 6 breaths

Contextualized project

Have students conduct research on a respiratory condition, such as asthma, and how it affects normal breathing functions, including respiratory rate, tidal volume and total lung capacity. Have students work in teams to create graphs comparing lung function of average healthy adults to lung function of asthmatics.

Additional or extension activities, multimedia, readings and/or resources

Extension: Have students take their respiratory rate throughout the day and for different activities such as first thing waking up in the morning, after eating, after exercising, and before going to bed. Have students keep a chart and/or construct graphs to show how the respiratory rate is affected by different activities. Have students present their charts and graphs to the class and discuss similarities or differences in their findings.

Career Resources

- Respiratory Therapist, Science Buddies
- Be an RT, American Association for Respiratory Care
- Respiratory Therapist, ExploreHealthCareers
- Respiratory Therapy 2012-2013, Des Moines Area Community College
- Respiratory Therapy Skills Guide, Des Moines Area Community College
- Respiratory Therapists, U.S. Bureau of Labor Statistics

Videos on the Work of Respiratory Therapists

- Respiratory Therapist: On the Job, Science Buddies
- Be an RT: Get More Information, American Association for Respiratory Care

Medical Mathematics Resources

- Medical Abbreviations and Dosage Calculations
- Practical Math for Respiratory Care
- Khan Academy: Finding Unit Rates

Worksheets

- Ratios, Rates and Proportions, Delta College
- Ratios, Rates and Proportions, Lake Washington Institute of Technology

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Massachusetts Community Colleges and Workforce Development Transformation Agenda (MCCWDTA) is 100% funded by a $20 million grant from the U.S. Department of Labor, Employment & Training Administration TAACCCT. Grant Agreement #TC-22505-11-60-A-25.