

GRADE 12 PHYSICAL EDUCATION & HEALTH

First edition

5 units

10 lessons • one quarter

A video for every lesson

FIRST EDITION

COURSE GUIDE

This is the last of the School Launch physical education courses, and it is written for a young adult about to leave home. Its five strands are the same as every year: keeping active, water, food, strength, and the heart and lungs. But the questions change. Not “What should I do in PE?” but “How will I stay strong for the next sixty years, when no one schedules it for me?” Each lesson is built on a real person or study: Ralph Paffenbarger’s study of Harvard alumni, the Candidate Physical Ability Test that firefighters must pass, the Marines at Parris Island who learned to measure heat with a wet bulb and a black globe, John Leal’s chlorine at the Boonton Reservoir in 1908, Fannie Farmer’s level measuring cups, Walter Cannon’s balloon experiment on hunger, Boyd Epley and the first college strength coach, John Wooden teaching his players to put on their socks, Bill Bowerman bringing jogging home from New Zealand, and Johnny Kelley running the Boston Marathon sixty-one times.

Every lesson follows the same path: **the story**, then **how they figured it out**, then **how your body works** at a real high-school level (MET-minutes, heat balance, the hunger hormones, estimated strength from a set of reps, heart-rate reserve), and last, **try it**. The student writes and lives a week of adult activity, works a household version of a firefighter circuit, plans water for a workday and a hike, shops and cooks for himself or herself on a budget, hosts a thankful family meal, writes and begins a strength program, coaches a family member through a lift, and builds an aerobic plan with heart-rate zones. The capstone is a twelve-week personal fitness plan to carry past graduation.

God made the body good and gave it to us to care for, and a grown man or woman is strong in order to serve. This course is about stewardship, strength, joy in movement and good habits, never about size or looks; students are measured only against their own effort and improvement. *Fabricando fit faber*: by making, one becomes a maker,

and by training, one becomes strong. The quarter ends with a family fitness day that the student plans and leads.

Videos come from public-health and professional sources chosen lesson by lesson: the JAMA Network and the American Heart Association, fire-service training academies, the California Department of Industrial Relations and Oregon OSHA, Scout Life, Next Gen Personal Finance and Consumer Reports, TED-Ed and Khan Academy, a university strength-and-conditioning lecturer, a physiotherapy teaching channel, NBC Sports, and Coach John Wooden himself. Every video was previewed for accuracy and modest dress. Some are made for adults in training (firefighter candidates, workers, coaching students), which suits a senior, and a few channels advertise their own paid courses in the description; nothing in this course requires buying anything. The lesson notes point out where a video uses a different formula or term than the lesson.

Start with Lesson 1.1 →

WHO IT IS FOR

Written for students in grade 12 (about ages 17–18) who read independently, handle basic algebra and percentages, and have done some strength and aerobic training in earlier grades. Lifting lessons use light free weights only with a knowledgeable adult present; every activity can also be done with household things such as water jugs, a backpack with books, a broom handle, a sturdy step, a wall, a kitchen and a timer. Nothing needs to be bought.

HOW TO USE THIS COURSE

1. **The weekly rhythm.** The quarter has 10 lessons, one a week, each with three sessions of 45–50 minutes. Session 1 is the warm-up, the video, the teaching and the picture study, with a little movement. Session 2 is the activity (the workout, the field test, the shopping trip or the meal) and the fitness journal. Session 3 repeats the activity and tries to improve on it. In the second week of each unit, use part of Session 3 for the unit review and the unit challenge. On the other days, keep moving: adults need at least 150 minutes a week of moderate activity, and teenagers still need about 60 minutes a day.

2. **Check with your doctor first.** A parent should know about every activity. If the student has asthma, a heart condition, diabetes, a recent injury or any other health concern, check with your doctor before starting, and follow the doctor's advice about what to change. A senior who has had a sports physical this year can share these plans with that doctor.
3. **Story, then science, then doing.** The core ideas are written for the student to read. The paragraphs marked *The story* and *How they figured it out* tell what happened; *How your body works* explains the science with worked numbers; *Try it* explains the activity. Ask the student to explain each worked example back to you, or to work a new one with his or her own numbers.
4. **Picture study.** Each lesson has one public-domain painting, print or historic photograph chosen for what it shows about work, service, water, food, rest or endurance. Look quietly for two minutes, put it away and tell what you remember, then work through the “look for” items and questions.
5. **The fitness journal.** Use one notebook for the quarter. Every activity is planned, done, recorded and done again: minutes, MET-minutes, reps and loads, effort ratings, heart rates, ounces of water, prices per serving. Date every page, write how it felt and what you will change. By the end, the journal holds the student's own training plans for life after school.
6. **Health, not looks.** We talk about what bodies can do and how to care for them, never about size or shape. Calories appear only as a unit of food energy. Foods are “nutrient-dense” foods and “treat” foods, never good or bad, and feasts are good gifts in their place. The one time a scale is used is the workday water check in Lesson 2.1, where the number recorded is fluid lost in sweat, not body weight. Grades come from effort, consistency and improvement, never from comparing one student with another.
7. **Lifting safety.** Strength lessons may use light free weights (dumbbells, a kettlebell) only with a knowledgeable adult present, a spotter for any pressing lift, technique first, and no one-repetition maximum testing. Strength is estimated from a set of 8–10 good reps instead. Every lift also has a household version.
8. **Optional books and gear.** Some units list a free government or Red Cross page, a book, or simple gear. They are never required.
9. **Unit review and unit challenge.** Each unit ends with a review worth 100 points, with worked calculations and short written answers, and a unit challenge: an

adult activity week, a water plan for a workday and a hike, a week of meals cooked on a budget, a strength program carried out and coached, and the twelve-week personal plan.

10. **Safety.** Read the safety note before each activity. Warm up first and cool down after. Stop and tell an adult right away at chest pain, dizziness, fainting, trouble breathing or sharp pain; tired muscles are normal, but joint pain is not. Outdoors, go with a buddy, stay clear of traffic, carry water, and avoid the hottest part of the day. A parent knows about stove and knife work, and food allergies are checked before any meal is shared. Exercise and food are never used as a reward or a punishment.
11. **The family fitness day.** In the last week the student plans and leads a family fitness day: a warm-up, a station from every unit, a cooked meal, a water table and a family walk-run, with everyone moving at his or her own pace.

SCOPE AND SEQUENCE

UNIT 1 • WEEKS 1-2

Keeping Active

The adult Physical Activity Guidelines and Ralph Paffenbarger's Harvard alumni study, with a week of adult activity measured in MET-minutes; and the fitness tests of firefighters, lifeguards and nurses, with a household service-fitness circuit.

- 1.1 Fitness for Life after School
- 1.2 Fit to Serve

UNIT 2 • WEEKS 3-4

Hydration

Water, work and heat: the wet-bulb globe temperature from Parris Island, the Water. Rest. Shade. rule and a workday sweat check; and safe water outdoors, from John Leal's chlorine in 1908 to boiling, filtering and disinfecting on a hike or mission trip.

- 2.1 Water, Work and Heat
- 2.2 Safe Water Outdoors

UNIT 3 • WEEKS 5–6

Nutrition

Shopping, budgeting and cooking for yourself, from Fannie Farmer’s level measurements to unit prices and cost per serving; and thankfulness and self-control at the table, with Cannon and Washburn’s hunger experiment and a family meal the student hosts.

3.1 Shopping, Budgeting and Cooking for Yourself

3.2 Thankfulness and Self-Control at the Table

UNIT 5 • WEEKS 9–10

Aerobic Training

Design your own aerobic plan: Bill Bowerman’s jogging and the hard-easy week, heart-rate reserve and training zones; and the capstone, a twelve-week personal fitness plan inspired by Johnny Kelley’s sixty-one Boston Marathons, and the family fitness day.

5.1 Design Your Own Aerobic Plan

5.2 Capstone: A Twelve-Week Personal Fitness Plan and the Family Fitness Day

UNIT 4 • WEEKS 7–8

Strength

Design your own strength program: Boyd Epley, sets, reps, rest, reps in reserve and estimated strength without maximum lifts; and coach someone else, with John Wooden’s socks and the science of good coaching cues.

4.1 Design Your Own Strength Program

4.2 Coach Someone Else

WEEKLY PACING CALENDAR

WEEK	PLAN
1	• Session 1: Lesson 1.1 Fitness for Life after School: warm-up, video, teaching and picture study • Session 2: Lesson 1.1 activity and fitness journal • Session 3: Repeat the activity, try to improve, and log it <i>Three short sessions a week is the usual rhythm: one to learn, two to move. Keep moving every day, even on days with no lesson.</i>

WEEK	PLAN
2	• Session 1: Lesson 1.2 Fit to Serve: warm-up, video, teaching and picture study • Session 2: Lesson 1.2 activity and fitness journal • Session 3: Repeat the activity, try to improve, and log it • Session 3 (end of unit): Unit 1 review and unit challenge
3	• Session 1: Lesson 2.1 Water, Work and Heat: warm-up, video, teaching and picture study • Session 2: Lesson 2.1 activity and fitness journal • Session 3: Repeat the activity, try to improve, and log it
4	• Session 1: Lesson 2.2 Safe Water Outdoors: warm-up, video, teaching and picture study • Session 2: Lesson 2.2 activity and fitness journal • Session 3: Repeat the activity, try to improve, and log it • Session 3 (end of unit): Unit 2 review and unit challenge
5	• Session 1: Lesson 3.1 Shopping, Budgeting and Cooking for Yourself: warm-up, video, teaching and picture study • Session 2: Lesson 3.1 activity and fitness journal • Session 3: Repeat the activity, try to improve, and log it
6	• Session 1: Lesson 3.2 Thankfulness and Self-Control at the Table: warm-up, video, teaching and picture study • Session 2: Lesson 3.2 activity and fitness journal • Session 3: Repeat the activity, try to improve, and log it • Session 3 (end of unit): Unit 3 review and unit challenge
7	• Session 1: Lesson 4.1 Design Your Own Strength Program: warm-up, video, teaching and picture study • Session 2: Lesson 4.1 activity and fitness journal • Session 3: Repeat the activity, try to improve, and log it
8	• Session 1: Lesson 4.2 Coach Someone Else: warm-up, video, teaching and picture study • Session 2: Lesson 4.2 activity and fitness journal • Session 3: Repeat the activity, try to improve, and log it • Session 3 (end of unit): Unit 4 review and unit challenge
9	• Session 1: Lesson 5.1 Design Your Own Aerobic Plan: warm-up, video, teaching and picture study • Session 2: Lesson 5.1 activity and fitness journal

WEEK	PLAN
	Session 3: Repeat the activity, try to improve, and log it
10	- Session 1: Lesson 5.2 Capstone: A Twelve-Week Personal Fitness Plan and the Family Fitness Day: warm-up, video, teaching and picture study - Session 2: Lesson 5.2 activity and fitness journal - Session 3: Repeat the activity, try to improve, and log it - Session 3 (end of unit): Unit 5 review and unit challenge <i>Last week. Hold a family fitness day: the student leads the family through a warm-up, a favorite activity from each unit and a cool-down, serves a healthy snack and water, and shows the fitness journal.</i>

MATERIALS

Fitness journal (any notebook)

For the whole quarter: activity logs, MET-minute tables, strength logs, heart-rate tables, water plans, budgets and the twelve-week plan.

A timer or stopwatch (a phone timer works)

For circuits, rest periods, heart-rate counts and timed runs.

Good athletic shoes and comfortable, modest clothes for exercise

Every activity lesson.

Household loads: two or three gallon water jugs, a backpack with books, a sturdy step, a broom handle, an old sheet or tarp

For the service circuit, strength work and coaching practice. Light dumbbells or a kettlebell may be used with a knowledgeable adult present.

A bathroom scale and a measuring cup

Only for the workday water check in Lesson 2.1, which measures fluid lost in sweat.

A pot with a lid, clean bottles, a clean cloth and unscented household bleach

For the water-treatment practice in Lesson 2.2, with a parent supervising the stove and the bleach.

A grocery budget, store receipts or online prices, a kitchen and basic cookware

For the shopping and cooking lessons in Unit 3.

A calculator and graph paper

For MET-minutes, unit prices, estimated strength, heart-rate reserve and training graphs.

GRADING

Grades come mostly from the activities and the fitness journal, because fitness and self-care are learned by planning, doing, recording and doing again. A student who works faithfully, records honestly, keeps good form and improves on his or her own numbers earns full credit, whatever those numbers are.

PART	%
Activities (effort, participation, good form and safety)	40
Fitness journal (dated logs, plans, calculations and reflections)	25
Unit reviews	15
Unit challenges	20

Scale: A 90–100, B 80–89, C 70–79, D 60–69. Below 60: repeat the activity or review with help.

- Fitness marks reward effort, consistency and improvement against the student's own earlier numbers. They never depend on body size, body measurements or comparison with other students.
- A journal page earns full marks when it has a date, the numbers with units (minutes, MET-minutes, reps and loads, beats per minute, ounces, dollars), the calculation shown, a sentence about how it felt and a sentence about what to change next time.
- Unit reviews include two or three worked calculations and one or two short written answers. They may be done orally for a student who writes slowly.
- A student with a health condition that limits some activities is graded on faithful effort within what the doctor allows. Every body can grow stronger; the goal is faithfulness, not being the best.

A NOTE TO PARENTS

This course is meant to hand your senior the tools to care for his or her own body without you. Let the student plan, shop, cook, time, coach and lead; your job is to supervise the risky parts (the stove, the bleach, any free weights), to be the training partner and the first person coached, and to ask good questions. Do the workouts alongside when you can.

Keep the talk about bodies on what they can do and how to care for them, and keep food talk on gratitude, skill and good stewardship, not rules and fear. Scripture says plainly that bodily exercise has some value and godliness has more (1 Timothy 4:8). We move, eat, drink and rest to the glory of God, and we grow strong in order to serve others.

A few stories touch hard things, told plainly and briefly for a high-school reader: heat illness among Marine recruits at Parris Island in the 1950s, waterborne disease in American cities before chlorination, and the heavy and sometimes dangerous work of firefighters and nurses. The Fit to Serve lesson describes occupational fitness tests as facts; it is not a recruiting lesson.

UNIT 1

KEEPING ACTIVE

For twelve years someone else has scheduled your activity: recess, PE, practice, a parent saying “Go outside.” Soon that will end. Work, college and family will fill the calendar, and for most adults the only activity they get is the activity they choose. In this unit you will learn what the evidence says adults need, starting with Ralph Paffenbarger, a doctor who followed the habits and health of nearly seventeen thousand Harvard graduates and then took up running himself at forty-five. You will measure activity the way scientists do, in METs and MET-minutes, and you will plan and live a full week of adult activity.

Then you will look at strength used for others. Firefighters, lifeguards, nurses and soldiers must be fit because other people’s lives may depend on it, and their jobs set plain, measurable tests. You will learn what those tests ask and why, and you will build and complete a household service-fitness circuit, timed and repeated to improve. Whether or not you ever wear a uniform, a strong body is a tool for serving your family, your church and your neighbors.

PREREQUISITES

- Knows how to warm up, cool down and find a pulse (earlier grades)
- Knows the youth guideline of at least 60 minutes of activity a day
- Can multiply, add up a weekly table and compute a percent

MASTERY CHECKLIST

- ☐ I can state the adult Physical Activity Guidelines for aerobic and muscle-strengthening activity.
- ☐ I can tell what Ralph Paffenbarger’s Harvard alumni study found and how it was done.
- ☐ I can classify activities as light, moderate or vigorous using METs and the talk test, and compute MET-minutes for a week.
- ☐ I can describe the events of a firefighter’s physical ability test and a lifeguard’s entry test and explain why jobs test fitness.
- ☐ I can complete a timed service-fitness circuit safely and improve on my own time.

OPTIONAL BOOKS AND GEAR FOR THIS UNIT

- **Physical Activity Guidelines for Americans, 2nd edition (U.S. Department of Health and Human Services, 2018)**: Free PDF. Chapter 4 (adults) and Chapter 3 (youth) are the source for Lesson 1.1. Plain, readable and full of examples.
- **Lifeguarding classes (American Red Cross)**: Free information page listing the swim, tread and timed-retrieval skills a candidate must pass before a lifeguard course. For Lesson 1.2; a real summer job for many 16–18-year-olds.
- **A metronome app or a simple online metronome**: Optional, to keep a steady 60-beats-per-minute step rhythm in the service circuit. Counting aloud works too.

Not required. Every activity in this unit works without them. School Launch has no ties to these authors, publishers or companies.

LESSONS IN THIS UNIT

1.1 Fitness for Life after School

3 sessions of 45–50 minutes

1.2 Fit to Serve

3 sessions of 45–50 minutes

UNIT 1 REVIEW

Answer each question. Show your work for the calculations. The review is worth 100 points.

1. 10 pts

State the adult Physical Activity Guidelines (2018) for aerobic activity and for muscle-strengthening activity. How do they differ from the youth guideline?

2. 10 pts

Describe Ralph Paffenbarger's 1986 Harvard alumni study: who was studied, for how long, what was measured and what was found.

3. 10 pts

Calculation. A student's week: 4 brisk walks of 30 minutes (4 METs), 2 runs of 25 minutes (10 METs) and 1 hour of raking (4 METs). Find (a) moderate-equivalent minutes and (b) MET-minutes. Does the week meet the adult aerobic guideline?

4. **10 pts**

Explain the talk test and give one example each of a light, a moderate and a vigorous activity with approximate METs.

5. **10 pts**

Calculation. A man spends 2,000 calories a week in exercise. If brisk walking uses about 100 calories per mile for him, how many miles a week is that? How many minutes at 3.5 miles per hour?

6. **10 pts**

Name the eight events of the CPAT in order. What is the time limit, and what does the 50-pound vest represent?

7. **10 pts**

What are the three American Red Cross lifeguard entry skills, and why does each make sense for the job?

8. **10 pts**

Calculation. A student's service circuit took 9:40 on the first try and 8:58 on the retest. What was the improvement in seconds and in percent?

9. **10 pts**

Why do hospitals use mechanical lifts and team lifts? Use the 35-pound figure in your answer.

10. **10 pts**

Short answer (4–6 sentences). After graduation no one will schedule your activity. Describe your plan to meet the adult guidelines, naming at least three built-in habits, and explain how 1 Timothy 4:8 shapes the way you think about it.

ANSWER KEY

1. Adults: 150–300 minutes a week of moderate activity, or 75–150 minutes of vigorous, or an equivalent mix, plus muscle strengthening for all major muscle groups on 2 or more days; more than 300 minutes gives added benefit. Youth (6–17): at least 60 minutes every day, mostly moderate to vigorous, with vigorous, muscle- and bone-strengthening activity on at least 3 days a week.
2. 16,936 Harvard alumni aged 35–74, followed 1962–1978. Walking, stair climbing and sport were turned into weekly energy spent. Death rates fell as activity rose to about 3,500 calories a week; men spending 2,000 or more calories a week in exercise had death rates one quarter to one third lower, even allowing for smoking, blood pressure and family history.
3. (a) Moderate minutes: $120 + 60 = 180$; vigorous 50 counts as 100; total 280 moderate-equivalent minutes. (b) MET-minutes: $4 \times 120 + 10 \times 50 + 4 \times 60 = 480 + 500 + 240 = 1,220$. Yes, it meets and exceeds the guideline.
4. Moderate: you can talk but not sing; vigorous: only a few words before pausing for breath; light: you could sing. Examples: slow stroll about 2.5 METs (light), brisk walk about 4 METs (moderate), running at 6 mph about 10 METs (vigorous).
5. $2,000 \div 100 = 20$ miles. $20 \div 3.5 \approx 5.7$ hours ≈ 343 minutes a week, about 49 minutes a day.
6. Stair climb, hose drag, equipment carry, ladder raise and extension, forcible entry, search, rescue, ceiling breach and pull. 10 minutes 20 seconds. The vest stands for the weight of breathing apparatus and protective gear.
7. A 300-yard continuous swim (endurance to reach a victim), a 2-minute legs-only tread (staying up with hands free for the victim), and a timed retrieval: swim 20 yards, dive 7–10 feet for a 10-pound object, swim back 20 yards within 1:40 (copying a real rescue from the bottom).
8. $9:40 = 580$ s; $8:58 = 538$ s. Improvement 42 s. $42 \div 580 \times 100 \approx 7.2\%$.
9. Thomas Waters of NIOSH calculated in 2007 that even in ideal conditions one person should lift no more than about 35 pounds of a patient by hand; most patients weigh far more and may move suddenly, so lifts and teamwork protect both nurse and patient from injury.
10. Answers vary. Full credit for: specific weekly minutes meeting 150 moderate-equivalent and 2 strength days; at least three built-in habits (walking or cycling to work or class, stairs, a regular partner or league, chores done briskly); and a

sentence explaining that exercise has real but limited value and godliness has more, so fitness is stewardship, not an idol.

UNIT CHALLENGE: TWO WEEKS OF ADULT ACTIVITY AND A PLAN FOR NEXT YEAR

Live two full weeks that meet the adult Physical Activity Guidelines and your own youth target, and log them. Include your intensity-test table, both weekly logs with minutes, MET-minutes and strength days, and a graph of daily active minutes. Add your two service-circuit results with splits. Finish with a one-page plan for staying active in the first year after graduation: where your activity will come from, who will train with you, and what you will do when the schedule gets crowded.

LOOK FOR	WHAT IT MEANS
Complete logs	Fourteen dated days with every bout recorded in minutes, METs and MET-minutes, and weekly totals worked out correctly.
Meets the guidelines	Each week reaches at least 150 moderate-equivalent minutes and two muscle-strengthening days, or the student explains honestly what got in the way and how the second week changed.
Service circuit	Both circuit attempts recorded with splits, effort and a planned change; good form and safe loads.
Plan for next year	A realistic, specific plan with at least three built-in habits and a backup for busy weeks.
Reflection	A thoughtful paragraph on stewardship and service. Effort and honesty count, not the size of the numbers.

1.1 FITNESS FOR LIFE AFTER SCHOOL

OBJECTIVES

- State the adult guidelines: 150–300 minutes of moderate or 75–150 minutes of vigorous aerobic activity a week, plus muscle strengthening on 2 or more days.
- Tell how Ralph Paffenbarger studied Harvard alumni and what he found about activity and length of life.
- Use METs, the talk test and heart rate to classify activities, and compute weekly MET-minutes.
- Plan and log a week of adult activity, and write habits that will last after graduation.

Warm-up. Walk briskly around the house or yard for 3 minutes, then do 10 squats, 10 arm circles each way, 10 walking lunges and 30 seconds of easy jogging in place. Think about it: write down every bit of activity your parents got yesterday. How much of it did they choose, and how much came with their work?

WATCH

How Much Exercise Should You Get Each Week (According to the Research)?

JAMA Network · 3:24

https://www.youtube.com/watch?v=G2HU4NJ_M3c

WHEN TO WATCH

After the “How your body works” paragraph. Write down the adult targets as you watch.

Note: From the *Journal of the American Medical Association*, made when the 2018 guidelines were published. It counts minutes of walking to work, yard work, stair climbing and cycling toward the weekly goal.

BACKUP VIDEO

Physical Activity Guidelines

American Heart Association · 2:07

<https://www.youtube.com/watch?v=bLgEKIYmBOg>

Any time in Session 1.

KEY TERMS

MET (metabolic equivalent)

A unit comparing the energy an activity uses with the energy used sitting quietly. Sitting is 1 MET; an activity of 4 METs uses about four times as much.

vigorous-intensity activity

Activity of 6 METs or more, such as running or a hard game of basketball. You can say only a few words without pausing for breath.

sedentary behavior

Time spent sitting or lying while awake, using about 1.5 METs or less.

moderate-intensity activity

Activity of about 3 to 5.9 METs, such as brisk walking or raking leaves. You can talk but not sing.

MET-minutes

METs $\times$ minutes. The adult aerobic guideline of 150–300 moderate minutes equals roughly 500–1,000 MET-minutes a week.

epidemiology

The study of health and disease in large groups of people, often by following them for many years.

CORE IDEAS

The story. In 1960 Ralph Paffenbarger, an American physician and epidemiologist, began one of the most patient studies in the history of exercise science. He tracked down tens of thousands of men who had entered Harvard and the University of Pennsylvania between 1916 and 1950, using their old college health records and new questionnaires about how they lived as grown men: how many blocks they walked each day, how many flights of stairs they climbed, what sports they played. Then he waited, and counted. In 1967, at forty-five, he took up running himself. He kept at it for decades, finishing more than 150 marathons and ultramarathons, and in 1996 he and the British scientist Jerry Morris shared the first Olympic Prize for sport science.

How they figured it out. In 1986 Paffenbarger and his colleagues published their best-known report in the *New England Journal of Medicine*. It followed 16,936 Harvard alumni, aged 35 to 74, from 1962 to 1978; 1,413 of them died during those years. The researchers turned each man's walking, stair climbing and sport into a weekly total of energy spent, in calories (here simply a unit of energy). Death rates fell steadily as weekly activity rose from under 500 to about 3,500 calories a week. Men who spent

2,000 or more calories a week in exercise, roughly the energy of 20 miles of brisk walking, had death rates one quarter to one third lower than less active men, and the difference held even after allowing for smoking, high blood pressure and family history. His alumni studies also showed something hopeful: men who had not played sports in college but became active later did better than college athletes who stopped moving. What mattered was what they did now.

How your body works. Scientists measure effort in **METs**. Sitting quietly is 1 MET; a slow walk about 2.5; a brisk walk at 3.5 miles per hour about 4; raking leaves about 4; climbing stairs about 8; running at 6 miles per hour about 10. The 2018 *Physical Activity Guidelines for Americans* ask adults for **150 to 300 minutes a week of moderate activity**, or **75 to 150 minutes of vigorous activity**, or a mix (one vigorous minute counts about the same as two moderate minutes), plus **muscle-strengthening activity for all major muscle groups on 2 or more days**. More than 300 minutes brings still more benefit. Teenagers, as you know, need about 60 minutes every day, with vigorous activity and bone- and muscle-strengthening on at least 3 days. Worked example: a week of 3 brisk 40-minute walks (4 METs) and 2 runs of 20 minutes (10 METs) gives 120 moderate minutes plus 40 vigorous minutes, which count as 80, for **200 moderate-equivalent minutes**. In MET-minutes: $4 \times 120 + 10 \times 40 = 480 + 400 = 880$ **MET-minutes**, well inside the 500–1,000 target. Regular activity strengthens the heart, lowers blood pressure, helps the body handle blood sugar, builds bone, improves sleep and mood, and lowers the risk of several diseases.

Think it through. The guidelines say plainly that some activity is better than none, and that the activity can come in any length of bout. That matters after school, when there is no coach. Habits that last are usually built into the day: walking or cycling to work or class, taking the stairs, a standing appointment with a friend for a run, a church or community sports league, a family walk after supper. Scripture puts exercise in its place: “For bodily exercise profiteth little: but godliness is profitable unto all things” (1 Timothy 4:8). Exercise has some value, real value for a lifetime of service, and godliness has more. Train the body as a steward, not as an idol.

Try it. In Session 2 you will test the intensity of four ordinary activities with the talk test and your heart rate and estimate their METs. In Session 3 you will plan a full week that meets the adult guidelines, begin living it, and log every bout in minutes and MET-minutes.

PICTURE STUDY



The Morning Bell, Winslow Homer, c. 1871 • Oil on canvas • Yale University Art Gallery, New Haven, Connecticut

Image: [Wikimedia Commons](#), public domain

Winslow Homer painted ordinary Americans at work and play. Here mill workers in New England walk to work at the sound of the morning bell. In the 1870s nearly every adult's day included long walks, stairs, lifting and carrying; activity was simply part of earning a living.

Look closely

- Follow the footbridge from the path to the mill. How far might these workers walk each morning and evening?
- Look at what the young woman carries. How would carrying it every day count toward strength?
- Look at the narrow footbridge. Why does crossing it take a little balance?
- Find the bell on the mill roof and the women waiting at the end of the path. What does the painting suggest about the pace of the morning?

Talk about it

1. If these workers walked 2 miles each way every day, about how many moderate minutes a week would that give them?
2. Today most adults drive to work and sit at desks. How must an adult's plan for activity be different from these workers'?

3. What part of your own future day could include walking, as theirs did?

Safety first. If you have asthma, a heart condition, diabetes, a recent injury or any other health concern, check with your doctor before starting this course, and a parent should know about every activity. Warm up before vigorous bouts and cool down after. Stop and tell an adult right away at chest pain, dizziness, fainting, trouble breathing or sharp pain; walk or jog outdoors with a buddy, away from traffic, in daylight or with reflective clothing.

ACTIVITY

My Adult Activity Week

You will measure how hard ordinary activities really are, then plan and live a week that meets the adult guidelines, the way you will need to plan your own weeks after graduation.

You will need

- A timer and a watch or phone to take your pulse
- A safe walking route, a staircase, a rake or broom, and running shoes
- Your fitness journal and a calculator

Steps

1. **Resting heart rate (Session 2).** Sit quietly for 3 minutes, then count your pulse at the wrist for 30 seconds and double it. Record it in beats per minute (bpm).
2. **Intensity test.** Do each of these for 8 minutes, with 3 minutes of easy walking between: (1) a slow stroll, (2) a brisk walk as if you were late, (3) yard work or vigorous sweeping, (4) stair climbing at a steady pace or an easy jog. In the last minute of each, try to talk in full sentences and then to sing a line of a hymn. Right after, count your pulse for 15 seconds and multiply by 4.
3. **Classify and estimate.** For each activity record the talk-test result (sing / talk / a few words), your heart rate and the approximate METs (stroll 2.5, brisk walk 4, yard work 4, stairs 8, easy jog 7–10). Mark each light (under 3 METs), moderate (3–5.9) or vigorous (6 or more).
4. **Plan the week (Session 3).** Make a 7-day table. Plan at least 150 moderate-equivalent minutes, with at least two vigorous sessions, plus two muscle-strengthening sessions (for example 2 sets of 10–15 squats, push-ups, lunges, rows with a backpack and a 30-second plank). Then add your youth target: aim for about 60 minutes of total activity each day. Leave Sunday for rest and worship, with an easy walk if you like.
5. **Build it into your day.** For each day, write when and where each bout will happen and what could get in the way. Include at least two “built-in” bouts

(walking or cycling for an errand, stairs instead of an elevator, a chore done briskly).

6. **Live and log it.** Each day record every bout: activity, minutes, METs, MET-minutes (METs × minutes) and the talk-test result. Total the week in moderate-equivalent minutes (vigorous minutes count double) and MET-minutes.
7. **Check the numbers.** Did you reach 150 moderate-equivalent minutes and 500 MET-minutes? Two strength days? An average of 60 active minutes a day?
8. **Improve.** Write what made it easy or hard, and change one thing in next week's plan: a time of day, a partner, a different route, a built-in bout.

Tips

- A step counter or phone can help, but minutes and the talk test are what the guidelines use.
- Short bouts count. Three 10-minute brisk walks add up to the same 30 minutes as one long walk.
- Your heart rate at a given activity will not match a friend's. Compare only with yourself.

Check your work

- ☐ I can classify an activity as light, moderate or vigorous with METs and the talk test.
- ☐ I planned and logged a week that meets the adult guidelines, with the totals worked out.
- ☐ I changed one thing in my plan to make the habit easier to keep.

FITNESS JOURNAL

1. Copy your intensity-test table: activity, heart rate, talk test, METs and intensity class.
2. Fill in your 7-day plan and log, with daily and weekly totals in minutes and MET-minutes, and a bar graph of active minutes per day.
3. Write a paragraph: "Where my activity will come from after graduation," naming at least three built-in habits.
4. Summarize Paffenbarger's study in five sentences: who, how long, what was measured, what was found, and what it means for you.

From history. Paffenbarger's colleague in that 1996 prize, Jerry Morris, had shown in 1953 that London bus conductors, who climbed the stairs of double-decker buses all day, had fewer heart attacks than the drivers who sat. Morris and Paffenbarger, working an ocean apart, are often called the founders of the science of physical activity and health.

COMMON MISTAKES

- Thinking only formal workouts count. Brisk walking, stairs, yard work and active jobs all count toward the guidelines.
- Forgetting muscle strengthening. The adult guideline asks for both aerobic activity and strength work on 2 or more days.
- Doubling the wrong minutes. Only vigorous minutes count double toward the moderate-minute goal.
- Treating exercise as a way to earn food or to punish yourself. It is care for the body God gave you, and rest is part of the plan.

Make it a game • Adult Week Audit. Total your week's activity in minutes and MET-minutes and compare it with 150 to 300 moderate or 75 to 150 vigorous minutes, plus two days of strength. Your parent challenges any gap. Tell Paffenbarger's Harvard alumni study. Plan next week to hit every target. Beat your audit score with one extra strength day.

Scripture. “For bodily exercise profiteth little: but godliness is profitable unto all things, having promise of the life that now is, and of that which is to come.” (1 Timothy 4:8, KJV)

Exercise has some value, and the evidence shows how real that value is for a long life of service. Godliness has more, because it reaches into the life to come. Keep both in their places.

1.2 FIT TO SERVE

OBJECTIVES

- Describe the fitness tests used for firefighters, lifeguards and soldiers, and the lifting demands of nursing.
- Explain why some jobs set fitness standards and how a job-related test is designed.
- Complete a timed household service-fitness circuit with good form, and retest to improve.
- Connect strength and endurance with serving others.

Warm-up. March in place for 1 minute, then do 10 squats, 10 push-ups at your level, 10 hip hinges with your hands on your hips, 5 inchworms and 30 seconds of quick feet. Think about it: if a neighbor fell and could not get up, or a fire broke out upstairs, what would you need your body to be able to do?

WATCH

CPAT Orientation

Becoming A Firefighter • 13:39

<https://www.youtube.com/watch?v=wh3EoE1yJnQ>

WHEN TO WATCH

After the story paragraph. List the eight events and the time limit as you watch.

Note: An orientation film for firefighter candidates, showing each of the eight CPAT events, the rules and the pass/fail time of 10 minutes 20 seconds. Candidates wear weighted vests and helmets; no fires or emergencies are shown.

BACKUP VIDEO

Alabama Fire College CPAT: Candidate Physical Ability Test

Alabama Fire College • 3:46

<https://www.youtube.com/watch?v=0tCADhIF-zE>

A shorter look at the same eight events.

KEY TERMS

occupational fitness test

A test of the physical abilities a particular job requires, often made of tasks that copy the real work.

job-task analysis

The careful study of what workers actually do, used to design a fair test that matches the job.

safe patient handling

Using lifts, slides and teamwork so nurses and aides can move patients without injuring the patient or themselves.

CPAT (Candidate Physical Ability Test)

A pass/fail test of eight firefighting tasks done in order while wearing a weighted vest, within 10 minutes 20 seconds.

muscular endurance

The ability of muscles to keep working against a load many times or for a long time without tiring.

CORE IDEAS

The story. In the 1990s the International Association of Fire Fighters and the International Association of Fire Chiefs joined to build a fair test for new firefighters. They studied what firefighters actually do and turned the hardest common tasks into eight events, done one after another with no rest except a short walk between: a **stair climb** (three minutes at 60 steps per minute on a stepping machine), a **hose drag**, an **equipment carry**, a **ladder raise and extension**, **forcible entry** (striking a target with a sledgehammer), a **search** through a dark crawling maze, a **rescue** (dragging a 165-pound mannequin) and a **ceiling breach and pull**. Candidates wear a 50-pound vest to stand for their breathing gear and protective clothing, with 25 more pounds on the shoulders for the stair climb. The whole test must be finished in **10 minutes 20 seconds**. It is called the Candidate Physical Ability Test, or CPAT.

How they figured it out. A fair job test must measure what the job requires, no more and no less. Designers watched and timed real firefighting work, measured the weights of real gear, and set the test to copy those demands. Other jobs do the same. American Red Cross lifeguard candidates must swim 300 yards without stopping, tread water for 2 minutes using only their legs, and, within 1 minute 40 seconds,

swim 20 yards, dive 7 to 10 feet to bring up a 10-pound object and swim it back 20 yards, because that is what a rescue can demand. The U.S. Army's current fitness test, begun in 2025, has five events: a deadlift for three repetitions, hand-release push-ups, a sprint-drag-carry, a plank and a two-mile run. Nursing has no entrance test, but the work is heavy: in 2007 Thomas Waters of the National Institute for Occupational Safety and Health calculated that even in ideal conditions one person should lift no more than about 35 pounds of a patient by hand, which is why hospitals use mechanical lifts and teamwork.

How your body works. These tests use every part of fitness at once. The stair climb and the long swim depend on the heart and lungs (aerobic endurance). Dragging, carrying and lifting depend on strength and **muscular endurance** in the legs, hips, back and grip. Crawling and ladder work need core strength, balance and coordination. Because the events come back to back, the body must keep producing energy as fatigue builds, and good technique saves energy: a flat back and strong hips in a drag, short quick steps under a load, steady breathing on the stairs. Notice too that a heavy vest is a large load for a smaller person; tests are pass/fail against the job's demands, so training strength and endurance, not size, is what prepares someone to pass.

Think it through. Why should an ordinary person be fit enough to serve? Because life gives everyone moments to carry, lift, help and rescue: moving furniture for a widow, carrying a child up a mountain path, helping an elderly parent stand, shoveling a neighbor's walk, a long day of work on a mission trip. "For, brethren, ye have been called unto liberty; only use not liberty for an occasion to the flesh, but by love serve one another" (Galatians 5:13). Strength is a gift to be spent on others.

Try it. You will build a six-station household circuit modeled on the CPAT (not the real test), time it, and retest to improve. The loads are deliberately light; the goal is to learn how combined tasks feel and how pacing and form save energy.

PICTURE STUDY



The American Fireman: Prompt to the Rescue, Currier & Ives (drawn by Louis Maurer), 1858 · Hand-colored lithograph · Library of Congress, Washington, D.C.

Image: [Wikimedia Commons](#), public domain

Before paid fire departments, American cities were protected by volunteer fire companies. The New York printmakers Currier & Ives sold many popular prints honoring these volunteers. In this one, drawn by Louis Maurer, a fireman carries a woman out of a burning house.

Look closely

- Look at the fireman's legs and back. How is he positioned to carry the weight safely and keep moving?
- Look at his arms. Where is the weight held, close to his body or far from it?
- Find the flames and smoke. Why would a firefighter need endurance as well as strength in a place like this?
- Look at his boots and helmet. How would heavy gear change the work?

Talk about it

1. The CPAT rescue event asks candidates to drag a 165-pound mannequin. Why does the test use a drag instead of a carry like this one?
2. Which parts of fitness did this fireman need most: aerobic endurance, strength, muscular endurance or balance? Give reasons.

3. How could you train now so you would be useful in an emergency?

Safety first. Warm up first and use only the light loads listed. Lift and drag with a flat back, bending at the hips and knees, and keep loads close to your body; set loads down if your back rounds. Stair stepping must be on a sturdy bottom step with a handrail, the crawl course clear of sharp corners, and the drag lane on grass or a smooth floor with nothing to trip over. Stop at chest pain, dizziness or sharp pain.

ACTIVITY

The Household Service Circuit

You will turn the idea of the CPAT into a safe home circuit: six stations done in order with a short walk between, timed. Then you will rest, study your splits, and retest in Session 3 to see what pacing and technique can do.

You will need

- A backpack with 10–15 pounds of books
- Two or three gallon jugs of water (about 8.3 pounds each) and an old sheet, tarp or sled
- A duffel bag or laundry bag packed with towels and a jug to about 20–25 pounds
- A bottom stair or sturdy step, a table or chairs for a crawl course, a broom handle
- A tape measure or 20 paces, a stopwatch and a helper to time and record

Steps

1. **Set up.** Mark a 50-foot lane on grass or a smooth floor. Plan the stations so you walk about 20 feet between them; the walk is your only rest.
2. **Station 1: Stair climb (3 minutes).** Wearing the backpack, step up and down on the bottom stair to a steady count of 60 steps a minute (one foot each beat: up, up, down, down), holding the rail if needed. Keep your whole foot on the step.
3. **Station 2: Hose drag (2 lengths).** Load two jugs on the sheet or tarp. Hold the corners over your shoulder or in both hands and walk it 50 feet down the lane and 50 feet back, leaning forward with a flat back and short, driving steps.
4. **Station 3: Equipment carry (100 feet).** Carry a jug in each hand 50 feet and back, standing tall with shoulders down. Set them down by bending your knees.
5. **Station 4: Search crawl (2 passes).** Crawl on hands and knees under a table and around chairs along a 20-foot course and back, keeping your head up and moving steadily.

6. **Station 5: Rescue drag (50 feet).** Grab the loaded duffel by its handles, squat low with a flat back, and walk backward 50 feet, dragging it, looking over your shoulder for the line.
7. **Station 6: Ceiling push and pull (20 reps).** Hold the broom handle with both hands at shoulder height. Press it overhead 10 times and pull it down to your chest 10 times, briskly but under control.
8. **Record.** Your helper records the time at the end of each station (your splits) and your total time. Then walk 3 minutes and stretch hips, hamstrings, chest and shoulders. Rate your effort from 1 to 10.
9. **Retest (Session 3).** Study your splits: where did you slow most? Plan one change in pacing or technique (steadier stair rhythm, shorter steps on the drag, less time between stations). Repeat the circuit with the same loads and compare total time and effort.

Tips

- Start the stair climb steady, not fast. Real candidates who sprint the first event often fade later.
- Breathe out on every hard push or pull. Never hold your breath.
- Your time is for comparing with your own next try, never with anyone else.

Check your work

- ☐ I can name the eight CPAT events and the time limit, and the lifeguard entry skills.
- ☐ I completed the circuit with good form and recorded splits and total time.
- ☐ I retested with one planned change and explained the result.

FITNESS JOURNAL

1. Copy your circuit table: each station's split, total time and effort rating for both days, with the change in seconds and percent.
2. Draw a bar graph comparing station splits on the two days.
3. Make a three-column chart for a firefighter, a lifeguard and a nurse: the physical demands of the job and the parts of fitness each needs most.
4. Write a paragraph on Galatians 5:13: three ways your strength could serve someone this month.

From history. Benjamin Franklin organized the Union Fire Company in Philadelphia in 1736, one of the first volunteer fire companies in America. Members promised to bring leather buckets and bags to every fire and to help one another, and similar companies soon spread to other towns.

COMMON MISTAKES

- Rounding the back when dragging or lifting. Hinge at the hips, bend the knees, and keep the load close.
- Starting too fast. Pacing the first station is often the difference between passing and failing a timed test.
- Training only to look fit. Jobs test what a body can do: carry, climb, drag and keep going.
- Using loads that are too heavy for a home circuit. The point here is the pattern of work, not maximum load.

Make it a game • Job Fitness Circuit. Pick a job such as firefighter or lifeguard. Build a household circuit that mimics its tasks: stair climbs, carries, drags. Time yourself and record. Explain job-task analysis and why occupational tests exist. Your parent grades whether each task relates to the job. Retest and shave seconds off safely.

Scripture. “For, brethren, ye have been called unto liberty; only use not liberty for an occasion to the flesh, but by love serve one another.” (Galatians 5:13, KJV)

Freedom and strength are given not for showing off but for serving. A fit body is one more way to love your neighbor.

UNIT 1

KEEPING ACTIVE

For twelve years someone else has scheduled your activity: recess, PE, practice, a parent saying “Go outside.” Soon that will end. Work, college and family will fill the calendar, and for most adults the only activity they get is the activity they choose. In this unit you will learn what the evidence says adults need, starting with Ralph Paffenbarger, a doctor who followed the habits and health of nearly seventeen thousand Harvard graduates and then took up running himself at forty-five. You will measure activity the way scientists do, in METs and MET-minutes, and you will plan and live a full week of adult activity.

Then you will look at strength used for others. Firefighters, lifeguards, nurses and soldiers must be fit because other people’s lives may depend on it, and their jobs set plain, measurable tests. You will learn what those tests ask and why, and you will build and complete a household service-fitness circuit, timed and repeated to improve. Whether or not you ever wear a uniform, a strong body is a tool for serving your family, your church and your neighbors.

PREREQUISITES

- Knows how to warm up, cool down and find a pulse (earlier grades)
- Knows the youth guideline of at least 60 minutes of activity a day
- Can multiply, add up a weekly table and compute a percent

MASTERY CHECKLIST

- ☐ I can state the adult Physical Activity Guidelines for aerobic and muscle-strengthening activity.
- ☐ I can tell what Ralph Paffenbarger’s Harvard alumni study found and how it was done.
- ☐ I can classify activities as light, moderate or vigorous using METs and the talk test, and compute MET-minutes for a week.
- ☐ I can describe the events of a firefighter’s physical ability test and a lifeguard’s entry test and explain why jobs test fitness.
- ☐ I can complete a timed service-fitness circuit safely and improve on my own time.

OPTIONAL BOOKS AND GEAR FOR THIS UNIT

- **Physical Activity Guidelines for Americans, 2nd edition (U.S. Department of Health and Human Services, 2018)**: Free PDF. Chapter 4 (adults) and Chapter 3 (youth) are the source for Lesson 1.1. Plain, readable and full of examples.
- **Lifeguarding classes (American Red Cross)**: Free information page listing the swim, tread and timed-retrieval skills a candidate must pass before a lifeguard course. For Lesson 1.2; a real summer job for many 16–18-year-olds.
- **A metronome app or a simple online metronome**: Optional, to keep a steady 60-beats-per-minute step rhythm in the service circuit. Counting aloud works too.

Not required. Every activity in this unit works without them. School Launch has no ties to these authors, publishers or companies.

LESSONS IN THIS UNIT

1.1 Fitness for Life after School

3 sessions of 45–50 minutes

1.2 Fit to Serve

3 sessions of 45–50 minutes

UNIT 1 REVIEW

Answer each question. Show your work for the calculations. The review is worth 100 points.

1. 10 pts

State the adult Physical Activity Guidelines (2018) for aerobic activity and for muscle-strengthening activity. How do they differ from the youth guideline?

2. 10 pts

Describe Ralph Paffenbarger's 1986 Harvard alumni study: who was studied, for how long, what was measured and what was found.

3. 10 pts

Calculation. A student's week: 4 brisk walks of 30 minutes (4 METs), 2 runs of 25 minutes (10 METs) and 1 hour of raking (4 METs). Find (a) moderate-equivalent minutes and (b) MET-minutes. Does the week meet the adult aerobic guideline?

4. 10 pts

Explain the talk test and give one example each of a light, a moderate and a vigorous activity with approximate METs.

5. 10 pts

Calculation. A man spends 2,000 calories a week in exercise. If brisk walking uses about 100 calories per mile for him, how many miles a week is that? How many minutes at 3.5 miles per hour?

6. 10 pts

Name the eight events of the CPAT in order. What is the time limit, and what does the 50-pound vest represent?

7. 10 pts

What are the three American Red Cross lifeguard entry skills, and why does each make sense for the job?

8. 10 pts

Calculation. A student's service circuit took 9:40 on the first try and 8:58 on the retest. What was the improvement in seconds and in percent?

9. 10 pts

Why do hospitals use mechanical lifts and team lifts? Use the 35-pound figure in your answer.

10. 10 pts

Short answer (4–6 sentences). After graduation no one will schedule your activity. Describe your plan to meet the adult guidelines, naming at least three built-in habits, and explain how 1 Timothy 4:8 shapes the way you think about it.

ANSWER KEY

1. Adults: 150–300 minutes a week of moderate activity, or 75–150 minutes of vigorous, or an equivalent mix, plus muscle strengthening for all major muscle groups on 2 or more days; more than 300 minutes gives added benefit. Youth (6–17): at least 60 minutes every day, mostly moderate to vigorous, with vigorous, muscle- and bone-strengthening activity on at least 3 days a week.
2. 16,936 Harvard alumni aged 35–74, followed 1962–1978. Walking, stair climbing and sport were turned into weekly energy spent. Death rates fell as activity rose to about 3,500 calories a week; men spending 2,000 or more calories a week in exercise had death rates one quarter to one third lower, even allowing for smoking, blood pressure and family history.
3. (a) Moderate minutes: $120 + 60 = 180$; vigorous 50 counts as 100; total 280 moderate-equivalent minutes. (b) MET-minutes: $4 \times 120 + 10 \times 50 + 4 \times 60 = 480 + 500 + 240 = 1,220$. Yes, it meets and exceeds the guideline.
4. Moderate: you can talk but not sing; vigorous: only a few words before pausing for breath; light: you could sing. Examples: slow stroll about 2.5 METs (light), brisk walk about 4 METs (moderate), running at 6 mph about 10 METs (vigorous).
5. $2,000 \div 100 = 20$ miles. $20 \div 3.5 \approx 5.7$ hours ≈ 343 minutes a week, about 49 minutes a day.
6. Stair climb, hose drag, equipment carry, ladder raise and extension, forcible entry, search, rescue, ceiling breach and pull. 10 minutes 20 seconds. The vest stands for the weight of breathing apparatus and protective gear.
7. A 300-yard continuous swim (endurance to reach a victim), a 2-minute legs-only tread (staying up with hands free for the victim), and a timed retrieval: swim 20 yards, dive 7–10 feet for a 10-pound object, swim back 20 yards within 1:40 (copying a real rescue from the bottom).
8. $9:40 = 580$ s; $8:58 = 538$ s. Improvement 42 s. $42 \div 580 \times 100 \approx 7.2\%$.
9. Thomas Waters of NIOSH calculated in 2007 that even in ideal conditions one person should lift no more than about 35 pounds of a patient by hand; most patients weigh far more and may move suddenly, so lifts and teamwork protect both nurse and patient from injury.
10. Answers vary. Full credit for: specific weekly minutes meeting 150 moderate-equivalent and 2 strength days; at least three built-in habits (walking or cycling to work or class, stairs, a regular partner or league, chores done briskly); and a

sentence explaining that exercise has real but limited value and godliness has more, so fitness is stewardship, not an idol.

UNIT CHALLENGE: TWO WEEKS OF ADULT ACTIVITY AND A PLAN FOR NEXT YEAR

Live two full weeks that meet the adult Physical Activity Guidelines and your own youth target, and log them. Include your intensity-test table, both weekly logs with minutes, MET-minutes and strength days, and a graph of daily active minutes. Add your two service-circuit results with splits. Finish with a one-page plan for staying active in the first year after graduation: where your activity will come from, who will train with you, and what you will do when the schedule gets crowded.

LOOK FOR	WHAT IT MEANS
Complete logs	Fourteen dated days with every bout recorded in minutes, METs and MET-minutes, and weekly totals worked out correctly.
Meets the guidelines	Each week reaches at least 150 moderate-equivalent minutes and two muscle-strengthening days, or the student explains honestly what got in the way and how the second week changed.
Service circuit	Both circuit attempts recorded with splits, effort and a planned change; good form and safe loads.
Plan for next year	A realistic, specific plan with at least three built-in habits and a backup for busy weeks.
Reflection	A thoughtful paragraph on stewardship and service. Effort and honesty count, not the size of the numbers.

UNIT 2

HYDRATION

Many grown-up jobs and services happen outdoors in the heat: roofing, farming, landscaping, construction, coaching, a summer camp, a mission trip, a long day of cleanup after a storm. In this unit you will learn how the body handles heat at work, starting with the Marine Corps recruit depot at Parris Island, South Carolina, where in the 1950s heat illness struck so many recruits that Navy scientists invented a better thermometer: the wet-bulb globe temperature. You will learn the workers' rule of Water. Rest. Shade., how to recognize heat exhaustion and heat stroke, how much to drink and why drinking far too much is also dangerous, and you will measure your own sweat loss during a real work session and plan a workday.

Then you will take your water into the field. Away from the tap, water must be carried or made safe. You will hear how John Leal, a New Jersey doctor, first added chlorine continuously to an American city's water in 1908, and you will practice the ways hikers, campers and mission teams make water safe: settling and straining, boiling, filtering and disinfecting. You will plan the water for a real day hike and carry it.

PREREQUISITES

- Knows what water does in the body and the signs of dehydration (earlier grades)
- Knows that sweat cools by evaporation and carries salt (earlier grades)
- Can convert pounds to ounces and work with rates per hour

MASTERY CHECKLIST

- ☐ I can explain how the body gains and loses heat and why humid heat is harder than dry heat.
- ☐ I can tell how the wet-bulb globe temperature was developed and compute one from its three readings.
- ☐ I can recognize heat exhaustion and heat stroke and say what to do for each.
- ☐ I can measure my sweat loss, plan my drinking for a workday, and explain the danger of hyponatremia.
- ☐ I can make water safe by boiling or disinfecting it, and plan the water for a day hike.

OPTIONAL BOOKS AND GEAR FOR THIS UNIT

- **Heat (Occupational Safety and Health Administration)**: Free. The U.S. Department of Labor's heat page for workers and employers, with the Water. Rest. Shade. message, warning signs and first aid. For Lesson 2.1.
- **Emergency Disinfection of Drinking Water (U.S. Environmental Protection Agency)**: Free. The bleach-drop table and boiling instructions used in Lesson 2.2. Worth printing for a camping or emergency kit.
- **A reusable water bottle or hydration bladder with ounce or milliliter marks**: Optional, for measuring what you drink during the workday check and the hike.

Not required. Every activity in this unit works without them. School Launch has no ties to these authors, publishers or companies.

LESSONS IN THIS UNIT

2.1 Water, Work and Heat

3 sessions of 45–50 minutes

2.2 Safe Water Outdoors

3 sessions of 45–50 minutes

UNIT 2 REVIEW

Answer each question. Show your work for the calculations. The review is worth 100 points.

1. **8 pts**

Explain heat balance during hard work. Where does the extra heat come from, and how does the body get rid of it?

2. **8 pts**

Why is humid heat more dangerous than dry heat at the same temperature?

3. **10 pts**

Calculation. Natural wet bulb 80°F, black globe 104°F, air 90°F. Compute the outdoor WBGT. Would the Marine Corps black flag be up?

4. **8 pts**

Who developed the WBGT, where, and why was a new measure needed?

5. **10 pts**

Compare heat exhaustion and heat stroke: signs and first aid.

6. **10 pts**

Calculation. During an hour of yard work a student's scale reading dropped 1.5 pounds and he drank 20 ounces. What was his sweat rate? How much should he drink afterward?

7. **10 pts**

What is hyponatremia, how does it happen, and what NIOSH limit helps prevent it?

8. **8 pts**

What did John Leal do in 1908, and why did it matter?

9. **10 pts**

Compare boiling, a portable filter and household bleach: which pathogens does each handle, and one limitation of each?

10. **10 pts**

Calculation. A 5-hour hike at 22 ounces an hour: how many ounces, liters and pounds of water? (1 liter $\approx$ 34 oz $\approx$ 2.2 lb.)

11. **8 pts**

Short answer (3–5 sentences). A friend is starting a summer roofing job next week. What would you tell him about acclimatization, drinking and the warning signs?

ANSWER KEY

1. Working muscles turn only about a quarter of their fuel into motion; the rest is heat. The body sends blood to the skin and sweats; evaporating sweat removes heat (about 580 calories of heat per liter). Some heat also leaves by convection, radiation and conduction.
2. Humid air slows the evaporation of sweat, so sweat drips off without cooling and body temperature rises faster.
3. $0.7 \times 80 + 0.2 \times 104 + 0.1 \times 90 = 56 + 20.8 + 9 = 85.8^\circ\text{F}$. No: the black flag is 90°F or more, but 85.8°F calls for great caution.
4. D. H. Minard and Constantin Yaglou, for the Marine Corps Recruit Depot at Parris Island in the 1950s (published 1957). Heat casualties among recruits were high, and air temperature alone did not capture humidity and sun.
5. Heat exhaustion: heavy sweating, weakness, dizziness, headache, nausea, cool clammy skin; stop, move to shade, loosen clothing, cool and sip water. Heat stroke: very high temperature (about $104^\circ\text{F}+$), confusion, slurred speech, collapse, sometimes hot dry skin; call 911 and cool immediately, ideally in cold water, while waiting.
6. $1.5 \times 16 = 24$ oz; $24 + 20 = 44$ ounces per hour. Afterward about 16–24 oz per pound lost: 1.5×16 to $24 = 24$ –36 ounces over the next couple of hours, with food.
7. Too little sodium in the blood from drinking far more water than is lost in sweat. It causes headache, nausea, swelling, confusion and can be fatal. NIOSH: drink about 8 oz every 15–20 minutes but no more than 48 ounces in an hour; gaining weight during work is a warning.
8. He began the first continuous chlorination of a U.S. public water supply, adding chloride of lime at the Boonton Reservoir for Jersey City. Small doses destroyed disease bacteria; other cities followed, and typhoid deaths fell dramatically.
9. Boiling (1 minute rolling, 3 at high altitude): bacteria, viruses and parasites; needs fuel and time. Portable filter: parasites and bacteria, usually not viruses; can clog. Bleach (8 drops of 6% per gallon, 30 minutes): bacteria and viruses; some parasites resist it; double for cloudy water. None removes chemicals.
10. $5 \times 22 = 110$ ounces; $110 \div 34 \approx 3.2$ liters; $3.2 \times 2.2 \approx 7.1$ pounds.
11. Answers vary. Full credit for: start with shorter or lighter heat exposure and build over 1–2 weeks (NIOSH: about 20% the first day, adding no more than 20% a day); drink about a cup every 15–20 minutes, not over 48 oz an hour, eat

normal meals; rest in shade; work early; know heat exhaustion and heat stroke signs and that confusion means call 911 and cool first.

UNIT CHALLENGE: WATER FOR THE WORK AND THE TRAIL

Assemble a water and heat plan you could use on a summer job or a mission trip. Include your two workday sweat checks with conditions, sweat rates and your 6-hour drinking and break plan; a one-page heat-illness card (signs and first aid for heat exhaustion and heat stroke, the 48-ounce limit, the acclimatization rule); your boiling and disinfection records; and your two hike water logs with the plan for a longer hike that includes a refill and treatment stop.

LOOK FOR	WHAT IT MEANS
Measured sweat checks	Two sessions with conditions, ounces drunk, scale drop recorded as fluid lost, and sweat rate correctly calculated.
Sound workday plan	Hourly drinking under 48 ounces, scheduled shade breaks, food, and acclimatization for the first week.
Heat-illness card	Accurate, clear signs and first aid, including “cool first” for heat stroke and the danger of hyponatremia.
Safe water	Boiling and bleach disinfection done correctly with a parent, and a treatment method chosen and justified for the trail.
Hike logs	Two hikes planned and logged with ounces per hour and pack weight, and an improved plan for a longer hike.

2.1 WATER, WORK AND HEAT

OBJECTIVES

- Explain heat balance: how working muscles make heat and how the body sheds it by sweating, and why humidity, sun and wind matter.
- Tell how the wet-bulb globe temperature (WBGT) came out of Parris Island in the 1950s, and compute a WBGT.
- Apply Water. Rest. Shade., acclimatization and the drinking guidelines, and explain hyponatremia.
- Measure sweat loss during a work session and write a personal drinking plan.

Warm-up. Do 2 minutes of brisk walking, 10 squats, 10 arm swings across the body, 10 lunges and 30 seconds of jogging in place. Then hold your wrist under cool running water for 30 seconds. Think about it: why does a breeze on a damp shirt feel so cool, and why does a muggy August afternoon feel hotter than a dry one at the same temperature?

WATCH

Heat Illness Prevention

CaliforniaDIR · 8:01

<https://www.youtube.com/watch?v=cR6FA5w8A1o>

WHEN TO WATCH

After the “How your body works” paragraph. List the signs of heat exhaustion and heat stroke as you watch.

Note: Made by the California Department of Industrial Relations for farm, construction and landscaping workers, who tell their own experiences of heat illness. It teaches about 4 cups of water an hour while working in the heat, shade, rest and acclimatization.

BACKUP VIDEO

Heat Stress Prevention | Safety, Hazards, Training, Oregon OSHA

Oregon Occupational Safety & Health (Oregon OSHA) · 2:16

https://www.youtube.com/watch?v=-E_0GU4fm9s

A short summary for review.

KEY TERMS

heat balance

The balance between heat the body gains (from working muscles, hot air and sun) and heat it loses (mostly by evaporating sweat).

acclimatization

The body's gradual adjustment to heat over 1–2 weeks: earlier and heavier sweating with less salt, a lower heart rate and better cooling.

heat stroke

A life-threatening emergency: body temperature very high (about 104°F or more), confusion or collapse, sometimes hot, dry skin. Call 911 and cool the person immediately.

wet-bulb globe temperature (WBGT)

A heat-stress index combining a wet-bulb reading (humidity and wind), a black-globe reading (sun) and air temperature: outdoors, $WBGT = 0.7 \times \text{wet bulb} + 0.2 \times \text{globe} + 0.1 \times \text{air}$.

heat exhaustion

Heat illness with heavy sweating, weakness, dizziness, headache, nausea and cool, clammy skin. Stop, move to shade, cool down and drink.

hyponatremia

Too little sodium in the blood, which can happen when a person drinks far more water than he or she loses. It causes headache, nausea, swelling and confusion and can be deadly.

CORE IDEAS

The story. In the early 1950s the Marine Corps Recruit Depot at Parris Island, South Carolina, had a serious problem. Every summer, recruits marching and drilling in the coastal heat and humidity collapsed with heat exhaustion and heat stroke, at times by the hundreds; in 1952 the depot accounted for about two-thirds of all Navy and Marine Corps heat casualties. A thermometer reading alone did not predict the danger, because a humid, sunny 88°F could be far worse than a dry, breezy 95°F. Navy physiologist D. H. Minard and Harvard scientist Constantin Yaglou set out to find a better measure.

How they figured it out. They combined three thermometers. A **natural wet-bulb** thermometer, its bulb wrapped in a wet wick, cools by evaporation the way skin does, so it reads low in dry, windy air and high in humid, still air. A **black-globe** thermometer, inside a hollow black ball, soaks up the sun's radiant heat. An ordinary **dry-bulb** thermometer reads the air. Weighting them 70, 20 and 10 percent gave the

wet-bulb globe temperature. Starting in 1954 the depot used flags to limit hard training as the heat index rose, and heat casualties fell sharply; Yaglou and Minard published the method in 1957. Today the Marine Corps' black flag (a WBGT of 90°F or more) still halts strenuous outdoor training, and the WBGT is used by OSHA, many athletic associations and high schools. Worked example: wet bulb 78°F, globe 110°F, air 92°F. $WBGT = 0.7 \times 78 + 0.2 \times 110 + 0.1 \times 92 = 54.6 + 22 + 9.2 = 85.8^\circ\text{F}$, a high-caution reading even though the air is “only” 92°F.

How your body works. Working muscles turn only about a quarter of their fuel into motion; the rest becomes heat. Hard work makes so much heat that, if none escaped, body temperature would climb by about a degree Fahrenheit every few minutes. The body sends warm blood to the skin and sweats. Each liter (about 34 ounces) of sweat that *evaporates* carries away about 580 calories of heat energy, but sweat that drips off cools very little, which is why humidity is dangerous: wet air slows evaporation. Sweat rates during hard work in heat are often 1 to 2 liters (34–68 ounces) an hour, so water must be replaced as you go. The National Institute for Occupational Safety and Health (NIOSH) advises workers in heat to drink about **1 cup (8 ounces) every 15 to 20 minutes**, about 24–32 ounces an hour, before you are thirsty, and **never more than 48 ounces in an hour**. Drinking far more than you sweat dilutes the sodium in your blood (**hyponatremia**), causing headache, nausea, bloating, confusion and, at worst, seizures and death. Normal meals replace salt for most workers. The body also adapts: in the first days of heat work, risk is highest, so NIOSH advises new workers to start with no more than about 20 percent of a full day's heat exposure and add no more than 20 percent a day.

Good form. OSHA's rule for outdoor work is three words: **Water. Rest. Shade.** Drink on a schedule; take rest breaks in shade, more often as the heat rises; and do the heaviest work in the cool morning. Wear light-colored, loose clothing and a hat. Watch your partner: heat exhaustion (heavy sweating, weakness, dizziness, headache, nausea) means stop, move to shade, loosen clothing, cool with water and fans, and sip water. **Heat stroke** (confusion, slurred speech, collapse, a very high body temperature, sometimes hot, dry skin) means call 911 and cool the person at once, best by immersing the body in cold water or soaking with cold water and fanning, while help comes. Cool first; every minute matters.

Try it. You will plan and do a real work session outdoors (yard work, garden work or another real chore), measure your sweat loss with a scale, and write your own

drinking plan for a workday.

PICTURE STUDY



Harvesters Resting (Ruth and Boaz), Jean-François Millet, 1850–1853 · Oil on canvas · Museum of Fine Arts, Boston

Image: [Wikimedia Commons](#), public domain

Jean-François Millet grew up on a farm in Normandy and painted the people who worked the fields. Here he set the Bible story of Ruth and Boaz in a French harvest: at the noon meal, Boaz brings Ruth, the young widow who has been gleaning, to sit with his reapers. “At mealtime come thou hither, and eat of the bread” (Ruth 2:14).

Look closely

- Find the big jug. Why would harvesters at noon need it close at hand?
- Look for shade. Where do the workers rest, and why there in the middle of the day?
- Look at their clothing: hats, headscarves and long sleeves. How do they protect against the sun?
- Find the harvesters lying down. What does their rest tell you about the work they did all morning?

Talk about it

1. How do these reapers follow Water. Rest. Shade. without ever hearing those words?

2. Why is the first week of harvest, or the first week of any summer job, the most dangerous for heat illness?
3. Boaz shared food and water with a stranger. What would you tell a friend starting a summer job roofing or landscaping?

Safety first. Work in the cooler part of the day, in light clothing and a hat, with water and shade close by and an adult or buddy nearby. Drink about a cup every 15–20 minutes but never more than 48 ounces in an hour. Stop at once and cool down at dizziness, headache, nausea, cramps or unusual weakness; confusion or collapse is an emergency, so call 911 and cool the person immediately.

ACTIVITY

My Workday Sweat Check and Drinking Plan

You will do 60 minutes of real outdoor work, measure the fluid you lose in sweat, and use the number to write a personal drinking plan for a summer workday. The scale is used only to measure water lost; record the difference, not your weight.

You will need

- A bathroom scale on a hard floor
- A water bottle with ounce marks (or a measuring cup)
- A real outdoor job for 60 minutes: mowing, raking, weeding, hauling mulch, washing a car, splitting kindling with an adult
- A thermometer or a weather app with temperature, humidity and heat index (some show WBGT); your fitness journal

Steps

1. **Check the heat.** Record the temperature, humidity and heat index (or WBGT if your weather app shows it) and the time of day. If the heat index is above about 103°F, choose a cooler time or a cooler day.
2. **Before (Session 2).** Use the bathroom, then step on the scale in the light clothes you will work in. Note the reading privately; you will need only the change. Fill your bottle and record how many ounces it holds.
3. **Work 60 minutes.** Warm up with 3 minutes of easy movement, then work steadily. Drink about 8 ounces every 15–20 minutes and take a 5-minute shade break every 20–30 minutes. Record every ounce you drink.
4. **After.** Towel off sweat (wet clothes add weight), use the bathroom only if needed and note it, and step on the scale in the same clothes. Find the drop in pounds.
5. **Calculate.** Sweat loss (ounces) = drop in pounds $\times$ 16 + ounces drunk.
Example: the scale dropped 1.2 pounds and you drank 16 ounces: $1.2 \times 16 = 19.2$; $19.2 + 16 = 35.2$ ounces of sweat in one hour. That is your sweat rate in these conditions.

6. **Rehydrate sensibly.** Over the next couple of hours, drink about 16–24 ounces for each pound lost, with a normal meal or salty snack, and check that your urine returns to pale yellow.
7. **Write your plan.** For a 6-hour summer workday in similar heat: total sweat expected, ounces to drink each hour (enough to replace most of the loss but never more than 48 ounces an hour), break schedule, what to eat, and the warning signs that mean stop.
8. **Repeat (Session 3).** Do the same job on another day using your plan. Compare scale drop, sweat rate and how you felt. Aim to finish having lost no more than about a pound or two, and never to have gained.

Tips

- Gaining weight during a work session means you drank more than you sweated, the first step toward hyponatremia.
- Sweat rates differ a great deal between people and days. Your own measured number is worth more than any rule of thumb.
- Thirst comes late. Drink on a schedule in the heat.

Check your work

- ☐ I can compute a WBGT and explain each of its three parts.
- ☐ I measured my sweat loss and computed my sweat rate in ounces per hour.
- ☐ I wrote a workday drinking and break plan that stays under 48 ounces an hour.

FITNESS JOURNAL

1. Record your heat conditions, ounces drunk, scale drop (in pounds lost only) and sweat rate for both sessions.
2. Draw a body diagram showing heat produced by muscles and the four ways heat leaves the body (evaporation, convection, radiation, conduction), and mark which one fails in humid air.
3. Make a two-column chart: heat exhaustion versus heat stroke, with signs and first aid for each.
4. Write your 6-hour workday plan as a table: hour, task, ounces, breaks, food.

From history. OSHA launched its national Water. Rest. Shade. campaign in 2011 to teach outdoor workers and employers the basics of heat safety, building on decades of military and industrial research like the work at Parris Island.

COMMON MISTAKES

- Waiting for thirst. In the heat, thirst lags behind need.
- Thinking more water is always better. More than about 48 ounces an hour, or more than you sweat, can cause dangerous hyponatremia.
- Starting a hot summer job at full effort on the first day. Acclimatize over one to two weeks.
- Treating confusion or collapse as tiredness. That is heat stroke: call 911 and cool first.

Make it a game • Workday Heat Index. Given dry-bulb, wet-bulb and globe temperatures, compute WBGT with the outdoor formula. Race your parent to the correct answer. Then decide what work-rest schedule and water plan you would use. Tell the Parris Island story. Explain heat balance and humidity. Score a point for each right choice.

2.2 SAFE WATER OUTDOORS

OBJECTIVES

- Tell how John Leal’s chlorination of Jersey City’s water in 1908 changed public health.
- Explain what makes water unsafe (bacteria, viruses, parasites and chemicals) and what each treatment method removes or inactivates.
- Make water safe by boiling and by bleach disinfection using the EPA table, with a parent supervising.
- Plan and carry the water for a day hike: how much, how heavy, where to refill and how to treat it.

Warm-up. Walk briskly for 3 minutes carrying a full gallon jug in one hand, switching hands each minute, then do 10 squats, 10 step-ups on each leg and 10 arm circles each way. Think about it: that gallon weighed about 8.3 pounds. How many gallons would a family of four need for a day of hiking in the heat, and could you carry them?

WATCH

Treating and purifying water in the backcountry

Scout Life • 1:20

<https://www.youtube.com/watch?v=Q-shzY2SSmw>

WHEN TO WATCH

After the “How your body works” paragraph. Name the four methods it shows.

Note: A short tip video from *Scout Life* (formerly *Boys’ Life*) magazine, with two young hikers showing boiling, filtering, chemical tablets and an ultraviolet pen. Brief, so read the lesson carefully for the details.

KEY TERMS

pathogen

A germ that causes disease. In water: bacteria (such as *E. coli*), viruses (such as hepatitis A) and parasites (such as *Giardia*).

disinfection

Treating water to inactivate pathogens, by heat (boiling), chemicals (chlorine, iodine, chlorine dioxide) or ultraviolet light.

filtration

Straining water through a fine material. Most portable filters remove parasites and bacteria but not the much smaller viruses.

micron

One millionth of a meter. Bacteria are about 0.2–10 microns long; most viruses are smaller than 0.3 micron.

contact time

How long a chemical disinfectant must sit in the water to work, such as 30 minutes for household bleach.

CORE IDEAS

The story. At the start of the 1900s, typhoid fever and other waterborne diseases still took the lives of thousands of Americans every year, many of them in growing cities that drew water from rivers and reservoirs fouled by sewage. Jersey City, New Jersey, received its water from the Boonton Reservoir, and the city sued the private water company, claiming the water was not “pure and wholesome.” The company’s sanitary adviser, a physician named John L. Leal, believed he had the answer. Working with the engineer George W. Fuller, he began adding small, steady doses of chloride of lime to the water at Boonton in 1908. It was the first continuous chlorination of a public drinking-water supply in the United States.

How they figured it out. Leal had found that a tiny amount of chlorine, a fraction of a part per million (0.2 to 0.35 parts per million at Boonton), was enough to destroy disease bacteria without harming people. Laboratory tests of the treated water showed bacteria counts plummeting. The court accepted the evidence, Leal and his colleagues presented their results to the American Water Works Association in 1909, and other cities quickly followed. By about 1930 nearly every large water system in the country chlorinated its water, and typhoid deaths fell dramatically. Every time you drink from a tap, you benefit from that fair test.

How your body works. Clear mountain water can still carry **pathogens**: bacteria, viruses and parasites such as *Giardia*, which causes days or weeks of cramps and diarrhea that drain the body of water and salt. There are four main ways to make water safe. **Boiling** is the most reliable: a rolling boil for 1 minute inactivates bacteria, viruses and parasites (the EPA says 3 minutes above about 5,000 feet, where water boils at a lower temperature). **Filtering** through a filter with pores of about 1

micron or smaller removes parasites, and hollow-fiber filters of about 0.1–0.2 micron remove bacteria, but most portable filters do not stop viruses. **Chemical disinfection** works on bacteria and viruses: the EPA says 8 drops of unscented 6% household bleach (or 6 drops of 8.25%) per gallon, stirred and left 30 minutes, doubled if the water is cloudy or very cold; some parasites resist chlorine, so chlorine dioxide tablets (which need longer contact time) or boiling are better where parasites are a concern. **Ultraviolet light** (pens, or full sun on a clear plastic bottle for about 6 hours, a method the World Health Organization describes for emergencies) damages germs' genes. Cloudy water shields germs from every method, so **clarify first**: let it settle and pour it through a clean cloth or coffee filter. None of these removes chemicals such as fuel or farm runoff, so choose the cleanest source you can.

Think it through. Water is heavy: a liter weighs about 2.2 pounds and a gallon about 8.3 pounds. A hiker in moderate weather often drinks about half a liter (17 ounces) or more an hour, more in heat or on steep ground. Worked example: a 6-hour hike at 20 ounces an hour needs 120 ounces, about 3.5 liters, or 7.8 pounds of water. Carrying it all is possible but heavy; carrying 2 liters and treating a refill halfway saves about 3 pounds. On a mission trip to a place where tap water is unsafe, the same skills protect a whole team. In the wilderness of Shur, Israel found only bitter water at Marah. Moses cried unto the LORD, “and the LORD shewed him a tree, which when he had cast into the waters, the waters were made sweet” (Exodus 15:25). Clean water is a gift, and a responsibility.

Try it. You will practice clarifying, boiling and bleach disinfection at home with a parent, then plan and carry the water for a real hike, recording how much you drank.

PICTURE STUDY



Kindred Spirits, Asher B. Durand, 1849 · Oil on canvas · Crystal Bridges Museum of American Art, Bentonville, Arkansas

Image: [Wikimedia Commons](#), public domain

Asher B. Durand painted this picture in memory of his friend, the painter Thomas Cole, shown here with the poet William Cullen Bryant in the Catskill Mountains of New York. Both men loved to walk long miles in the wild country, sketching and talking. The streams and falls of the Catskills later supplied drinking water to New York City.

Look closely

- Follow the stream from the waterfalls to the bottom of the gorge. Where would you choose to fill a bottle, and why?
- Look at the rocks and fallen trees along the water. What could make even this clear water unsafe to drink untreated?
- Look at how the two men are dressed and what they carry. What would a modern hiker carry for water?
- Find the path or ledge they climbed. How much effort did it take to reach this spot?

Talk about it

1. If these men hiked 10 miles in a day, about how much water might they need, and how heavy would it be?

2. Which treatment method would you choose here: boiling, filtering, chemical or ultraviolet? Defend your choice.
3. How does walking in creation, as these friends did, help both body and soul?

Safety first. A parent supervises the stove and the bleach: use only unscented regular bleach, measure drops exactly, never mix bleach with other cleaners, and keep it away from eyes and skin. Do not drink the muddy practice water, even after straining; drink only tap water you have boiled or disinfected. Hike with an adult or buddy on a known trail, tell someone your route, carry more water than you think you need, and turn back if you run low.

ACTIVITY

Make It Safe, Then Carry It

You will practice the steps a hiker or mission team uses to make water safe, then plan, pack and carry the water for a real hike, measuring what you actually drink.

You will need

- A jar of muddy water (a spoonful of garden soil in tap water), a clean cloth or coffee filter and two clear jars
- A pot with a lid, a stove, clean bottles and a measuring cup
- Unscented regular household bleach (check the percent on the label) and a dropper
- Water bottles holding at least 2 liters in total, a daypack, a trail map and a watch

Steps

1. **Clarify (Session 2).** Let the muddy jar settle for 30 minutes, then pour the top water slowly through the cloth or coffee filter into a clean jar. Compare the two jars and record how clear each looks. Pour this practice water out; it was for seeing only.
2. **Boil.** With a parent, bring 1 quart of tap water to a full rolling boil (big bubbles that do not stop when you stir) and time 1 minute. Cover and let it cool, then pour it between two clean containers a few times to improve the flat taste. Taste it.
3. **Disinfect.** Read your bleach label. Using the EPA table, add the right number of drops to 1 gallon of tap water (8 drops for 6%, 6 drops for 8.25%). Stir, cover and wait 30 minutes. It should have a slight chlorine smell; if not, repeat the dose and wait 15 more minutes. Record the time and smell.
4. **Plan the hike.** Choose a hike or long walk of 2 to 4 hours. Estimate your needs at about 17–24 ounces an hour (more if hot), and compute the total in ounces, liters and pounds. Mark any refill points and decide how you would treat water there.

5. **Pack.** Carry your planned water, a snack, a hat, sun protection, a phone and a small first-aid kit. Weigh or estimate the pack.
6. **Hike and log.** Note the start time. Drink a few swallows every 15–20 minutes. At the end, measure the water left and compute ounces drunk per hour. Record the temperature, the terrain and how you felt.
7. **Repeat (Session 3).** Take the same or a similar hike with an adjusted plan: change the amount you carry or plan a refill and treatment stop. Compare ounces per hour, pack weight and how you felt.

Tips

- Collect water from moving water above a trail crossing or campsite, not from still pools or below a camp.
- Label treated and untreated bottles clearly, and never let untreated water drip onto the threads of a clean bottle.
- Treated water still needs a clean container. Wash bottles with hot soapy water.

Check your work

- ☐ I can explain what boiling, filtering, chemicals and ultraviolet light each do and do not remove.
- ☐ I boiled and disinfected water correctly with a parent supervising.
- ☐ I planned, carried and logged the water for a hike and adjusted my plan the second time.

FITNESS JOURNAL

1. Make a table of the four treatment methods: what each removes or inactivates (bacteria, viruses, parasites, chemicals), time needed, weight to carry and one drawback.
2. Write your hike water plan and log: hours, ounces planned, ounces drunk, ounces per hour, pack weight, for both hikes.
3. Draw a sketch map of a stream with a trail crossing and a campsite, and mark the best place to collect water.
4. Write a short paragraph on how John Leal's chlorine changed daily life in American cities.

From history. Chlorination came to many American cities alongside sand filtration, which had been used in Europe for decades. Together they were so effective that historians of public health count safe drinking water among the great achievements of the twentieth century.

COMMON MISTAKES

- Trusting clear water. Clear mountain streams can carry germs.
- Thinking a filter removes everything. Most portable filters do not stop viruses or chemicals.
- Skipping the clarifying step. Cloudy water shields germs from boiling, chemicals and light.
- Carrying too little because water is heavy. Plan the refill and treatment instead of hoping.

Make it a game • Safe Water Quiz. Your parent names a water threat: bacteria, virus, protozoa or chemical. Answer within ten seconds which treatment works: boiling, filtration, chlorine or carbon, and the contact time. Tell John Leal's Jersey City story. Then make a safe-water plan for a two-day hike. Streak of eight correct answers wins.

Scripture. “and the LORD shewed him a tree, which when he had cast into the waters, the waters were made sweet” (Exodus 15:25, KJV)

At Marah God turned bitter water sweet for a thirsty people. Making water safe is a small way of caring for the lives He has given us.

UNIT 2

HYDRATION

Many grown-up jobs and services happen outdoors in the heat: roofing, farming, landscaping, construction, coaching, a summer camp, a mission trip, a long day of cleanup after a storm. In this unit you will learn how the body handles heat at work, starting with the Marine Corps recruit depot at Parris Island, South Carolina, where in the 1950s heat illness struck so many recruits that Navy scientists invented a better thermometer: the wet-bulb globe temperature. You will learn the workers' rule of Water. Rest. Shade., how to recognize heat exhaustion and heat stroke, how much to drink and why drinking far too much is also dangerous, and you will measure your own sweat loss during a real work session and plan a workday.

Then you will take your water into the field. Away from the tap, water must be carried or made safe. You will hear how John Leal, a New Jersey doctor, first added chlorine continuously to an American city's water in 1908, and you will practice the ways hikers, campers and mission teams make water safe: settling and straining, boiling, filtering and disinfecting. You will plan the water for a real day hike and carry it.

PREREQUISITES

- Knows what water does in the body and the signs of dehydration (earlier grades)
- Knows that sweat cools by evaporation and carries salt (earlier grades)
- Can convert pounds to ounces and work with rates per hour

MASTERY CHECKLIST

- ☐ I can explain how the body gains and loses heat and why humid heat is harder than dry heat.
- ☐ I can tell how the wet-bulb globe temperature was developed and compute one from its three readings.
- ☐ I can recognize heat exhaustion and heat stroke and say what to do for each.
- ☐ I can measure my sweat loss, plan my drinking for a workday, and explain the danger of hyponatremia.
- ☐ I can make water safe by boiling or disinfecting it, and plan the water for a day hike.

OPTIONAL BOOKS AND GEAR FOR THIS UNIT

- **Heat (Occupational Safety and Health Administration)**: Free. The U.S. Department of Labor’s heat page for workers and employers, with the Water. Rest. Shade. message, warning signs and first aid. For Lesson 2.1.
- **Emergency Disinfection of Drinking Water (U.S. Environmental Protection Agency)**: Free. The bleach-drop table and boiling instructions used in Lesson 2.2. Worth printing for a camping or emergency kit.
- **A reusable water bottle or hydration bladder with ounce or milliliter marks**: Optional, for measuring what you drink during the workday check and the hike.

Not required. Every activity in this unit works without them. School Launch has no ties to these authors, publishers or companies.

LESSONS IN THIS UNIT

2.1 Water, Work and Heat

3 sessions of 45–50 minutes

2.2 Safe Water Outdoors

3 sessions of 45–50 minutes

UNIT 2 REVIEW

Answer each question. Show your work for the calculations. The review is worth 100 points.

1. 8 pts

Explain heat balance during hard work. Where does the extra heat come from, and how does the body get rid of it?

2. 8 pts

Why is humid heat more dangerous than dry heat at the same temperature?

3. 10 pts

Calculation. Natural wet bulb 80°F, black globe 104°F, air 90°F. Compute the outdoor WBGT. Would the Marine Corps black flag be up?

4. 8 pts

Who developed the WBGT, where, and why was a new measure needed?

5. 10 pts

Compare heat exhaustion and heat stroke: signs and first aid.

6. 10 pts

Calculation. During an hour of yard work a student's scale reading dropped 1.5 pounds and he drank 20 ounces. What was his sweat rate? How much should he drink afterward?

7. 10 pts

What is hyponatremia, how does it happen, and what NIOSH limit helps prevent it?

8. 8 pts

What did John Leal do in 1908, and why did it matter?

9. **10 pts**

Compare boiling, a portable filter and household bleach: which pathogens does each handle, and one limitation of each?

10. **10 pts**

Calculation. A 5-hour hike at 22 ounces an hour: how many ounces, liters and pounds of water? (1 liter $\approx$ 34 oz $\approx$ 2.2 lb.)

11. **8 pts**

Short answer (3–5 sentences). A friend is starting a summer roofing job next week. What would you tell him about acclimatization, drinking and the warning signs?

ANSWER KEY

1. Working muscles turn only about a quarter of their fuel into motion; the rest is heat. The body sends blood to the skin and sweats; evaporating sweat removes heat (about 580 calories of heat per liter). Some heat also leaves by convection, radiation and conduction.
2. Humid air slows the evaporation of sweat, so sweat drips off without cooling and body temperature rises faster.
3. $0.7 \times 80 + 0.2 \times 104 + 0.1 \times 90 = 56 + 20.8 + 9 = 85.8^\circ\text{F}$. No: the black flag is 90°F or more, but 85.8°F calls for great caution.
4. D. H. Minard and Constantin Yaglou, for the Marine Corps Recruit Depot at Parris Island in the 1950s (published 1957). Heat casualties among recruits were high, and air temperature alone did not capture humidity and sun.
5. Heat exhaustion: heavy sweating, weakness, dizziness, headache, nausea, cool clammy skin; stop, move to shade, loosen clothing, cool and sip water. Heat stroke: very high temperature (about $104^\circ\text{F}+$), confusion, slurred speech, collapse, sometimes hot dry skin; call 911 and cool immediately, ideally in cold water, while waiting.
6. $1.5 \times 16 = 24$ oz; $24 + 20 = 44$ ounces per hour. Afterward about 16–24 oz per pound lost: 1.5×16 to $24 = 24$ –36 ounces over the next couple of hours, with food.
7. Too little sodium in the blood from drinking far more water than is lost in sweat. It causes headache, nausea, swelling, confusion and can be fatal. NIOSH: drink about 8 oz every 15–20 minutes but no more than 48 ounces in an hour; gaining weight during work is a warning.
8. He began the first continuous chlorination of a U.S. public water supply, adding chloride of lime at the Boonton Reservoir for Jersey City. Small doses destroyed disease bacteria; other cities followed, and typhoid deaths fell dramatically.
9. Boiling (1 minute rolling, 3 at high altitude): bacteria, viruses and parasites; needs fuel and time. Portable filter: parasites and bacteria, usually not viruses; can clog. Bleach (8 drops of 6% per gallon, 30 minutes): bacteria and viruses; some parasites resist it; double for cloudy water. None removes chemicals.
10. $5 \times 22 = 110$ ounces; $110 \div 34 \approx 3.2$ liters; $3.2 \times 2.2 \approx 7.1$ pounds.
11. Answers vary. Full credit for: start with shorter or lighter heat exposure and build over 1–2 weeks (NIOSH: about 20% the first day, adding no more than 20% a day); drink about a cup every 15–20 minutes, not over 48 oz an hour, eat

normal meals; rest in shade; work early; know heat exhaustion and heat stroke signs and that confusion means call 911 and cool first.

UNIT CHALLENGE: WATER FOR THE WORK AND THE TRAIL

Assemble a water and heat plan you could use on a summer job or a mission trip. Include your two workday sweat checks with conditions, sweat rates and your 6-hour drinking and break plan; a one-page heat-illness card (signs and first aid for heat exhaustion and heat stroke, the 48-ounce limit, the acclimatization rule); your boiling and disinfection records; and your two hike water logs with the plan for a longer hike that includes a refill and treatment stop.

LOOK FOR	WHAT IT MEANS
Measured sweat checks	Two sessions with conditions, ounces drunk, scale drop recorded as fluid lost, and sweat rate correctly calculated.
Sound workday plan	Hourly drinking under 48 ounces, scheduled shade breaks, food, and acclimatization for the first week.
Heat-illness card	Accurate, clear signs and first aid, including “cool first” for heat stroke and the danger of hyponatremia.
Safe water	Boiling and bleach disinfection done correctly with a parent, and a treatment method chosen and justified for the trail.
Hike logs	Two hikes planned and logged with ounces per hour and pack weight, and an improved plan for a longer hike.

UNIT 3

NUTRITION

Soon you may be the one who decides what is in the refrigerator. In this unit you will learn to feed yourself well on a budget, beginning with Fannie Farmer, the Boston cooking teacher whose 1896 cookbook taught Americans to measure ingredients level and exactly, so that anyone who followed a recipe could succeed. You will plan meals with the MyPlate pattern, compare unit prices and cost per serving, work out protein per dollar, practice safe kitchen habits, and shop for and cook several meals yourself.

Then you will think about how we eat, not only what. In 1912 the physiologist Walter Cannon and his student A. L. Washburn used a swallowed balloon to show what happens in the stomach when we feel hungry, and later scientists found the hormones that tell the brain we are full. You will learn how hunger and fullness work, why slow, thankful meals around a table serve both body and soul, and what Scripture says about gratitude, feasting and self-control. You will plan, cook and host a family meal.

PREREQUISITES

- Knows the five food groups, the macronutrients and how to read a Nutrition Facts label (earlier grades)
- Has helped in the kitchen with a parent supervising knives and the stove
- Can divide money amounts and compute a rate (price per ounce)

MASTERY CHECKLIST

- ☐ I can plan balanced meals for several days using the MyPlate pattern and a budget.
- ☐ I can compare unit prices and compute cost per serving and protein per dollar.
- ☐ I can follow kitchen food-safety rules: hand washing, safe internal temperatures and refrigerating leftovers.
- ☐ I can explain how hunger and fullness signals work, from Cannon and Washburn's balloon to the hormones ghrelin, cholecystokinin and leptin.
- ☐ I can plan, cook and host a thankful family meal.

OPTIONAL BOOKS AND GEAR FOR THIS UNIT

- **The Boston Cooking-School Cook Book, by Fannie Merritt Farmer (Project Gutenberg)**: Free, public domain. Read her opening pages on measuring and try one of her simple recipes for Lesson 3.1. Some methods are old-fashioned; use modern food-safety temperatures.
- **USDA Food Plans: Cost of Food Monthly Reports (U.S. Department of Agriculture)**: Free. Monthly estimates of what nutritious meals cost on four budget levels, from thrifty to generous, by age. Use it to set your budget in Lesson 3.1.
- **An instant-read food thermometer**: Optional but useful for checking that chicken, ground meat and leftovers reach safe temperatures.

Not required. Every activity in this unit works without them. School Launch has no ties to these authors, publishers or companies.

LESSONS IN THIS UNIT

3.1 Shopping, Budgeting and Cooking for Yourself

3 sessions of 45–50 minutes

3.2 Thankfulness and Self-Control at the Table

3 sessions of 45–50 minutes

UNIT 3 REVIEW

Answer each question. Show your work for the calculations. The review is worth 100 points.

1. **8 pts**

What did Fannie Farmer change about American cooking in 1896, and why did it matter?

2. **10 pts**

Calculation. Rice: a 2-pound bag costs \$2.49 and a 5-pound bag costs \$5.29. Find the unit price per pound of each. Which is the better buy, and by how much per pound?

3. **10 pts**

Calculation. A pot of chili used beans \$1.58, ground turkey \$4.99, canned tomatoes \$1.89, an onion \$0.60 and spices \$0.40, and made 6 servings. What is the cost per serving?

4. **10 pts**

Calculation. A jar of peanut butter costs \$3.20 and holds 14 servings with 7 grams of protein each. Find the grams of protein per dollar and compare with lentils at about 60 grams per dollar.

5. **8 pts**

Describe the MyPlate pattern and name four inexpensive nutrient-dense staples.

6. **10 pts**

Name the four food-safety habits and give the safe internal temperatures for poultry and ground beef, and the rule for leftovers.

7. **10 pts**

Describe the Cannon and Washburn experiment of 1912: method and finding.

8. **10 pts**

Match each signal to its role: ghrelin, cholecystokinin, leptin, stomach stretch. Where in the brain are they weighed?

9. **8 pts**

Why does eating slowly, at a table without screens, help the body notice fullness?

10. **8 pts**

Name two passages of Scripture about feasting or thankfulness and one about self-control at the table.

11. **8 pts**

Short answer (3–5 sentences). Explain why gratitude and self-control at the table go together, and why undereating is not self-control.

ANSWER KEY

1. Her *Boston Cooking-School Cook Book* taught exact, level measurements and clear steps instead of vague amounts, so any cook who followed a recipe could get the same result; cooking became teachable and repeatable.
2. $2.49 \div 2 = \$1.245$ per lb; $5.29 \div 5 = \$1.058$ per lb. The 5-pound bag, by about 19 cents per pound.
3. Total \$9.46; $9.46 \div 6 \approx \$1.58$ per serving.
4. $14 \times 7 = 98$ g; $98 \div 3.20 \approx 31$ grams per dollar, about half as much protein per dollar as lentils.
5. Half the plate fruits and vegetables, a quarter grains (at least half whole grains), a quarter protein foods, plus dairy or another calcium food. Staples: oats, rice, beans, lentils, eggs, milk, peanut butter, frozen vegetables, potatoes, carrots, bananas, canned fish.
6. Clean, separate, cook, chill. Poultry 165°F, ground beef 160°F. Refrigerate leftovers within 2 hours at 40°F or below and eat within 3–4 days; reheat to 165°F.
7. Washburn swallowed a balloon on a tube connected to a recorder that traced stomach contractions; he pressed a key whenever he felt hunger, without seeing the record. His hunger pangs lined up with strong stomach contractions.
8. Ghrelin: made by the stomach, rises before meals, signals hunger. CCK: released by the small intestine when food arrives, signals fullness. Leptin: from fat tissue, reports long-term energy stores. Stomach stretch: signals fullness through the vagus nerve. The hypothalamus weighs them.
9. Fullness signals (stretch, gut hormones, blood sugar) take many minutes to build; a slow, attentive meal gives them time to reach the brain before you have eaten past satisfaction.
10. Any two of: John 6:11 (Jesus gave thanks), Nehemiah 8:10 (eat the fat, drink the sweet, send portions), 1 Corinthians 10:31 (eat and drink to God's glory). Self-control: Proverbs 23:20-21 (riotous eaters) or Proverbs 25:16 (eat honey as is sufficient) or temperance as a fruit of the Spirit.
11. Answers vary. Full credit for: a thankful person enjoys food as a gift, notices when it is enough and shares it; self-control is eating in the right measure, not as little as possible; an active, growing body needs enough food, so undereating fails to care for it, just as overeating does.

UNIT CHALLENGE: A WEEK AT MY OWN TABLE

Plan, shop for and cook a full week of dinners for your family or yourself (at least five you cook), within a budget you set from the USDA food plans. Record the shopping list with unit prices, the cost per serving and time of each dinner, and your food-safety checks. Include your hosted family meal with its hunger notes and conversation questions, and the meal you cooked for someone else. Finish with a one-page “first apartment” plan: ten staple foods, five meals you can cook, and a weekly budget.

LOOK FOR	WHAT IT MEANS
Balanced, budgeted plan	Five or more dinners following the MyPlate pattern, within the budget, with the arithmetic shown.
Smart shopping	Unit prices compared for at least eight items and cost per serving computed for each dinner.
Safe, skilled cooking	Dinners cooked with safe temperatures, clean habits and leftovers stored correctly; a parent confirms.
Thankful table and service	The hosted meal and the meal for someone else are planned, done and reflected on.
First-apartment plan	A realistic list of staples, meals and budget the student could actually use. Effort and growth count, not perfect meals.

3.1 SHOPPING, BUDGETING AND COOKING FOR YOURSELF

OBJECTIVES

- Tell how Fannie Farmer’s level measurements made cooking teachable and reliable.
- Plan several days of balanced meals with the MyPlate pattern and a set budget.
- Compute unit prices, cost per serving and protein per dollar to shop wisely.
- Shop for and cook meals safely, recording the cost and time of each.

Warm-up. Do 2 minutes of brisk walking, 10 squats, 10 counter push-ups at the kitchen counter, 10 calf raises and 10 lunges. Think about it: if you had \$40 to feed yourself for three days, what would you buy first, and why?

WATCH

MATH: Unit Price

Next Gen Personal Finance • 2:49

<https://www.youtube.com/watch?v=JQ5ejwzZAaY>

WHEN TO WATCH

After the “How your body works” paragraph. Pause before each answer is shown and work the problem on paper first, then do the same for protein per dollar.

Note: From Next Gen Personal Finance, a nonprofit that writes free personal-finance lessons for high schools. A short worked example divides total price by number of units to find the better buy among package sizes.

BACKUP VIDEO

Unit pricing helps you save money at the grocery store | Consumer Reports

Consumer Reports • 1:48

<https://www.youtube.com/watch?v=KMe85qahPbk>

A short follow-up before your shopping trip.

KEY TERMS

unit price

The price per standard unit (per ounce, pound or count), found by dividing the total price by the size. It lets you compare packages of different sizes.

level measurement

Filling a measuring cup or spoon and leveling it off with a straight edge, so the amount is exact every time; Fannie Farmer's great teaching.

safe minimum internal temperature

The temperature a food must reach inside to destroy harmful bacteria: 165°F for poultry and leftovers, 160°F for ground beef and pork, 145°F for whole cuts of beef, pork and fish (with a 3-minute rest for whole cuts of meat).

cost per serving

The price of a package divided by the number of servings it holds.

nutrient-dense food

A food with many vitamins, minerals, protein or fiber for its food energy, such as beans, eggs, vegetables, fruit, whole grains and milk.

CORE IDEAS

The story. In the 1800s American recipes often said things like “butter the size of an egg,” “a teacup of milk” or “flour enough to make a stiff batter.” Cooks learned by watching their mothers, and a new cook could easily fail. Fannie Merritt Farmer studied at the Boston Cooking School and became its principal. In 1896 she published *The Boston Cooking-School Cook Book*, which insisted on **level measurements**: a cupful, a tablespoonful and a teaspoonful filled and then leveled with a knife. Her recipes listed exact amounts and clear steps. The book was a success from its first printing and has gone through many editions; people called her “the mother of level measurements.”

How they figured it out. Farmer's insight was that cooking could be taught like a science: if the measurements and steps are exact, anyone who follows them can repeat the result. That is the same idea behind every fair test in this course. Shopping can be done the same way, with numbers instead of guesses. The USDA

publishes monthly estimates of what nutritious meals cost for people of each age on four budget levels, from thrifty to generous; you can use one as your target. Then you compare foods by **unit price** and by **cost per serving**. Worked example: a 42-ounce canister of oats for \$4.29 costs $4.29 \div 42 \approx \$0.102$ an ounce; an 18-ounce canister for \$2.79 costs \$0.155 an ounce, about half again as much. The big canister holds about 30 half-cup servings, about 14 cents each.

How your body works. A growing, active young adult needs enough food energy, protein for muscle and repair, carbohydrate for fuel, healthy fats, fiber, and vitamins and minerals such as calcium, iron and vitamin D. The simplest plan is the MyPlate pattern: half the plate fruits and vegetables, a quarter whole grains, a quarter protein foods, with milk, yogurt or another calcium food. Inexpensive nutrient-dense staples make this affordable: oats, rice, whole-wheat pasta, dry or canned beans and lentils, eggs, peanut butter, milk, frozen vegetables, bananas, apples, carrots, cabbage, potatoes, chicken thighs and canned fish. Worked example in protein per dollar (prices are examples): a 1-pound bag of dry lentils at \$1.79 makes about 9 servings with about 12 grams of protein each, about 108 grams, or $108 \div 1.79 \approx 60$ **grams per dollar**. A dozen eggs at \$3.00 give about 72 grams, **24 grams per dollar**. A pound of boneless chicken thighs at \$3.49 gives about four servings of 22 grams, about 88 grams, **25 grams per dollar**. All are good choices; beans and lentils stretch a budget furthest.

Good form. Cooking for yourself is safe when you keep four habits: **clean** (wash hands for 20 seconds, wash produce, keep raw meat away from ready-to-eat food), **separate** (separate cutting boards for raw meat), **cook** (check temperatures: 165°F for poultry and reheated leftovers, 160°F for ground meat), and **chill** (refrigerate leftovers within 2 hours, in a refrigerator at 40°F or below, and eat them within 3 to 4 days). With a knife, curl the fingers of your guiding hand into a “claw” and keep the blade sharp.

Try it. You will plan three days of meals for yourself on a budget, shop with unit prices, cook at least three dinners, and record the cost per serving and the time each took. In Session 3 you will cook again and try to make one meal faster, cheaper or more nutritious.

PICTURE STUDY



The Return from Market, Jean-Baptiste-Siméon Chardin, 1739 · Oil on canvas · Musée du Louvre, Paris

Image: [Wikimedia Commons](#), public domain

Jean-Baptiste-Siméon Chardin painted quiet scenes of ordinary Paris households: kitchens, pantries and the people who kept them running. Here a young servant has carried the household's food home from market and pauses for a moment, still holding her load.

Look closely

- Find the loaves of bread and the bag of provisions. How heavy might the load have been to carry home on foot?
- Look at the bottles and jugs on the floor. What do they tell you about how this household stored food and drink?
- Look at her face and posture. Is she rushing or resting?
- Find the open doorway. What other daily work goes on in this house?

Talk about it

1. Shopping in 1739 meant walking to market and carrying everything home. How does your shopping trip compare in effort and planning?
2. Bread was a staple then. What are the inexpensive staples on your own shopping list?

3. Fannie Farmer said exact measurements make cooking teachable. What else would a new cook in this kitchen need to learn?

Safety first. A parent knows about all stove and knife work. Wash hands for 20 seconds before cooking and after touching raw meat or eggs, keep raw meat on its own board, and cook poultry to 165°F and ground meat to 160°F. Turn pot handles inward, keep a lid nearby for grease flare-ups (never water), and check for food allergies before serving anyone.

ACTIVITY

Three Days on My Own Budget

You will act as your own household manager: set a budget, plan balanced meals, shop by unit price, cook, and record what it cost and how long it took.

You will need

- A budget (use the USDA monthly food-plan cost for your age on the thrifty or low-cost plan, divided to three days, or a figure your parents set)
- A grocery store or its online prices, a calculator and your fitness journal
- A kitchen, basic pots and pans, a cutting board, a sharp knife, measuring cups and spoons, and a food thermometer if you have one

Steps

1. **Set the budget (Session 1 or 2).** Write your three-day budget. Example: if the monthly thrifty-plan cost for your age were \$300, three days would be about $300 \div 30 \times 3 = \$30$.
2. **Plan.** Write three days of breakfasts, lunches, dinners and two snacks a day using the MyPlate pattern. Choose at least three dinners you will cook yourself (for example: a sheet-pan dinner of chicken thighs, potatoes and carrots; lentil and vegetable soup with bread; a stir-fry of eggs or beans, frozen vegetables and rice). Plan to use leftovers for lunches.
3. **Make the list.** List every ingredient and the amount needed. Check the pantry first.
4. **Shop.** For at least five items, compare two sizes or brands by unit price and choose. Record the price, size, unit price and servings of every item.
5. **Cook.** Cook your three dinners with a parent nearby. Measure level, time each step, check temperatures, and record total time from start to clean kitchen.
6. **Count the cost.** For each dinner, add the cost of the amounts you actually used and divide by the servings. Total the three days and compare with your budget.
7. **Store leftovers.** Refrigerate within 2 hours in labeled, dated containers.

8. Improve (Session 3). Cook one meal again, aiming to make it faster, cheaper or more nutritious (add a vegetable, swap in beans, use a cheaper cut). Record the new cost and time.

Tips

- Frozen vegetables and fruit are picked ripe, store well and are often cheapest per serving.
- Cook once, eat twice: a pot of soup or a pan of rice can become several meals.
- A treat or a favorite food fits in a budget. Plan it in; there is nothing wrong with enjoying food.

Check your work

- ☐ I planned three balanced days within a budget.
- ☐ I compared unit prices and computed cost per serving for my dinners.
- ☐ I cooked safely and improved one meal on the second try.

FITNESS JOURNAL

1. Copy your three-day plan and shopping table: item, size, price, unit price, servings, cost per serving.
2. Record each dinner: ingredients, time, cost per serving and a rating of taste and effort, for both tries.
3. Make a bar graph of protein per dollar for five foods you priced.
4. Write five lines on what surprised you about the cost of feeding yourself, and one habit you will keep.

From history. Fannie Farmer later opened her own school of cookery in Boston and taught nurses and doctors about feeding the sick. She believed good food was part of good health and that cooking deserved careful study.

COMMON MISTAKES

- Comparing package prices instead of unit prices. A bigger package is often, but not always, cheaper per ounce.
- Buying food without a plan, then wasting it. Plan, list, use leftovers.
- Undercooking poultry or leaving leftovers out for hours. Cook to 165°F and refrigerate within 2 hours.

- Thinking healthy eating must be expensive. Beans, oats, eggs, milk and frozen vegetables are among the cheapest nutrient-dense foods.

Make it a game · Three Day Budget Pitch. Plan three days of meals on a set budget and present to your parent as a financial coach. She quizzes unit price and cost per serving for three items. Use level measurements as Fannie Farmer would. State safe minimum internal temperatures for chicken, beef and leftovers. Lowest cost with best nutrition wins.

3.2 THANKFULNESS AND SELF-CONTROL AT THE TABLE

OBJECTIVES

- Tell how Cannon and Washburn studied hunger in 1912, and explain the hunger and fullness signals of the stomach, gut hormones and brain.
- Explain why eating slowly, without distraction, helps the body notice fullness.
- Describe what Scripture teaches about thankfulness, feasting and self-control at the table.
- Plan, cook and host a thankful family meal, and serve a meal to someone else.

Warm-up. Walk for 2 minutes, then do 10 squats, 10 push-ups at your level, 10 bird-dogs on each side and a 30-second plank. Sit quietly for a minute afterward. Think about it: how often do you eat while looking at a screen? Would you notice when you were full?

WATCH

How does your body know you're full? - Hilary Collier

TED-Ed · 4:33

<https://www.youtube.com/watch?v=YVfyYrEmzgM>

WHEN TO WATCH

After the story paragraph. Write down each hormone it names and what it does.

Note: A TED-Ed cartoon tracing the signals from stomach and gut to the brain's hypothalamus, with the hormones cholecystokinin, leptin and others. It opens with a short quotation about an empty stomach.

BACKUP VIDEO

Hormone control of hunger

khanacademymedicine · 3:37

<https://www.youtube.com/watch?v=EVkFPeP5sFI>

For a more detailed look at the hormones.

KEY TERMS

hunger

The body's signal that it needs food, felt in the stomach and driven by the brain.

ghrelin

A hormone made mainly by the stomach that rises before meals and signals hunger; discovered in 1999.

leptin

A hormone made by fat tissue that tells the brain about the body's long-term energy stores; discovered in 1994.

satiety

The feeling of fullness that tells you to stop eating, which builds during and after a meal.

cholecystokinin (CCK)

A hormone released by the small intestine when food arrives, which helps digestion and signals fullness.

temperance

Self-control: enjoying good things in their right measure. Scripture lists it among the fruit of the Spirit.

CORE IDEAS

The story. In 1912 at Harvard Medical School, the physiologist Walter Cannon and his student A. L. Washburn set out to answer an old question: is the pang of hunger really in the stomach? Washburn trained himself to swallow a narrow rubber tube with a small balloon on the end. Once it was in his stomach, the balloon was gently inflated, and the tube was connected to a recording drum, so every squeeze of the stomach drew a line on paper. Washburn could not see the record. Whenever he felt a hunger pang, he pressed a key that made a separate mark.

How they figured it out. When Cannon compared the two records, Washburn's hunger marks lined up with strong contractions of his empty stomach. Hunger pangs, they concluded, come with the stomach's contractions. Later scientists found the story is bigger: people still feel hunger after the stomach is removed, because the brain also reads chemical messengers. In 1973 researchers showed that the gut hormone **cholecystokinin** makes animals stop eating sooner; in 1994 Jeffrey Friedman's laboratory discovered **leptin**; and in 1999 Japanese scientists discovered **ghrelin**, the "hunger hormone" made in the stomach.

How your body works. Before a meal, ghrelin rises and the stomach begins to churn, and the brain's hypothalamus says, "Eat." As you eat, the stomach stretches, sending signals up the vagus nerve. Food reaching the small intestine releases CCK and other

hormones; rising blood sugar releases insulin; and over the longer term, leptin reports how much energy is stored. The hypothalamus weighs all these signals and fullness grows. These signals take time to build, often many minutes, so a fast meal eaten in front of a screen can outrun them, and a slow meal with conversation gives them time. The aim is to eat **enough**: to stop when satisfied rather than stuffed, and also never to skip the food an active, growing body needs. Undereating is as poor a stewardship as overeating; an athlete or worker who does not eat enough grows weak and tired. If thoughts about food ever feel troubling or out of control, talk to your parents and your doctor; that is wise and brave.

Think it through. Scripture treats the table as a place of thanksgiving. Jesus took the loaves, “and when he had given thanks,” fed five thousand (John 6:11). God commands feasts: on the day the law was read, Nehemiah told the people to “eat the fat, and drink the sweet” and to send portions to those who had nothing, “for the joy of the LORD is your strength” (Nehemiah 8:10). Scripture also warns against being “among riotous eaters of flesh” (Proverbs 23:20-21), and says of honey, “eat so much as is sufficient for thee” (Proverbs 25:16). Temperance, self-control, is a fruit of the Spirit. Gratitude and self-control are not opposites: a thankful person enjoys the gift, notices when it is enough, and shares. And Paul sums it up for every meal: “Whether therefore ye eat, or drink, or whatsoever ye do, do all to the glory of God” (1 Corinthians 10:31).

Try it. You will plan, cook and host a family meal: a set table, a grace, no screens, good conversation, an unhurried pace and a dessert enjoyed together. You will notice your own hunger before, during and after the meal. In Session 3 you will cook a meal for someone outside your household.

PICTURE STUDY



Old Woman Saying Grace (The Prayer without End), Nicolaes Maes, c. 1656 · Oil on canvas · Rijksmuseum, Amsterdam

Image: [Wikimedia Commons](#), public domain

Nicolaes Maes, a pupil of Rembrandt, painted quiet scenes of Dutch homes. Here an old woman bows her head over a plain meal. The painting has long been nicknamed “The Prayer without End,” because the cat is about to pull the food off the table while she prays.

Look closely

- Name every food on the table. Is this a feast or an everyday meal?
- Look at her hands and face. What do they tell you about her thankfulness?
- Find the cat. What is it doing, and what does it add to the story?
- Look at the room and her clothes. Is she rich or poor?

Talk about it

1. Why might someone with a plain meal be especially thankful for it?
2. How does pausing to give thanks change the way you eat?
3. The cat is impatient for the food. How does self-control at the table show love for others?

Safety first. A parent knows about all stove and knife work. Wash hands, cook meats to safe temperatures and refrigerate leftovers within 2 hours. Ask every guest about food allergies before planning the menu, and label any dish you take to someone else with its ingredients.

ACTIVITY

Host a Thankful Table

You will plan, cook and host a family meal the old-fashioned way: a set table, a grace, no screens, real conversation and time to enjoy the food. Then you will carry a meal to someone else.

You will need

- A menu you plan (a main dish, a vegetable, a grain or bread, and a dessert) and the ingredients
- Plates, cups, napkins and a tablecloth; a card with three conversation questions
- Your fitness journal and a simple hunger scale: 1 = very hungry, 5 = comfortable, 8 = stuffed

Steps

1. **Plan (Session 2).** Choose a balanced menu, check allergies, write the shopping list and a cooking timeline that ends with everything ready at the same moment.
2. **Cook and set the table.** Cook the meal with a parent nearby. Set the table neatly; put phones and screens in another room.
3. **Before the meal.** Note your hunger number (1–8). Ask a family member to say grace, or say it yourself, giving thanks for the food and the hands that made it.
4. **An unhurried meal.** Serve yourself a sensible first plate. Put your fork down between bites. Ask your conversation questions (for example: “What was the best part of your week?” “What are you thankful for today?” “What is a meal you remember from childhood?”). Aim for at least 20–30 minutes at the table.
5. **Halfway.** Pause and notice your hunger number. Take seconds if you are still hungry; that is what food is for.
6. **Dessert.** Serve the dessert as a feast to enjoy together, not a reward.
7. **After.** Note your hunger number 15 minutes after the meal. Clean up together and thank whoever helped.

8. Serve someone else (Session 3). Cook a simple meal (soup, bread and fruit, or a casserole) for a neighbor, an elderly church member, a new mother or a family going through a hard time. Label it with ingredients and reheating directions, deliver it with a parent, and record what you made and how it was received.

Tips

- Start the slowest dish first and work backward from the serving time.
- Eating slowly is not a rule to make food smaller; it is a way to taste it and to enjoy the people at the table.
- A thank-you to the cook is part of good manners and good gratitude.

Check your work

- ☐ I can explain how hunger and fullness signals work and why slow meals help.
- ☐ I planned, cooked and hosted a family meal with grace and conversation.
- ☐ I cooked and delivered a meal to someone outside my household.

FITNESS JOURNAL

1. Record your hunger numbers before, halfway and after the meal, how long the meal lasted, and what you noticed.
2. Draw a diagram of the hunger and fullness signals: stomach, small intestine, vagus nerve, hormones (ghrelin, CCK, insulin, leptin) and the hypothalamus.
3. Write a list of twenty things you are thankful for about food and the people who provide it.
4. Write a paragraph on 1 Corinthians 10:31: what eating to the glory of God looks like in your own life.

From history. Walter Cannon also coined the term “fight or flight” for the body’s alarm response and wrote about homeostasis, the body’s way of keeping its inner conditions steady. Hunger and fullness are one of the many balances he studied.

COMMON MISTAKES

- Eating every meal in front of a screen and never noticing fullness or the people around you.
- Thinking self-control means eating as little as possible. It means eating well and enough, in the right measure.

- Treating dessert or food as a reward or a punishment. Feasts and treats are gifts to share.
- Skipping meals on busy days, then eating in a rush later. Plan regular meals and snacks.

Make it a game · Fullness Signal Relay. Eat a small snack slowly with no distractions and pause halfway to note hunger and fullness signals. Explain ghrelin, CCK and leptin in order. Tell Cannon and Washburn's 1912 stomach balloon experiment. Your parent asks the next signal in sequence each time. Then thank God for the food aloud before the next bite.

Scripture. “Whether therefore ye eat, or drink, or whatsoever ye do, do all to the glory of God.” (1 Corinthians 10:31, KJV)

Every meal can be an act of worship: received with thanks, enjoyed in the right measure and shared with others.

UNIT 3

NUTRITION

Soon you may be the one who decides what is in the refrigerator. In this unit you will learn to feed yourself well on a budget, beginning with Fannie Farmer, the Boston cooking teacher whose 1896 cookbook taught Americans to measure ingredients level and exactly, so that anyone who followed a recipe could succeed. You will plan meals with the MyPlate pattern, compare unit prices and cost per serving, work out protein per dollar, practice safe kitchen habits, and shop for and cook several meals yourself.

Then you will think about how we eat, not only what. In 1912 the physiologist Walter Cannon and his student A. L. Washburn used a swallowed balloon to show what happens in the stomach when we feel hungry, and later scientists found the hormones that tell the brain we are full. You will learn how hunger and fullness work, why slow, thankful meals around a table serve both body and soul, and what Scripture says about gratitude, feasting and self-control. You will plan, cook and host a family meal.

PREREQUISITES

- Knows the five food groups, the macronutrients and how to read a Nutrition Facts label (earlier grades)
- Has helped in the kitchen with a parent supervising knives and the stove
- Can divide money amounts and compute a rate (price per ounce)

MASTERY CHECKLIST

- ☐ I can plan balanced meals for several days using the MyPlate pattern and a budget.
- ☐ I can compare unit prices and compute cost per serving and protein per dollar.
- ☐ I can follow kitchen food-safety rules: hand washing, safe internal temperatures and refrigerating leftovers.
- ☐ I can explain how hunger and fullness signals work, from Cannon and Washburn's balloon to the hormones ghrelin, cholecystokinin and leptin.
- ☐ I can plan, cook and host a thankful family meal.

OPTIONAL BOOKS AND GEAR FOR THIS UNIT

- ***The Boston Cooking-School Cook Book*, by Fannie Merritt Farmer (Project Gutenberg)**: Free, public domain. Read her opening pages on measuring and try one of her simple recipes for Lesson 3.1. Some methods are old-fashioned; use modern food-safety temperatures.
- **USDA Food Plans: Cost of Food Monthly Reports (U.S. Department of Agriculture)**: Free. Monthly estimates of what nutritious meals cost on four budget levels, from thrifty to generous, by age. Use it to set your budget in Lesson 3.1.
- **An instant-read food thermometer**: Optional but useful for checking that chicken, ground meat and leftovers reach safe temperatures.

Not required. Every activity in this unit works without them. School Launch has no ties to these authors, publishers or companies.

LESSONS IN THIS UNIT

3.1 Shopping, Budgeting and Cooking for Yourself

3 sessions of 45–50 minutes

3.2 Thankfulness and Self-Control at the Table

3 sessions of 45–50 minutes

UNIT 3 REVIEW

Answer each question. Show your work for the calculations. The review is worth 100 points.

1. **8 pts**

What did Fannie Farmer change about American cooking in 1896, and why did it matter?

2. **10 pts**

Calculation. Rice: a 2-pound bag costs \$2.49 and a 5-pound bag costs \$5.29. Find the unit price per pound of each. Which is the better buy, and by how much per pound?

3. (10 pts)

Calculation. A pot of chili used beans \$1.58, ground turkey \$4.99, canned tomatoes \$1.89, an onion \$0.60 and spices \$0.40, and made 6 servings. What is the cost per serving?

4. (10 pts)

Calculation. A jar of peanut butter costs \$3.20 and holds 14 servings with 7 grams of protein each. Find the grams of protein per dollar and compare with lentils at about 60 grams per dollar.

5. (8 pts)

Describe the MyPlate pattern and name four inexpensive nutrient-dense staples.

6. (10 pts)

Name the four food-safety habits and give the safe internal temperatures for poultry and ground beef, and the rule for leftovers.

7. (10 pts)

Describe the Cannon and Washburn experiment of 1912: method and finding.

8. (10 pts)

Match each signal to its role: ghrelin, cholecystokinin, leptin, stomach stretch. Where in the brain are they weighed?

9. (8 pts)

Why does eating slowly, at a table without screens, help the body notice fullness?

10. (8 pts)

Name two passages of Scripture about feasting or thankfulness and one about self-control at the table.

11. (8 pts)

Short answer (3–5 sentences). Explain why gratitude and self-control at the table go together, and why undereating is not self-control.

ANSWER KEY

1. Her *Boston Cooking-School Cook Book* taught exact, level measurements and clear steps instead of vague amounts, so any cook who followed a recipe could get the same result; cooking became teachable and repeatable.
2. $2.49 \div 2 = \$1.245$ per lb; $5.29 \div 5 = \$1.058$ per lb. The 5-pound bag, by about 19 cents per pound.
3. Total \$9.46; $9.46 \div 6 \approx \$1.58$ per serving.
4. $14 \times 7 = 98$ g; $98 \div 3.20 \approx 31$ grams per dollar, about half as much protein per dollar as lentils.
5. Half the plate fruits and vegetables, a quarter grains (at least half whole grains), a quarter protein foods, plus dairy or another calcium food. Staples: oats, rice, beans, lentils, eggs, milk, peanut butter, frozen vegetables, potatoes, carrots, bananas, canned fish.
6. Clean, separate, cook, chill. Poultry 165°F, ground beef 160°F. Refrigerate leftovers within 2 hours at 40°F or below and eat within 3–4 days; reheat to 165°F.
7. Washburn swallowed a balloon on a tube connected to a recorder that traced stomach contractions; he pressed a key whenever he felt hunger, without seeing the record. His hunger pangs lined up with strong stomach contractions.
8. Ghrelin: made by the stomach, rises before meals, signals hunger. CCK: released by the small intestine when food arrives, signals fullness. Leptin: from fat tissue, reports long-term energy stores. Stomach stretch: signals fullness through the vagus nerve. The hypothalamus weighs them.
9. Fullness signals (stretch, gut hormones, blood sugar) take many minutes to build; a slow, attentive meal gives them time to reach the brain before you have eaten past satisfaction.
10. Any two of: John 6:11 (Jesus gave thanks), Nehemiah 8:10 (eat the fat, drink the sweet, send portions), 1 Corinthians 10:31 (eat and drink to God's glory). Self-control: Proverbs 23:20-21 (riotous eaters) or Proverbs 25:16 (eat honey as is sufficient) or temperance as a fruit of the Spirit.
11. Answers vary. Full credit for: a thankful person enjoys food as a gift, notices when it is enough and shares it; self-control is eating in the right measure, not as little as possible; an active, growing body needs enough food, so undereating fails to care for it, just as overeating does.

UNIT CHALLENGE: A WEEK AT MY OWN TABLE

Plan, shop for and cook a full week of dinners for your family or yourself (at least five you cook), within a budget you set from the USDA food plans. Record the shopping list with unit prices, the cost per serving and time of each dinner, and your food-safety checks. Include your hosted family meal with its hunger notes and conversation questions, and the meal you cooked for someone else. Finish with a one-page “first apartment” plan: ten staple foods, five meals you can cook, and a weekly budget.

LOOK FOR	WHAT IT MEANS
Balanced, budgeted plan	Five or more dinners following the MyPlate pattern, within the budget, with the arithmetic shown.
Smart shopping	Unit prices compared for at least eight items and cost per serving computed for each dinner.
Safe, skilled cooking	Dinners cooked with safe temperatures, clean habits and leftovers stored correctly; a parent confirms.
Thankful table and service	The hosted meal and the meal for someone else are planned, done and reflected on.
First-apartment plan	A realistic list of staples, meals and budget the student could actually use. Effort and growth count, not perfect meals.

UNIT 4

STRENGTH

In earlier grades you learned how muscles grow stronger, the main movement patterns and the idea of progressive overload. Now you will write your own program, the way a strength coach does. The story begins in 1969 at the University of Nebraska, where a pole vaulter named Boyd Epley, recovering from a back injury, started helping football players in the weight room and became the first full-time strength coach in college sports. He went on to gather the coaches who founded the National Strength and Conditioning Association. You will learn the variables of program design (exercise choice, order, sets, reps, load, rest, frequency and progression), how to judge effort with reps in reserve, and how to estimate your strength from a set of reps without ever testing a maximum lift.

Then you will learn to coach. The best coaches are teachers, and the great UCLA basketball coach John Wooden began each season by teaching his players how to put on their socks. You will learn what makes coaching cues work, how to spot a lift, and how to keep a beginner safe, and you will coach a family member through a movement and measure the improvement. Throughout this unit, free weights are used only with a knowledgeable adult present, with a spotter for any pressing lift, technique first, and no one-repetition maximum testing.

PREREQUISITES

- Can perform the squat, hinge, push, pull and carry with good form using body weight or household loads (earlier grades)
- Knows sets, reps, rest and progressive overload (earlier grades)
- Can compute a percent change and evaluate a simple formula

MASTERY CHECKLIST

- ☐ I can design a full-body strength program with exercises, order, sets, reps, rest, frequency and a progression rule.
- ☐ I can judge effort with reps in reserve and estimate strength from a set of 8–10 reps without maximum testing.
- ☐ I can tell how Boyd Epley and the NSCA made strength coaching a profession.
- ☐ I can teach a movement using explanation, demonstration, short cues and feedback, as John Wooden did.
- ☐ I can spot a dumbbell press safely and keep a beginner safe.

OPTIONAL BOOKS AND GEAR FOR THIS UNIT

- **“Strength Training” (Nemours KidsHealth for Teens):** Free. A clear teen article on how strength training works, supervision and safety. Read it with Lesson 4.1.
- **A pair of light dumbbells or one light kettlebell:** Optional. Water jugs, a backpack with books and a broom handle do most of the same jobs. Free weights are used only with a knowledgeable adult present.
- **A light or medium resistance band:** Optional, for rows, pull-aparts and presses.

Not required. Every activity in this unit works without them. School Launch has no ties to these authors, publishers or companies.

LESSONS IN THIS UNIT

4.1 Design Your Own Strength Program

3 sessions of 45–50 minutes

4.2 Coach Someone Else

3 sessions of 45–50 minutes

UNIT 4 REVIEW

Answer each question. Show your work for the calculations. The review is worth 100 points.

1. (8 pts)

Who was Boyd Epley, and what did he do in 1969 and 1978?

2. (10 pts)

Calculation. Use the Epley formula to estimate one-rep strength for (a) a 40-pound dumbbell Romanian deadlift for 9 reps and (b) a 20-pound overhead press for 12 reps.

3. (10 pts)

Calculation. A student's goblet-squat estimate rose from 40 pounds to 48 pounds over six weeks. What is the percent increase? Why is this method safer than testing a maximum?

4. (10 pts)

Calculation. Find the volume load for 3 sets of 10 at 30 pounds, and for 3 sets of 12 at 30 pounds. What percent did volume load increase?

5. (10 pts)

List the program variables a coach must choose, and give recommended values for a high-school lifter for frequency, sets, reps, effort and rest.

6. (8 pts)

Explain reps in reserve. Why do coaches usually prefer ending sets with 1–3 reps in reserve rather than at failure?

7. (8 pts)

State this course's four lifting safety rules.

8. (8 pts)

What did John Wooden teach at the first practice each season, and why? Name his four laws of learning.

9. **10 pts**

Describe Wulf's 1998 ski-simulator experiment and its finding. Turn the internal cue "bend your knees and push your hips back" into an external cue.

10. **8 pts**

Describe how to spot a dumbbell press correctly.

11. **10 pts**

Short answer (4–6 sentences). Explain how you would coach a beginner through the hip hinge, step by step, using Wooden's laws, one cue at a time and safety first.

ANSWER KEY

1. A Nebraska pole vaulter whose career ended with a back injury; in 1969 he became the first full-time strength coach in college sports at Nebraska; in 1978 he gathered 76 strength coaches in Lincoln to found the National Strength Coaches Association, now the NSCA.
2. (a) $40 \times (1 + 9 \div 30) = 40 \times 1.3 = 52$ pounds. (b) $20 \times (1 + 12 \div 30) = 20 \times 1.4 = 28$ pounds.
3. $(48 - 40) \div 40 \times 100 = 20\%$. It uses a set of 8–10 reps with a moderate load, so the lifter never strains a maximal weight with risk to back, joints and form.
4. 900 pounds and 1,080 pounds. $(1,080 - 900) \div 900 \times 100 = 20\%$.
5. Exercise choice, order, frequency, sets, reps, load/effort, rest, progression. Frequency 2–3 non-consecutive days; 2–3 sets; 8–12 reps; 1–3 reps in reserve; 1–2 minutes rest (up to 3 for big lifts).
6. RIR is how many more good reps you could have done. Stopping 1–3 short keeps form clean, lowers injury risk and speeds recovery, while still giving most of the strength benefit.
7. A knowledgeable adult present for free weights; a spotter for any pressing lift; technique first with light loads; no one-repetition maximum testing (estimate from a set of 8–10).
8. How to put on socks without wrinkles and lace shoes firmly, to prevent blisters that keep players off the court. Explanation, demonstration, imitation, repetition.
9. Beginners on a ski simulator told to push on the platform's outer wheels (external focus) learned better than those told to push with their outer foot (internal). Example external cue: "Reach back to close a car door with your hips" or "Sit between your heels."
10. Stand close at the lifter's head, hands near the wrists or forearms, ready to guide the dumbbells up if a rep slows; agree on a signal beforehand; do not grab the elbows; stay attentive every rep.
11. Answers vary. Full credit for: asking about injuries; a brief explanation of why; a slow demonstration (right, wrong, right); learner imitates with a broom handle; one external cue at a time with short feedback; repetition in small sets; counting good reps before and after; light load only once the pattern is solid.

UNIT CHALLENGE: SIX WEEKS STRONGER, AND A COACH

Carry out your six-week program and present it. Include your needs check, the written A/B program with progression rule, a log of every workout (load, reps, RIR), your test sets and Epley estimates before and after with percent changes, and a graph of volume load for one lift. Add your coaching record: checklists, cues, baseline and post-test counts for both coaching sessions, and a note from your learner. Finish with a paragraph on what you learned about planning, patience and teaching.

LOOK FOR	WHAT IT MEANS
Sound program	Covers squat, hinge, push, pull, carry and core; 2–3 non-consecutive days; sets, reps, RIR, rest and a clear progression rule.
Faithful, safe training	About 12–18 workouts logged over six weeks; adult present for free weights, spotter for presses, no maximum testing, loads added in small steps.
Honest retest	Same lifts, warm-up and method as the first test; Epley estimates and percent changes worked correctly.
Coaching	Two coaching sessions with checklists, external cues, before-and-after counts and a revised approach.
Reflection	A thoughtful paragraph on stewardship, patience and serving others through coaching. Effort and growth count, not the size of the numbers.

4.1 DESIGN YOUR OWN STRENGTH PROGRAM

OBJECTIVES

- Tell how Boyd Epley became the first full-time college strength coach and helped found the NSCA.
- Explain the program variables: exercise choice and order, sets, reps, load, rest, frequency and progression.
- Use reps in reserve to set effort, and estimate strength from a set of reps with the Epley formula instead of maximum testing.
- Write a six-week, two-to-three-day full-body program and complete its first workouts with good form.

Warm-up. Do 3 minutes of brisk walking or easy cycling, then 10 bodyweight squats, 10 hip hinges with a broom handle along your back, 10 push-ups at your level, 10 band pull-aparts or arm circles, 5 walking lunges each leg and a 20-second plank. Think about it: a coach once said, “Train movements, not muscles.” What do you think he meant?

WATCH

Program Design for Resistance Training | Volume & Rest Periods | CSCS Chapter 17

Dr. Jacob Goodin · 8:29

<https://www.youtube.com/watch?v=HgCqnDA6cio>

WHEN TO WATCH

After the “How your body works” paragraph. Copy the definitions of volume and the rest-period guidelines.

Note: A university strength-and-conditioning lecture, given with slides, explaining the NSCA’s guidelines for training volume and rest between sets. It is made for college students studying to become strength coaches, so it is dense; pause and take notes. It speaks of loads as percentages of a one-rep maximum; in this course we set loads by reps in reserve instead and never test a maximum. The description advertises the lecturer’s exam-preparation course, which is not needed.

KEY TERMS

training volume

The total work in a session: sets $\times$ reps, or sets $\times$ reps $\times$ load (volume load).

Example: 3 sets $\times$ 10 reps $\times$ 30 pounds = 900 pounds.

estimated one-rep strength

A calculated figure for tracking progress, found from a set of reps. The Epley formula: weight $\times$ (1 + reps $\div$ 30). It is never tested by lifting a maximum.

compound (multi-joint) exercise

An exercise that moves several joints and large muscle groups at once, such as a squat, a hinge or a row.

reps in reserve (RIR)

How many more good reps you could have done when you stop a set. Ending a set with 2 RIR means you could have done 2 more with good form.

2-for-2 rule

An NSCA progression guide: if you can do 2 or more reps beyond your goal in the last set in two workouts in a row, add a little load next time.

CORE IDEAS

The story. In 1969 Boyd Epley was a pole vaulter at the University of Nebraska whose athletic career had been ended by a back injury. While rebuilding his own strength in a cramped weight room, he began helping football players train. Many coaches of that time thought lifting weights made athletes slow and “muscle-bound,” but Epley’s players grew stronger and stayed healthier, and head coach Bob Devaney hired him: the first full-time strength coach in college sports. In 1978 Epley invited strength coaches from across the country to a meeting in Lincoln, Nebraska. Seventy-six came, and together they founded the National Strength Coaches Association, today the National Strength and Conditioning Association (NSCA), which in 1985 began certifying strength coaches.

How they figured it out. Epley and the coaches who followed him turned strength training into a planned, measured craft: test, plan, train, record, progress and test again. They also needed a safe way to track strength without asking athletes to lift as much as possible every few weeks. In a 1985 workout book, Epley published a chart based on a simple formula still used everywhere: **estimated one-rep strength = weight $\times$ (1 + reps $\div$ 30).** Worked example: a goblet squat with a 30-pound dumbbell

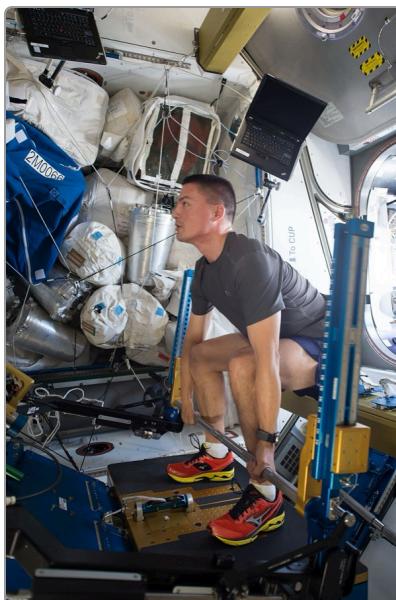
for 10 good reps gives $30 \times (1 + 10 \div 30) = 30 \times 1.33 = \mathbf{40 \text{ pounds}}$. Six weeks later, 35 pounds for 10 reps gives $35 \times 1.33 \approx \mathbf{46.7 \text{ pounds}}$, an increase of $(46.7 - 40) \div 40 \times 100 \approx \mathbf{17 \text{ percent}}$, measured without a single maximum lift. The formula is an estimate, most accurate for sets of about 10 reps or fewer, and it is a number for your journal, not a target to test.

How your body works. A program is built from a few variables. **Exercise choice:** cover the main patterns, squat, hinge, push, pull and carry, plus core work. **Order:** big compound lifts first while you are fresh, smaller exercises after. **Frequency:** 2 or 3 non-consecutive days a week for each muscle group. **Sets and reps:** for a high-school lifter, 2 to 3 sets of 8 to 12 reps per exercise builds strength and muscle safely. **Effort:** end most sets with 1 to 3 **reps in reserve**; grinding to failure adds little and costs form. **Rest:** about 1 to 2 minutes between sets (up to 3 for big lifts). **Progression:** use double progression or the NSCA's 2-for-2 rule, adding small amounts of load (about 2.5 to 5 pounds for upper-body lifts, 5 to 10 for lower-body lifts) only when form stays perfect. Track **volume load** (sets $\times$ reps $\times$ load) to see your work grow: $3 \times 10 \times 30 = 900$ pounds in week 1, $3 \times 10 \times 35 = 1,050$ pounds in week 6. The early gains of training come largely from the nervous system learning to recruit muscle fibers; later gains come from fibers growing, which needs protein, food energy and sleep.

Good form. Our lifting rules are firm. Free weights are used **only with a knowledgeable adult present**. Any pressing lift with dumbbells (a floor or bench press, an overhead press) has a **spotter**. Technique comes first: learn each lift with a broom handle or a light load before adding weight. Brace your trunk, breathe out through the hard part, and never hold your breath. **No one-repetition maximum testing:** we estimate strength from a set of 8–10 reps. Stop a set when form breaks, and stop the session at sharp or joint pain.

Try it. You will run a needs check, write a six-week, two-day (A/B) full-body program with a progression rule, find your starting loads with a set of 8–10 reps at 2 reps in reserve, and complete your first workouts.

PICTURE STUDY



Kjell Lindgren Exercising on the Advanced Resistive Exercise Device, NASA, 2015 · Photograph · International Space Station

Image: [Wikimedia Commons](#), public domain

In weightlessness, bones and muscles that no longer have to hold up the body begin to weaken. To prevent this, astronauts on the International Space Station exercise about two hours a day. The Advanced Resistive Exercise Device uses vacuum cylinders to create resistance of up to several hundred pounds, so astronauts can squat, deadlift, row and press. Their programs are planned by NASA strength and conditioning specialists, a profession that grew from coaches like Boyd Epley.

Look closely

- Look at the bar and his hips and knees. Which movement pattern is he doing?
- Look at his back and stance. What signs of good form can you see?
- Look around the module. Why does every piece of equipment need to be fastened down?
- Look for anything that shows the photo was taken in space and not in a gym on Earth.

Talk about it

1. Why would an astronaut's program include squats and deadlifts most of all?

2. Astronauts train with careful plans and records. What would happen if they trained at random?
3. How is your six-week program like an astronaut's?

Safety first. Free weights are used only with a knowledgeable adult present, and any pressing lift with dumbbells has a spotter. Learn each lift with a broom handle or the lightest load first, train on a clear, non-slip floor in good shoes, add load only in small steps when every rep has good form, and never test a one-rep maximum. Stop at sharp pain, joint pain, dizziness or chest pain, and rest at least one day between hard sessions for the same muscles.

ACTIVITY

My Six-Week Strength Program

You will design a real program the way a strength coach would, find your starting loads safely, and begin training. The goal is steady, faithful progress with good form, not a big number.

You will need

- Light dumbbells or a kettlebell (with a knowledgeable adult present), or water jugs and a backpack with books
- A broom handle, a sturdy bench or step, a towel or mat, a light resistance band if you have one
- A timer and your fitness journal

Steps

1. **Needs check (Session 1 or 2).** Write your goals (general strength, a sport, a job, service), any past injuries, the equipment you have and the days you can train. If you have a health concern, ask your doctor first.
2. **Choose the exercises.** Day A: goblet squat; dumbbell floor press or push-up; one-arm dumbbell row with a hand on a bench; farmer carry; front plank. Day B: dumbbell Romanian deadlift (hinge); split squat; standing overhead press with dumbbells or a band; inverted row under a sturdy table or band row; suitcase carry; side plank. Big lifts first.
3. **Learn the technique.** Practice each lift with a broom handle or the lightest load for 2 sets of 8, with your adult watching and giving feedback. Write two form cues for each (for example: “chest tall, sit between your heels” for the squat; “push your hips back, bar close” for the hinge).
4. **Find starting loads.** For each main lift, choose a load you can lift 8–10 times with good form and about 2 reps left in the tank. Do 1 test set; record load, reps and RIR. Rest 2 minutes between tests. Compute your estimated one-rep strength with the Epley formula for the goblet squat, press, row and Romanian deadlift. (No maximum lifts.)
5. **Write the plan.** Make a 6-week table, alternating A and B on 2 or 3 non-consecutive days a week. Each exercise: 2–3 sets of 8–12 reps, 1–3 RIR, 60–120

seconds rest. Carries: 2–3 trips of 40–60 feet. Planks: 2–3 holds of 20–45 seconds.

6. **Write the progression rule.** Use double progression: when you reach 3 sets of 12 with good form at your target RIR, add the smallest load step (2.5–5 pounds upper body, 5–10 pounds lower body) and return to 8 reps. Plan an easier week (fewer sets) in week 4 if you feel run down.
7. **Workout 1 and 2 (Sessions 2 and 3).** Warm up, then train exactly as planned. A spotter stands by for the floor press and overhead press. Log every set: load, reps, RIR. Compute volume load for the goblet squat.
8. **Plan the retest.** In week 6, repeat your test sets with the same warm-up and loads, and recompute estimated strength and percent change.

Tips

- Write your target load and reps for every set before you lift. A plan on paper keeps you honest.
- If a rep looks different from the first rep, the set is over.
- Progress slows after the first weeks. Small, steady gains are still gains.

Check your work

- ☐ I wrote a six-week program with exercises, order, sets, reps, rest, frequency and a progression rule.
- ☐ I found my starting loads with sets of 8–10 reps and computed estimated strength without maximum testing.
- ☐ I trained with good form, with an adult present and a spotter for pressing lifts.

FITNESS JOURNAL

1. Copy your six-week A/B program as a neat table and fill it in after every workout.
2. Record your test sets and Epley estimates for four lifts, with the formula worked out.
3. Graph the volume load of one lift workout by workout.
4. Write a form card for each exercise with two cues and one common error.

From history. Before the 1960s many coaches warned athletes away from weights. Researchers such as Peter Karpovich of Springfield College measured lifters and found that strength training did not make athletes slow or stiff, and coaches like Epley put the evidence to work.

COMMON MISTAKES

- Testing a maximum lift to see “how strong I am.” Estimate strength from a set of reps instead; it is safer and just as useful for tracking.
- Adding load before form is solid, or adding too much at once.
- Training to failure every set. Leaving 1–3 reps in reserve builds strength with better form and recovery.
- Skipping the hinge and pull patterns and training only the muscles you can see in a mirror.

Make it a game • Program Variable Drill. Your parent names a program variable such as order, sets, reps, load, rest, frequency or progression, and you give a sixty-second explanation. Then apply the two-for-two rule to a lift example. A parent supervises any load. Tell Boyd Epley's story. Draft week one of a six-week plan on paper.

4.2 COACH SOMEONE ELSE

OBJECTIVES

- Tell how John Wooden taught fundamentals, beginning with socks and shoes, and name his four laws of learning.
- Explain why short, external-focus cues help learners, citing Gabriele Wulf's experiments.
- Teach a family member a movement safely with explanation, demonstration, practice and feedback.
- Spot a dumbbell press correctly and measure the learner's improvement.

Warm-up. Lead a family member through your own warm-up: 2 minutes of marching, 10 squats, 10 hip hinges, 10 arm circles each way and 5 inchworms. Watch their form as you go. Think about it: who taught you something well, a skill, a sport, a job, and what did that teacher do that worked?

WATCH

John Wooden's Lesson on Socks and Shoes

John Wooden's Wisdom • 7:55

<https://www.youtube.com/watch?v=3rV32q6jHPM>

WHEN TO WATCH

After the story paragraph. The lesson itself begins after a few minutes of introduction by the broadcaster Vin Scully.

Note: A recording from a public event late in Coach Wooden's life, in which he invites a boy onto the stage and teaches him, step by step, to put on his socks and shoes. A small channel that collects Wooden material; chosen because it shows the coach teaching in his own words.

KEY TERMS

coaching cue

A short word or phrase that reminds a learner what to do, such as “push the floor away.”

external focus

Attention on the effect of a movement in the world (the floor, the bar, a target) rather than on body parts; it usually helps learning.

internal focus

Attention on one's own body parts (“bend your knees,” “squeeze your glutes”).

spotter

A trained helper who stands ready to assist a lifter and take the weight if a rep fails.

laws of learning

Wooden's teaching steps: explanation, demonstration, imitation and repetition.

CORE IDEAS

The story. John Wooden coached basketball at UCLA from 1948 to 1975, and his teams won ten national championships in twelve years, seven of them in a row. Yet at the first practice of every season, he sat his players down, some of them the best high-school players in the country, and showed them how to put on their socks: pull them up snug, smooth out every wrinkle around the heel and toes, then lace and tie the shoes firmly, double-knotted. Wrinkles cause blisters, he explained, and blisters keep a player off the court. Wooden, a devout Christian, saw himself first as a teacher; he had taught high-school English before he ever coached in college.

How they figured it out. Wooden described his method as four “laws of learning”: **explanation, demonstration, imitation and repetition.** Researchers who watched his practices in the 1970s found that most of what he said was short, specific instruction, often a quick demonstration of the right way, the wrong way, and the right way again, rather than long speeches or praise. Later science added a refinement. In 1998 the German researcher Gabriele Wulf and her colleagues taught beginners on a ski simulator. Those told to push on the platform's outer wheels (an **external focus**) learned the movement better than those told to push with their outer foot (an **internal focus**). Dozens of later studies found the same: learners usually move better when cues point to the effect of the movement than to their body parts.

How your body works. A new movement is controlled at first by conscious attention, so it is slow and shaky. With repetition, the nervous system builds a smoother pattern that runs with less thought. Too many instructions at once overload a learner, so give **one cue at a time**. External cues work well for strength movements: for the squat, “sit between your heels” or “spread the floor with your feet”; for the hinge, “push your hips back to close the door behind you” or “slide the bar down

your legs”; for the push-up, “push the floor away.” Give feedback right after a rep, then less often as the learner improves, so he or she learns to feel the movement without you.

Good form. A coach’s first job is safety. Before you teach, ask about injuries and pain; anyone with a health concern checks with a doctor first. Use a broom handle or body weight to teach a pattern, and add only light loads. To **spot a dumbbell press**, stand close at the lifter’s head, hands near the lifter’s wrists or forearms (not the elbows), ready to guide the dumbbells up if a rep slows or stalls; agree beforehand on a signal such as “take it.” Never coach by shouting or by making exercise a punishment. “Two are better than one... For if they fall, the one will lift up his fellow” (Ecclesiastes 4:9-10).

Try it. You will teach a parent, sibling or grandparent either the goblet squat or the hip hinge with a broom handle, count good reps before and after, and reteach in Session 3 with better cues.

PICTURE STUDY



The Country School, Winslow Homer, 1871 · Oil on canvas · Saint Louis Art Museum, Missouri

Image: [Wikimedia Commons](#), public domain

Winslow Homer painted many scenes of country schools in the years after the Civil War. In a one-room school, a single teacher taught children of every age at once, and older pupils often helped teach the younger ones.

Look closely

- Find the teacher. How does she hold the attention of so many children of different ages?
- Look for a child who is not paying attention. What might a good teacher do?
- Look at the ages of the children. How would a lesson for the youngest differ from one for the oldest?
- Find the windows and the light. What does the painting suggest about the mood of the room?

Talk about it

1. In a one-room school, older pupils helped teach younger ones. Why does teaching someone else help you learn?
2. What would Wooden's four laws of learning look like in this classroom?
3. Whom could you teach a skill to this month?

Safety first. Ask your learner about injuries, pain and health concerns first; anyone with a concern checks with a doctor before training. Teach with a broom handle or body weight and add only light loads, with a knowledgeable adult present for free weights and a spotter for any pressing lift. Keep the space clear and stop the lesson at any sharp pain, dizziness or joint pain.

ACTIVITY

Coach a Family Member

You will be the coach: choose a movement, teach it with Wooden's four laws and external cues, measure your learner's good reps before and after, and improve your own coaching the second time.

You will need

- A broom handle, a light dumbbell, kettlebell or water jug, and a sturdy box or chair
- A willing learner (a parent, sibling or grandparent)
- A checklist of 4–5 form points for your movement, a timer and your fitness journal

Steps

1. **Prepare (Session 2).** Choose the goblet squat or the hip hinge. Write a checklist of 4–5 form points (squat: feet about shoulder-width, heels down, knees track over toes, chest tall, hips to at least knee height; hinge: soft knees, hips back, flat back, bar or broom close, stand tall by squeezing the hips forward). Write three external cues.
2. **Safety check.** Ask your learner about injuries and pain. Clear the space.
3. **Baseline.** With no coaching at all, ask your learner to do 8 reps with body weight (squat) or a broom handle along the back (hinge). Count how many reps meet every point on your checklist. Record it.
4. **Explain and demonstrate.** In under a minute, explain why the movement matters (lifting groceries, picking up a child, protecting the back). Show it slowly, the right way, the wrong way, the right way again.
5. **Imitate and repeat.** Have your learner do 3 sets of 5, with 1 minute of rest. Give one external cue at a time and brief feedback after each set (“That was it. This time, sit between your heels.”).
6. **Post-test.** Ask for 8 more reps with no coaching and count the reps that meet every checkpoint. Compute the change.

7. **Spotting practice.** If your household uses dumbbells, have the knowledgeable adult teach you to spot a light dumbbell floor press: hands near the lifter's wrists, agreed signal, guide up, never grab the elbows. Practice with a very light load.
8. **Reteach (Session 3).** Ask your learner what helped most and what confused them. Revise your cues, teach again (or teach a second learner), and record baseline and post-test counts again. If ready, add a light goblet load for one set of 8.

Tips

- Talk less, show more. Most coaching should fit in one short sentence.
- Praise the specific thing done well ("Your back stayed flat that time") rather than saying "good job."
- Coach a beginner as you would want to be coached: patiently and with respect.

Check your work

- ☐ I can name Wooden's four laws of learning and explain why external cues help.
- ☐ I taught a movement safely and measured my learner's good reps before and after.
- ☐ I revised my coaching and taught again.

FITNESS JOURNAL

1. Record your checklist, cues, and the baseline and post-test counts for both sessions, with the change in good reps and percent.
2. Write your learner's feedback and what you changed in your coaching.
3. Write three internal cues and turn each into an external cue.
4. Draw and label the spotter's position for a dumbbell floor press.

From history. Wooden also wrote a "Pyramid of Success," fifteen qualities such as industriousness, self-control and team spirit, with faith and patience at the top. He defined success as peace of mind from knowing you did your best to become the best you are capable of becoming.

COMMON MISTAKES

- Giving five instructions at once. One cue at a time.

- Teaching with a heavy load before the pattern is learned.
- Spotting at the elbows instead of near the wrists, or standing too far away to help.
- Correcting with sarcasm or shouting. Good coaches correct the movement and respect the person.

Make it a game • Coach the Cue. Teach a family member one movement using only short external-focus cues, like push the floor away. Compare to an internal cue like straighten your knees. Time how fast each cue produces improvement. Cite Wulf's experiments and Wooden's four laws of learning. Starting with socks and shoes, show how a good coach begins.

Scripture. “Two are better than one; because they have a good reward for their labour. For if they fall, the one will lift up his fellow: but woe to him that is alone when he falleth; for he hath not another to help him up.” (Ecclesiastes 4:9-10, KJV)

A spotter, a coach and a training partner are living examples of this verse. Strength grows best, and most safely, together.

UNIT 4

STRENGTH

In earlier grades you learned how muscles grow stronger, the main movement patterns and the idea of progressive overload. Now you will write your own program, the way a strength coach does. The story begins in 1969 at the University of Nebraska, where a pole vaulter named Boyd Epley, recovering from a back injury, started helping football players in the weight room and became the first full-time strength coach in college sports. He went on to gather the coaches who founded the National Strength and Conditioning Association. You will learn the variables of program design (exercise choice, order, sets, reps, load, rest, frequency and progression), how to judge effort with reps in reserve, and how to estimate your strength from a set of reps without ever testing a maximum lift.

Then you will learn to coach. The best coaches are teachers, and the great UCLA basketball coach John Wooden began each season by teaching his players how to put on their socks. You will learn what makes coaching cues work, how to spot a lift, and how to keep a beginner safe, and you will coach a family member through a movement and measure the improvement. Throughout this unit, free weights are used only with a knowledgeable adult present, with a spotter for any pressing lift, technique first, and no one-repetition maximum testing.

PREREQUISITES

- Can perform the squat, hinge, push, pull and carry with good form using body weight or household loads (earlier grades)
- Knows sets, reps, rest and progressive overload (earlier grades)
- Can compute a percent change and evaluate a simple formula

MASTERY CHECKLIST

- ☐ I can design a full-body strength program with exercises, order, sets, reps, rest, frequency and a progression rule.
- ☐ I can judge effort with reps in reserve and estimate strength from a set of 8–10 reps without maximum testing.
- ☐ I can tell how Boyd Epley and the NSCA made strength coaching a profession.
- ☐ I can teach a movement using explanation, demonstration, short cues and feedback, as John Wooden did.
- ☐ I can spot a dumbbell press safely and keep a beginner safe.

OPTIONAL BOOKS AND GEAR FOR THIS UNIT

- **“Strength Training” (Nemours KidsHealth for Teens):** Free. A clear teen article on how strength training works, supervision and safety. Read it with Lesson 4.1.
- **A pair of light dumbbells or one light kettlebell:** Optional. Water jugs, a backpack with books and a broom handle do most of the same jobs. Free weights are used only with a knowledgeable adult present.
- **A light or medium resistance band:** Optional, for rows, pull-aparts and presses.

Not required. Every activity in this unit works without them. School Launch has no ties to these authors, publishers or companies.

LESSONS IN THIS UNIT

4.1 Design Your Own Strength Program

3 sessions of 45–50 minutes

4.2 Coach Someone Else

3 sessions of 45–50 minutes

UNIT 4 REVIEW

Answer each question. Show your work for the calculations. The review is worth 100 points.

1. (8 pts)

Who was Boyd Epley, and what did he do in 1969 and 1978?

2. (10 pts)

Calculation. Use the Epley formula to estimate one-rep strength for (a) a 40-pound dumbbell Romanian deadlift for 9 reps and (b) a 20-pound overhead press for 12 reps.

3. (10 pts)

Calculation. A student's goblet-squat estimate rose from 40 pounds to 48 pounds over six weeks. What is the percent increase? Why is this method safer than testing a maximum?

4. (10 pts)

Calculation. Find the volume load for 3 sets of 10 at 30 pounds, and for 3 sets of 12 at 30 pounds. What percent did volume load increase?

5. (10 pts)

List the program variables a coach must choose, and give recommended values for a high-school lifter for frequency, sets, reps, effort and rest.

6. (8 pts)

Explain reps in reserve. Why do coaches usually prefer ending sets with 1–3 reps in reserve rather than at failure?

7. (8 pts)

State this course's four lifting safety rules.

8. (8 pts)

What did John Wooden teach at the first practice each season, and why? Name his four laws of learning.

9. **10 pts**

Describe Wulf's 1998 ski-simulator experiment and its finding. Turn the internal cue "bend your knees and push your hips back" into an external cue.

10. **8 pts**

Describe how to spot a dumbbell press correctly.

11. **10 pts**

Short answer (4–6 sentences). Explain how you would coach a beginner through the hip hinge, step by step, using Wooden's laws, one cue at a time and safety first.

ANSWER KEY

1. A Nebraska pole vaulter whose career ended with a back injury; in 1969 he became the first full-time strength coach in college sports at Nebraska; in 1978 he gathered 76 strength coaches in Lincoln to found the National Strength Coaches Association, now the NSCA.
2. (a) $40 \times (1 + 9 \div 30) = 40 \times 1.3 = 52$ pounds. (b) $20 \times (1 + 12 \div 30) = 20 \times 1.4 = 28$ pounds.
3. $(48 - 40) \div 40 \times 100 = 20\%$. It uses a set of 8–10 reps with a moderate load, so the lifter never strains a maximal weight with risk to back, joints and form.
4. 900 pounds and 1,080 pounds. $(1,080 - 900) \div 900 \times 100 = 20\%$.
5. Exercise choice, order, frequency, sets, reps, load/effort, rest, progression. Frequency 2–3 non-consecutive days; 2–3 sets; 8–12 reps; 1–3 reps in reserve; 1–2 minutes rest (up to 3 for big lifts).
6. RIR is how many more good reps you could have done. Stopping 1–3 short keeps form clean, lowers injury risk and speeds recovery, while still giving most of the strength benefit.
7. A knowledgeable adult present for free weights; a spotter for any pressing lift; technique first with light loads; no one-repetition maximum testing (estimate from a set of 8–10).
8. How to put on socks without wrinkles and lace shoes firmly, to prevent blisters that keep players off the court. Explanation, demonstration, imitation, repetition.
9. Beginners on a ski simulator told to push on the platform's outer wheels (external focus) learned better than those told to push with their outer foot (internal). Example external cue: "Reach back to close a car door with your hips" or "Sit between your heels."
10. Stand close at the lifter's head, hands near the wrists or forearms, ready to guide the dumbbells up if a rep slows; agree on a signal beforehand; do not grab the elbows; stay attentive every rep.
11. Answers vary. Full credit for: asking about injuries; a brief explanation of why; a slow demonstration (right, wrong, right); learner imitates with a broom handle; one external cue at a time with short feedback; repetition in small sets; counting good reps before and after; light load only once the pattern is solid.

UNIT CHALLENGE: SIX WEEKS STRONGER, AND A COACH

Carry out your six-week program and present it. Include your needs check, the written A/B program with progression rule, a log of every workout (load, reps, RIR), your test sets and Epley estimates before and after with percent changes, and a graph of volume load for one lift. Add your coaching record: checklists, cues, baseline and post-test counts for both coaching sessions, and a note from your learner. Finish with a paragraph on what you learned about planning, patience and teaching.

LOOK FOR	WHAT IT MEANS
Sound program	Covers squat, hinge, push, pull, carry and core; 2–3 non-consecutive days; sets, reps, RIR, rest and a clear progression rule.
Faithful, safe training	About 12–18 workouts logged over six weeks; adult present for free weights, spotter for presses, no maximum testing, loads added in small steps.
Honest retest	Same lifts, warm-up and method as the first test; Epley estimates and percent changes worked correctly.
Coaching	Two coaching sessions with checklists, external cues, before-and-after counts and a revised approach.
Reflection	A thoughtful paragraph on stewardship, patience and serving others through coaching. Effort and growth count, not the size of the numbers.

UNIT 5

AEROBIC TRAINING

In 1962 the Oregon track coach Bill Bowerman visited his friend Arthur Lydiard in New Zealand, went out for a run with a club of ordinary townspeople, and could barely keep up. He came home convinced that running was not only for champions but for everyone, started a public jogging program in Eugene, and in 1966 wrote a little book called *Jogging* with a cardiologist, W. E. Harris. In this unit you will design your own aerobic plan the way a coach would: find your resting and estimated maximum heart rates, compute training zones with heart-rate reserve, balance hard and easy days, and plan six weeks of progression.

Then you will put the whole course together. Johnny Kelley started the Boston Marathon sixty-one times and finished fifty-eight, the last at age eighty-four; his secret was not talent alone but a lifetime of steady habits. Your capstone is a twelve-week personal fitness plan for life after school that combines aerobic training, strength, mobility, food, water and rest, with tests at the start and end. The course ends with a family fitness day that you plan and lead.

PREREQUISITES

- Can find a pulse and compute heart rate in beats per minute (earlier grades)
- Knows aerobic and anaerobic energy, intervals and pacing (earlier grades)
- Has completed the strength program in Unit 4 and the activity week in Unit 1

MASTERY CHECKLIST

- ☐ I can estimate maximum heart rate two ways and compute training zones with the Karvonen (heart-rate reserve) method.
- ☐ I can tell how Bill Bowerman brought jogging to America and explain the hard-easy principle.
- ☐ I can design a six-week aerobic plan with frequency, intensity, time, type and a sensible progression.
- ☐ I can design a twelve-week personal fitness plan with goals, tests, phases and an easier recovery week.
- ☐ I can plan and lead a family fitness day.

OPTIONAL BOOKS AND GEAR FOR THIS UNIT

- **A heart-rate monitor or sports watch:** Optional. Counting your pulse for 15 seconds and multiplying by 4 works for every activity in this unit.
- **A measured route: a school track (4 laps $\approx$ 1 mile) or a mapped loop:** Optional but helpful for the time trial. A phone map app can measure a loop around your neighborhood.

Not required. Every activity in this unit works without them. School Launch has no ties to these authors, publishers or companies.

LESSONS IN THIS UNIT

5.1 Design Your Own Aerobic Plan

3 sessions of 45–50 minutes

5.2 Capstone: A Twelve-Week Personal Fitness Plan and the Family Fitness Day

3 sessions of 45–50 minutes

UNIT 5 REVIEW

Answer each question. Show your work for the calculations. The review is worth 100 points.

1. **8 pts**

How did Bill Bowerman bring jogging to America? Name the book and its co-author.

2. **8 pts**

What is the hard-easy principle, and what did Stephen Seiler's studies of endurance athletes find about training intensity?

3. **12 pts**

Calculation. An 18-year-old has a resting heart rate of 58 bpm. Estimate HRmax with $208 - 0.7 \times \text{age}$, find HRR, and compute the easy zone (60–70%) and the 90% interval target.

4. **8 pts**

Name four ways aerobic training changes the body.

5. **8 pts**

Explain FITT and give a sensible weekly example for a beginner.

6. **10 pts**

Calculation. A runner's 1-mile time trial improved from 9:12 to 8:30 over six weeks. What is the improvement in seconds and percent?

7. **8 pts**

Tell the story of Johnny Kelley and what it shows about fitness for life.

8. **10 pts**

Calculation. Weekly aerobic minutes: weeks 1–4 are 150, 165, 180, 135. Find the percent change from week 1 to week 2, week 2 to week 3, and week 3 to week 4. What is week 4 for?

9. **8 pts**

Write one SMART goal for strength and one for a habit, and explain what makes each SMART.

10. **8 pts**

Define periodization, specificity and reversibility.

11. **12 pts**

Short answer (5–7 sentences). Describe your twelve-week plan: goals, phases, a typical week, how you will handle a busy week, and how Hebrews 12:1 and 1 Timothy 4:8 shape your view of training.

ANSWER KEY

1. After running with Arthur Lydiard's jogging club in New Zealand in 1962, he started a public jogging program in Eugene and in 1966 published *Jogging* with cardiologist W. E. Harris; it sold over a million copies and helped start the running boom.
2. A hard workout is followed by one or more easy days for recovery. Seiler found that endurance athletes do most of their training, often about 80%, at easy intensity, with a smaller share of hard work.
3. $HR_{max} = 208 - 12.6 = 195.4 \approx 195$. $HRR = 195 - 58 = 137$. 60%: $0.6 \times 137 + 58 = 140.2 \approx 140$; 70%: $95.9 + 58 \approx 154$. Easy zone ≈ 140 – 154 bpm. 90%: $123.3 + 58 \approx 181$ bpm.
4. Larger, stronger left ventricle and higher stroke volume; lower resting heart rate; more blood volume; more capillaries and mitochondria in muscle; higher VO_2 max.
5. Frequency, Intensity, Time, Type. Example: 4 days a week; three easy sessions (talk-test pace) and one interval session; 20–40 minutes each; running or cycling.
6. $9:12 = 552$ s; $8:30 = 510$ s. 42 seconds; $42 \div 552 \times 100 \approx 7.6\%$.
7. Kelley won Boston in 1935 and 1945, ran in two Olympics, started Boston 61 times and finished 58, the last full race in 1992 at 84, and lived to 97. Steady, enjoyed habits kept over decades matter more than talent or a perfect plan.
8. $150 \rightarrow 165$: +10%; $165 \rightarrow 180$: about +9%; $180 \rightarrow 135$: -25%. Week 4 is a recovery (deload) week so the body can adapt.
9. Answers vary. Example: "Raise my estimated goblet-squat strength by 15% by week 12" and "Sleep at least 8 hours on 5 nights a week for 12 weeks." Each is specific, measurable, achievable, relevant and has a deadline.
10. Periodization: planning training in phases with purposes, including recovery weeks. Specificity: you improve at what you practice. Reversibility: fitness fades when training stops.
11. Answers vary. Full credit for: three SMART goals; three four-week phases with recovery weeks; a typical week with 3–5 aerobic sessions (mostly easy), 2 strength days, mobility, rest and Sunday rest; a realistic plan for busy weeks; and a thoughtful connection: run the long race with patience, keep exercise below godliness, use strength to serve.

UNIT CHALLENGE: MY PERSONAL FITNESS PLAN FOR LIFE AFTER SCHOOL

Present your capstone: three SMART goals, your baseline tests, your twelve-week plan with weekly numbers and recovery weeks, your zone card and six-week aerobic log from Lesson 5.1, and your plan for busy weeks, illness, weather and travel.

Include the record of the family fitness day you led. Finish with a one-page reflection drawing on the whole course: activity, water, food, strength and endurance, and how you will keep caring for the body God gave you while serving others.

LOOK FOR	WHAT IT MEANS
Goals and tests	Three SMART goals and a complete, dated baseline test table that can be repeated fairly in week 12.
Sound twelve-week plan	Three phases with recovery weeks, mostly easy aerobic work with one quality session a week, two strength days, mobility, rest days and the numbers worked out.
Realism and adherence	A plan the student can actually follow, with backups for busy weeks, illness, weather and travel, and a named partner.
Family fitness day	Planned and led safely, with stations from every unit, a cooked meal and everyone included at his or her own level.
Reflection	A thoughtful page tying the course together with stewardship and service. Effort and honesty count, not the size of the numbers.

5.1 DESIGN YOUR OWN AEROBIC PLAN

OBJECTIVES

- Tell how Bill Bowerman's visit to New Zealand in 1962 led to the American jogging movement, and explain the hard-easy principle.
- Estimate maximum heart rate ($220 - \text{age}$ and $208 - 0.7 \times \text{age}$) and compute zones with the Karvonen formula.
- Explain how aerobic training changes the heart, blood and muscles.
- Write and begin a six-week aerobic plan using FITT and hard-easy days.

Warm-up. Walk 2 minutes, jog easily 2 minutes, then do 10 leg swings each way on each leg, 10 walking lunges, 10 high knees, 10 butt kicks and 2 relaxed strides of 15 seconds. Count your pulse for 15 seconds right after. Think about it: could you run for 30 minutes without stopping if you went slowly enough? What usually makes beginners quit?

WATCH

The Karvonen Formula for Target Heart Rate Calculation

Physiotutors • 3:43

https://www.youtube.com/watch?v=UzRZDDMoD_M

WHEN TO WATCH

After the “How your body works” paragraph. Work his example alongside him, then redo it with your own numbers.

Note: A physiotherapy teaching channel explains the Karvonen formula on a whiteboard. He estimates maximum heart rate with $220 - \text{age}$; the lesson also shows the newer $208 - 0.7 \times \text{age}$ formula. The description advertises the channel's app and courses, which are not needed.

KEY TERMS

maximum heart rate (HRmax)

The highest heart rate a person can reach. Estimated by $220 - \text{age}$ or, more accurately for many people, $208 - 0.7 \times \text{age}$ (Tanaka, 2001).

heart-rate reserve (HRR)

HRmax minus resting heart rate: the range available for exercise.

Karvonen formula

Target heart rate = (HRR × training percentage) + resting heart rate.
Published by the Finnish scientist Martti Karvonen in 1957.

FITT

Frequency, Intensity, Time and Type: the four dials of any training plan.

hard-easy principle

Following a hard training day with one or more easy days, so the body can recover and adapt. Bowerman made it a rule for his runners.

stroke volume

The amount of blood the heart pumps with each beat. Aerobic training increases it, so resting heart rate falls.

CORE IDEAS

The story. Bill Bowerman coached track and field at the University of Oregon for twenty-four years, and his teams won four national championships. In 1962 he travelled to New Zealand to visit Arthur Lydiard, the coach whose runners had won Olympic gold in 1960. Lydiard had started a jogging club in Auckland for ordinary people, including middle-aged men recovering from heart trouble. Out on a run with the club, Bowerman, a famous coach in his fifties, found he could hardly keep up. He came home and started a public jogging program in Eugene, and a crowd of townspeople turned out.

How they figured it out. Bowerman and a Eugene cardiologist, W. E. Harris, studied the beginners in their program, recording how they progressed and what kept them going. In 1966 they published a short book, *Jogging*, that sold over a million copies and helped start the running boom in America. Their advice was simple: start slowly, alternate jogging and walking, run at a pace where you can talk, and add a little at a time. With his college runners Bowerman insisted on the **hard-easy principle**: a hard workout must be followed by one or more easy days. Modern research agrees. Studies of endurance athletes by the exercise scientist Stephen Seiler found that most of their training, often about 80 percent, is done at an easy, conversational intensity, with a smaller share of hard work.

How your body works. Aerobic training makes the heart's left ventricle larger and stronger, so **stroke volume** rises and the same output needs fewer beats; resting heart rate falls. Blood volume increases, muscles grow more capillaries and mitochondria, and VO₂ max (the most oxygen you can use) rises, often by 15 percent

or more over months of training in a beginner. To guide intensity, use **heart-rate reserve**. Worked example for a 17-year-old with a resting heart rate of 62 bpm: $HR_{max} \approx 208 - 0.7 \times 17 = 208 - 11.9 \approx 196$ bpm (the older $220 - 17$ gives 203). $HRR = 196 - 62 = 134$. Easy zone, 60–70%: $0.60 \times 134 + 62 \approx 142$ to $0.70 \times 134 + 62 \approx 156$ bpm. Tempo, about 80–85%: about **169–176 bpm**. Intervals, 90% and above: about **183 bpm** or more. Formulas are estimates; individuals vary by 10 bpm or more, so check zones with the talk test (easy: full sentences; tempo: short phrases; intervals: a word or two).

Think it through. A good aerobic plan sets the FITT dials. **Frequency:** 3 to 5 days a week. **Intensity:** mostly easy, with one harder session (intervals or a tempo run) and, if you like, one longer easy session. **Time:** start where you are (even 20 minutes of run-walk) and add about 10 percent a week as a rule of thumb, with an easier week every third or fourth week. **Type:** running, cycling, brisk hiking, swimming, rowing or a mix; choose what you will keep doing. Rest days and sleep are when adaptation happens. “They that wait upon the LORD shall renew their strength; they shall run, and not be weary” (Isaiah 40:31): training is a picture of patient, faithful renewal.

Try it. You will measure your resting heart rate, compute your zones, run a 1-mile time trial as a baseline, check your easy zone with the talk test, and write a six-week aerobic plan.

PICTURE STUDY



The Hunters in the Snow, Pieter Bruegel the Elder, 1565 · Oil on wood panel · Kunsthistorisches Museum, Vienna

Image: [Wikimedia Commons](#), public domain

Pieter Bruegel painted a series of pictures of the seasons for a merchant in Antwerp. In this winter scene, hunters return home on foot through the snow after a long day, while in the valley below villagers skate, play and work on the frozen ponds.

Look closely

- Look at the hunters' posture and the dogs' tails. How long do you think they have been walking? Is this an easy day or a hard one?
- Find the skaters on the ponds below. Which of them are working hard and which are gliding easily?
- Find the people at the fire by the inn. What are they doing, and why would warmth and food matter after a day in the cold?
- Follow the path down the hill toward the village. How far do the hunters still have to go?

Talk about it

1. A long day of hunting on foot in snow is endurance work. Which zone would most of it be in, and when might it reach a hard zone?

2. How does the painting show the hard-easy principle: work, then rest and warmth?
3. What winter activities could keep your aerobic plan going through the cold months?

Safety first. Warm up for at least 5–10 minutes before the time trial and cool down after. Run with a buddy on a track or a safe route away from traffic, in daylight or with reflective clothing, with water, and in the cooler part of hot days. Stop and tell an adult at chest pain, dizziness, fainting, trouble breathing or sharp pain; a doctor should clear anyone with a heart condition or asthma before all-out efforts.

ACTIVITY

My Zones and My Six-Week Aerobic Plan

You will find your own numbers, test your fitness with a time trial, check your easy zone, and write a six-week plan you can actually follow.

You will need

- A watch or phone timer (a heart-rate monitor is optional)
- A track or measured 1-mile route
- Your fitness journal and a calculator

Steps

1. **Resting heart rate.** On three mornings before getting out of bed, count your pulse for 60 seconds. Average the three. (Start this before Session 2.)
2. **Compute your zones (Session 2).** Estimate HRmax both ways ($220 - \text{age}$ and $208 - 0.7 \times \text{age}$). Using the second, compute HRR and your zones: easy 60–70%, steady 70–80%, tempo 80–88%, intervals 90%+. Write them on a card.
3. **Time trial.** Warm up 10 minutes (walk, jog, 3 strides). Run 1 mile as evenly as you can at your best sustainable effort (walk if you need to). Record each quarter split, total time and your pulse at the finish ($15 \text{ seconds} \times 4$). Cool down 10 minutes.
4. **Check your easy zone (Session 3).** Jog or walk-jog 20–30 minutes at a pace where you can speak in full sentences. Check your pulse every 5 minutes. Does the talk test match your computed easy zone? Adjust the zone card if needed.
5. **Write the plan.** Make a 6-week table with 3–5 sessions a week: 2–3 easy sessions (easy zone, 20–45 minutes), 1 quality session (for example 6×2 minutes in the interval zone with 2 minutes easy between, or 15–20 minutes in the tempo zone), and optionally 1 longer easy session. Put an easy or rest day after every hard day.
6. **Progress sensibly.** Increase total weekly minutes by about 10% for two weeks, then hold or ease back in week 3; repeat for weeks 4–6. Plan to repeat the 1-mile time trial in week 6.

7. **Fit it with strength.** Place your two Unit 4 strength days on easy aerobic days, not right before your quality session.
8. **Log.** For every session record type, minutes, average pulse or talk-test result, effort (1–10) and how you felt.

Tips

- Easy days should feel easy. Most beginners run their easy days too hard and their hard days not hard enough.
- Walk breaks are a tool, not a failure. Bowerman's beginners alternated jogging and walking.
- Your numbers are for comparing with yourself next time, not with anyone else.

Check your work

- ☐ I computed my heart-rate zones with the Karvonen method and checked my easy zone with the talk test.
- ☐ I ran a 1-mile time trial with splits as my baseline.
- ☐ I wrote a six-week plan using FITT, hard-easy days and a sensible progression.

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1. Copy your resting heart rates, HRmax estimates, HRR and zone card, with the arithmetic shown.
2. Record your time-trial splits and graph them; mark whether you paced evenly.
3. Write your six-week plan as a table and log each session.
4. Write a paragraph on Bowerman and Lydiard: why jogging for ordinary people was a new idea in the 1960s.

From history. Martti Karvonen published his heart-rate method in 1957 after a small study of young men training on a treadmill. He found that training at about 60 percent or more of heart-rate reserve improved fitness, while lighter training did little; that finding still shapes training zones today.

COMMON MISTAKES

- Running every session as hard as possible. Most training should be easy; hard days need easy days after them.

- Treating a formula's HRmax as exact. Check zones with the talk test and adjust.
- Increasing distance or time too fast. About 10% a week, with easier weeks, is a sensible guide.
- Skipping the warm-up before a time trial or intervals.

Make it a game • Zone Duel. Estimate maximum heart rate two ways, 220 minus age and 208 minus 0.7 times age, and calculate your Karvonen zones. Race your parent to finish. Do a twenty-minute session in zone two with pulse checks. Tell Bowerman's New Zealand story. Explain the hard-easy principle. Closest estimates after a test win.

5.2 CAPSTONE: A TWELVE-WEEK PERSONAL FITNESS PLAN AND THE FAMILY FITNESS DAY

OBJECTIVES

- Tell the story of Johnny Kelley’s sixty-one Boston Marathons and what it shows about lifelong habits.
- Write SMART fitness goals and choose fair tests to measure them.
- Design a twelve-week plan in three four-week phases with an easier recovery week in each, combining aerobic, strength, mobility, food, water and rest.
- Plan and lead a family fitness day.

Warm-up. Lead the family in a warm-up you design: 2 minutes of marching or easy jogging, then 8–10 reps each of squats, arm circles, lunges, hip hinges and push-ups at everyone’s own level, and 2 relaxed strides. Think about it: picture yourself at sixty. What would you like your body to be able to do, and what would you need to start doing now?

WATCH

The man who ran 61 Boston Marathons – Doc Emrick remembers the legendary Johnny Kelley | NBC Sports

NBC Sports • 6:17

<https://www.youtube.com/watch?v=3zCqmr4CAi4>

WHEN TO WATCH

After the story paragraph.

Note: A short NBC Sports feature narrated by the broadcaster Doc Emrick, with archival photographs and film of Kelley from the 1930s to the 1990s and his statue on the course. It opens with quick images of other long-career athletes.

KEY TERMS

SMART goal

A goal that is Specific, Measurable, Achievable, Relevant and Time-bound, such as “Run 3 miles without walking by March 1.”

periodization

Planning training in phases, each with a purpose, so the body builds, recovers and peaks instead of doing the same thing every week.

recovery (deload) week

A planned easier week, often about 25–40% less training, that lets the body absorb the work of the weeks before.

adherence

Sticking with a plan over time. The best plan is the one you will actually follow.

baseline test

A measurement at the start of a plan, repeated the same way at the end to see progress.

CORE IDEAS

The story. John A. Kelley was born in Medford, Massachusetts, in 1907. He ran his first Boston Marathon in 1928, won it in 1935 and again in 1945, and ran the marathon for the United States at the Olympic Games of 1936 and 1948. But what made him a legend came later. He kept running Boston, year after year, into his seventies and eighties. When he ran his last full Boston Marathon in 1992, at eighty-four, he had started the race sixty-one times and finished fifty-eight. In 1993 a statue was put up on the course near Heartbreak Hill showing two runners hand in hand: young Johnny Kelley and old Johnny Kelley. He lived to ninety-seven.

How they figured it out. Kelley had no laboratory and no heart-rate watch. What he had was a habit: he ran most days, often at an easy pace, for decades, and he enjoyed it. Researchers who study lifelong exercisers find what his life suggests. Fitness falls with age far more slowly in people who keep training; a seventy-year-old who has trained for life can have the aerobic fitness of a sedentary person decades younger. And the most important factor in any plan is **adherence**: whether you keep doing it. A modest plan followed for years beats a perfect plan abandoned in March.

How your body works. Every principle of this course comes together in a twelve-week plan. **Overload** and **progression** make the body adapt; **recovery** lets it adapt; **specificity** means you improve at what you practice; **reversibility** means fitness fades if you stop. Coaches organize this with **periodization**: three four-week phases, each with three building weeks and one easier recovery week. Worked example of weekly aerobic minutes: phase 1: 150, 165, 180, then 135 (recovery); phase 2: 180, 195, 210, then 160; phase 3: 210, 225, 240, then a test week. Each building week rises by about 8–10%; each recovery week drops about 25%; and week 11 is 60% above week 1. Strength follows the same pattern: two days a week, adding reps then load,

easing off in weeks 4, 8 and 12. Sleep (8–10 hours for teenagers), enough food and steady water are part of the plan, not extras.

Think it through. “Wherefore seeing we also are compassed about with so great a cloud of witnesses, let us lay aside every weight, and the sin which doth so easily beset us, and let us run with patience the race that is set before us” (Hebrews 12:1). The Christian life is a long race, run with patience, and so is a healthy life. Train the body as a faithful steward, keep exercise in its place below godliness, and use your strength for others. Then gather your family and celebrate the gift of a body that can move.

Try it. You will set goals, take baseline tests, write your twelve-week plan, and plan and lead a family fitness day.

PICTURE STUDY



Clarence DeMar, Boston Marathon Champion, Bain News Service, c. 1910s · Photograph · Library of Congress, Washington, D.C.

Image: [Wikimedia Commons](#), public domain

Clarence DeMar won the Boston Marathon seven times between 1911 and 1930, more than anyone else, and won a bronze medal in the marathon at the 1924 Olympic Games. He worked as a printer and later taught printing at a teachers' college in New Hampshire. Like Johnny Kelley, who ran against him, he kept racing for decades, finishing his last Boston Marathon at sixty-five and running a 15-kilometer race at sixty-nine.

Look closely

- Look at the runner's clothes and shoes. How are they different from a modern runner's?
- Look at his posture and face. What qualities do you think a seven-time marathon champion needed?
- Look for anything in the photograph that tells you when it was taken.
- Look at his build. Does a champion need a particular look, or a particular habit of training?

Talk about it

1. DeMar and Kelley both ran for more than forty years. What habits make that possible?

2. Which of your own activities could you still be doing at sixty or seventy?
3. Who in your family or church could be part of your “cloud of witnesses” in keeping your plan?

Safety first. Warm up before every test and cool down after. Baseline tests are done at your own best safe effort, with an adult present for any free-weight lift, a spotter for pressing lifts and no maximum lifts. On the family fitness day, let everyone move at his or her own level, offer water and shade, check food allergies, and have anyone with a health concern follow the doctor’s advice.

ACTIVITY

My Twelve-Week Plan and the Family Fitness Day

You will write the plan you will follow after this course ends, test yourself at the start, and lead your family in a day of movement, food and thanksgiving.

You will need

- Your fitness journal with your logs from Units 1–5
- A track or measured route, a timer, your strength equipment and a family calendar
- Food and water for a family meal, and simple station equipment from earlier units

Steps

1. **Set goals (Session 1).** Write three SMART goals: one aerobic (for example “Run 2 miles continuously in my easy zone by week 12”), one strength (“Raise my estimated goblet-squat strength by 15%”), and one habit (“Sleep at least 8 hours on 5 nights a week”).
2. **Baseline tests (Session 2).** After a thorough warm-up: 1-mile time trial; maximum good push-ups in one set; a 2-minute count of good bodyweight squats; a front-plank hold (to 2 minutes); a sit-and-reach; and a test set of 8–10 reps for two lifts with Epley estimates. Record everything with the date. These will be retested in week 12.
3. **Write the plan.** A 12-week calendar in three phases of four weeks: three building weeks and one recovery week (about 25% less) in each. Each week: 3–5 aerobic sessions (mostly easy, one quality), 2 strength sessions, 2–3 short mobility sessions, one full rest day, and a Sunday of worship and rest.
4. **Show the numbers.** List weekly aerobic minutes and strength sets for all 12 weeks, with the percent change between weeks. Check that no building week rises more than about 10% and that recovery weeks fall in weeks 4, 8 and 12.
5. **Plan for real life.** Write what you will do on a busy week (a 20-minute minimum), when sick or injured (rest and see a doctor), in bad weather, and when traveling. Name a training partner.

6. **Plan the family fitness day.** Schedule 90 minutes to 2 hours: your warm-up; stations from each unit (the service circuit, a water table with a hydration quiz, a balance or strength station you coach, a heart-rate station); a family walk-run or relay where everyone sets his or her own goal; a cool-down; and a balanced meal you cook.
7. **Lead it (Session 3).** Lead the day. Coach with one cue at a time, keep everyone safe, and record what each person did. Give thanks together at the meal.
8. **Start.** Begin week 1 of your plan the next day, and set a calendar reminder for your week-12 retest.

Tips

- Choose activities you enjoy. Enjoyment is the strongest predictor of sticking with a plan.
- Write your plan where you will see it, and tell someone your goals.
- On the family day, praise effort, not speed. The youngest and oldest set the pace for everyone's joy.

Check your work

- ☐ I wrote three SMART goals and recorded baseline tests.
- ☐ I designed a twelve-week plan with three phases, recovery weeks and the numbers shown.
- ☐ I planned and led a family fitness day safely.

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1. Copy your goals, baseline test table and twelve-week calendar.
2. Graph your planned weekly aerobic minutes across the 12 weeks, marking the recovery weeks.
3. Record the family fitness day: stations, who did what, the meal and a few lines on how it went.
4. Write a letter to yourself to open in one year: what you hope you are still doing, and why.

From history. The Boston Marathon was first run in 1897, inspired by the marathon at the first modern Olympic Games in Athens the year before. It is the oldest annual marathon in the world.

COMMON MISTAKES

- Writing a plan so ambitious that it collapses in week two. Start where you are.
- Leaving out recovery weeks and rest days. Adaptation happens during rest.
- Measuring success by looks instead of what you can do. Our tests measure ability, effort and habit.
- Stopping when the course ends. The real course starts now.

Make it a game • Lifetime Plan Defense. Defend your twelve-week plan to your parent as a coach would. State three SMART goals and the fair test for each. She plays Johnny Kelley and asks what keeps a habit alive for sixty-one marathons. Name your deload week. Take your baseline test and sign your plan. Strongest defense scores the round.

Scripture. “Wherefore seeing we also are compassed about with so great a cloud of witnesses, let us lay aside every weight, and the sin which doth so easily beset us, and let us run with patience the race that is set before us,” (Hebrews 12:1, KJV)

The life of faith and a life of good health are both long races, run with patience and encouraged by others who ran before us.

UNIT 5

AEROBIC TRAINING

In 1962 the Oregon track coach Bill Bowerman visited his friend Arthur Lydiard in New Zealand, went out for a run with a club of ordinary townspeople, and could barely keep up. He came home convinced that running was not only for champions but for everyone, started a public jogging program in Eugene, and in 1966 wrote a little book called *Jogging* with a cardiologist, W. E. Harris. In this unit you will design your own aerobic plan the way a coach would: find your resting and estimated maximum heart rates, compute training zones with heart-rate reserve, balance hard and easy days, and plan six weeks of progression.

Then you will put the whole course together. Johnny Kelley started the Boston Marathon sixty-one times and finished fifty-eight, the last at age eighty-four; his secret was not talent alone but a lifetime of steady habits. Your capstone is a twelve-week personal fitness plan for life after school that combines aerobic training, strength, mobility, food, water and rest, with tests at the start and end. The course ends with a family fitness day that you plan and lead.

PREREQUISITES

- Can find a pulse and compute heart rate in beats per minute (earlier grades)
- Knows aerobic and anaerobic energy, intervals and pacing (earlier grades)
- Has completed the strength program in Unit 4 and the activity week in Unit 1

MASTERY CHECKLIST

- ☐ I can estimate maximum heart rate two ways and compute training zones with the Karvonen (heart-rate reserve) method.
- ☐ I can tell how Bill Bowerman brought jogging to America and explain the hard-easy principle.
- ☐ I can design a six-week aerobic plan with frequency, intensity, time, type and a sensible progression.
- ☐ I can design a twelve-week personal fitness plan with goals, tests, phases and an easier recovery week.
- ☐ I can plan and lead a family fitness day.

OPTIONAL BOOKS AND GEAR FOR THIS UNIT

- **A heart-rate monitor or sports watch:** Optional. Counting your pulse for 15 seconds and multiplying by 4 works for every activity in this unit.
- **A measured route: a school track (4 laps $\approx$ 1 mile) or a mapped loop:** Optional but helpful for the time trial. A phone map app can measure a loop around your neighborhood.

Not required. Every activity in this unit works without them. School Launch has no ties to these authors, publishers or companies.

LESSONS IN THIS UNIT

5.1 Design Your Own Aerobic Plan

3 sessions of 45–50 minutes

5.2 Capstone: A Twelve-Week Personal Fitness Plan and the Family Fitness Day

3 sessions of 45–50 minutes

UNIT 5 REVIEW

Answer each question. Show your work for the calculations. The review is worth 100 points.

1. **8 pts**

How did Bill Bowerman bring jogging to America? Name the book and its co-author.

2. **8 pts**

What is the hard-easy principle, and what did Stephen Seiler's studies of endurance athletes find about training intensity?

3. **12 pts**

Calculation. An 18-year-old has a resting heart rate of 58 bpm. Estimate HRmax with $208 - 0.7 \times \text{age}$, find HRR, and compute the easy zone (60–70%) and the 90% interval target.

4. **8 pts**

Name four ways aerobic training changes the body.

5. **8 pts**

Explain FITT and give a sensible weekly example for a beginner.

6. **10 pts**

Calculation. A runner's 1-mile time trial improved from 9:12 to 8:30 over six weeks. What is the improvement in seconds and percent?

7. **8 pts**

Tell the story of Johnny Kelley and what it shows about fitness for life.

8. **10 pts**

Calculation. Weekly aerobic minutes: weeks 1–4 are 150, 165, 180, 135. Find the percent change from week 1 to week 2, week 2 to week 3, and week 3 to week 4. What is week 4 for?

9. **8 pts**

Write one SMART goal for strength and one for a habit, and explain what makes each SMART.

10. **8 pts**

Define periodization, specificity and reversibility.

11. **12 pts**

Short answer (5–7 sentences). Describe your twelve-week plan: goals, phases, a typical week, how you will handle a busy week, and how Hebrews 12:1 and 1 Timothy 4:8 shape your view of training.

ANSWER KEY

1. After running with Arthur Lydiard's jogging club in New Zealand in 1962, he started a public jogging program in Eugene and in 1966 published *Jogging* with cardiologist W. E. Harris; it sold over a million copies and helped start the running boom.
2. A hard workout is followed by one or more easy days for recovery. Seiler found that endurance athletes do most of their training, often about 80%, at easy intensity, with a smaller share of hard work.
3. $HR_{max} = 208 - 12.6 = 195.4 \approx 195$. $HRR = 195 - 58 = 137$. 60%: $0.6 \times 137 + 58 = 140.2 \approx 140$; 70%: $95.9 + 58 \approx 154$. Easy zone ≈ 140 –154 bpm. 90%: $123.3 + 58 \approx 181$ bpm.
4. Larger, stronger left ventricle and higher stroke volume; lower resting heart rate; more blood volume; more capillaries and mitochondria in muscle; higher VO_2 max.
5. Frequency, Intensity, Time, Type. Example: 4 days a week; three easy sessions (talk-test pace) and one interval session; 20–40 minutes each; running or cycling.
6. $9:12 = 552$ s; $8:30 = 510$ s. 42 seconds; $42 \div 552 \times 100 \approx 7.6\%$.
7. Kelley won Boston in 1935 and 1945, ran in two Olympics, started Boston 61 times and finished 58, the last full race in 1992 at 84, and lived to 97. Steady, enjoyed habits kept over decades matter more than talent or a perfect plan.
8. $150 \rightarrow 165$: +10%; $165 \rightarrow 180$: about +9%; $180 \rightarrow 135$: -25%. Week 4 is a recovery (deload) week so the body can adapt.
9. Answers vary. Example: "Raise my estimated goblet-squat strength by 15% by week 12" and "Sleep at least 8 hours on 5 nights a week for 12 weeks." Each is specific, measurable, achievable, relevant and has a deadline.
10. Periodization: planning training in phases with purposes, including recovery weeks. Specificity: you improve at what you practice. Reversibility: fitness fades when training stops.
11. Answers vary. Full credit for: three SMART goals; three four-week phases with recovery weeks; a typical week with 3–5 aerobic sessions (mostly easy), 2 strength days, mobility, rest and Sunday rest; a realistic plan for busy weeks; and a thoughtful connection: run the long race with patience, keep exercise below godliness, use strength to serve.

UNIT CHALLENGE: MY PERSONAL FITNESS PLAN FOR LIFE AFTER SCHOOL

Present your capstone: three SMART goals, your baseline tests, your twelve-week plan with weekly numbers and recovery weeks, your zone card and six-week aerobic log from Lesson 5.1, and your plan for busy weeks, illness, weather and travel.

Include the record of the family fitness day you led. Finish with a one-page reflection drawing on the whole course: activity, water, food, strength and endurance, and how you will keep caring for the body God gave you while serving others.

LOOK FOR	WHAT IT MEANS
Goals and tests	Three SMART goals and a complete, dated baseline test table that can be repeated fairly in week 12.
Sound twelve-week plan	Three phases with recovery weeks, mostly easy aerobic work with one quality session a week, two strength days, mobility, rest days and the numbers worked out.
Realism and adherence	A plan the student can actually follow, with backups for busy weeks, illness, weather and travel, and a named partner.
Family fitness day	Planned and led safely, with stations from every unit, a cooked meal and everyone included at his or her own level.
Reflection	A thoughtful page tying the course together with stewardship and service. Effort and honesty count, not the size of the numbers.