Lung volumes: calculate, then explain

John Hay Biomedical | Human Body Systems | Original simulated practice | Review candidate

Start here

How much air can move, and how much stays behind? First, calculate with the supplied records. Next, explain what the comparison shows. Use this packet, paper or a document, and a calculator. No equipment or personal health information is needed for this practice.

This original practice supports **PLTW HBS Activity 3.1.6, A Little TLC**. Its numbers were created for this exercise. They are not student measurements, real patient records, normal ranges or the official PLTW case. Your teacher assigns any separate hands-on work.

Reference R: the words and rules

Volume means the amount of space something occupies. Here, air volume is recorded in **liters (L)**. A capacity combines two or more lung volumes.

Symbol	Meaning
TV: tidal volume	Air moved during one quiet breath.
IRV: inspiratory reserve volume	Extra air that can be inhaled after a normal breath in.
ERV: expiratory reserve volume	Extra air that can be exhaled after a normal breath out.
RV: residual volume	Air left after breathing out as fully as possible.
VC: vital capacity	The largest volume moved between a full breath in and a full breath out.
TLC: total lung capacity	All the air in the lungs after a full breath in, including the air that stays behind.

Figure F1: how the parts fit

TV + IRV + ERV = VC

VC + RV = TLC

This original text model groups the volumes. Notice that RV belongs in TLC but not VC. The model shows how quantities combine, not lung shape or a breathing trace.

Think of three bins that can be emptied and one reserve bin that stays filled. The emptied bins model VC. All four model TLC. Lungs do not contain separate bins; this analogy only tracks amounts.

Air moves when breathing muscles change chest volume and pressure. A spirometer measures air moving in or out. RV stays inside after a full exhale and is not measured by spirometry. In this packet, RV is a stated assumption used for arithmetic, not a measured result.

Model M: one worked example

Use this example to learn the steps. Use Records E1 and E2 for your own work.

Model M input	Value (L)
TV	0.4
IRV	2.0
ERV	0.8
RV, assumed for this model	1.1

1. Write the rule: VC = TV + IRV + ERV.

2. Put in the values: VC = 0.4 + 2.0 + 0.8 = **3.2 L**.

3. Write the second rule: TLC = VC + RV.

4. Put in the values: TLC = 3.2 + 1.1 = **4.3 L**.

These totals describe Model M. They do not tell us whether a person is healthy.

Try the rule: If Model M's IRV rises by 0.2 L while all other values stay the same, how would VC change? Explain without starting the whole calculation again.

Records E1 and E2: your simulated inputs

Copy these values exactly. All entries use liters. E1 and E2 are separate original classroom models, not two tests on one person.

Input (L)	E1: Model A	E2: Model B
TV	0.6	0.7
IRV	2.4	2.6
ERV	0.9	1.0
RV, assumed for each model	1.2	1.2

Record E3: what is and is not supplied

Only the volumes above and the rules in Reference R are supplied. There are no breathing-time measurements, medical histories, reference ranges, oxygen measurements or images of air sacs. You may compare the calculated capacities. You cannot use this packet to rank health or fitness or to identify a disease.

Day 1: build your calculation record

I want you to show where each total came from. Keep your own record even if you discuss the steps with a partner.

1. Read Reference R and Figure F1. Study Model M, then answer its Try the rule question.

2. Copy E1 and E2 into your notes. Mark each RV value **assumed**, not measured.

3. Complete all four rows below. Write the formula, the substituted values, the total and L.

4. Answer the two check questions. Save the table and answers as one PDF. Check that each page is readable.

Model M change prediction and reason: _____

Your calculation	Formula, substituted values and result
Model A: VC	_____
Model A: TLC	_____
Model B: VC	_____
Model B: TLC	_____

Check 1: Which supplied quantity is excluded from VC? Explain why.

_____

_____

Check 2: What did you calculate using an assumed value? Explain why that result is not a direct measurement.

_____

_____

Turn in: your Model M prediction, the four calculation rows and both check answers. Use **Wk15 Data table: Spirometry lab** in your own Schoology section. Follow its posted due date. Keep the same record for Day 2. If I already accepted equivalent work, do not submit it again.

Need a smaller first step? Start with Model A's VC row. Copy the first formula from F1. Put the three matching E1 values under it. Add them and write L. RV is used in the next row.

Sources and official activity

OpenStax: The Process of Breathing supports the definitions and capacity relationships. MedlinePlus: Lung Function Tests explains the different tests. Checked September 5, 2026. These links are optional; the required rules are printed in this packet.

For the official PLTW activity, open **PLTW Student Handouts and Daily Directions (HBS)** in your Schoology section: HBS 1292 or HBS 6792. Look for **3.1.6 A Little TLC**. Keep official case work separate. This practice does not complete the official activity or its hands-on skills.

Day 2: explain the comparison

Use yesterday's table to answer: **Which model has the larger calculated VC, and what does that tell us?** A claim is your answer. Evidence is the exact information supporting it. Reasoning explains how the evidence supports the answer.

1. Recheck the two VC calculations against Reference R. If you find an error, revise the row and keep the correction visible.

2. Name the model with the larger VC. Subtract the smaller VC from the larger VC and record the difference in liters.

3. Write one paragraph using the five prompts below. Use E1 and E2 for the comparison and E3 for its limit.

4. Check your paragraph, then save it with the corrected calculation table as one PDF. Submit it to your section's Day 2 assignment.

Paragraph part	Write a sentence that does this
Claim	Name the model with the larger calculated VC.
Evidence	State both calculated VC values and their difference, with L. Identify E1 and E2.
Reasoning	Use Reference R and the three component values to explain why the VC totals differ.
Meaning	Explain what the VC comparison describes about the amount of air that can move in these models.
Limit	Use E3 to explain one conclusion the records cannot support.

Use these prompts as an outline, not five additional assignments. Do not infer the size or number of air sacs from a volume total.

Turn in: one paragraph and your corrected table in **Wk15 CER: Spirometry data CER analysis**. Follow the posted due date. If upload fails, save your work and tell me; continue the work.

Find your own section

Course section	Day 1: calculation record	Day 2: explanation
HBS 1292	Open Day 1 assignment	Open Day 2 assignment
HBS 6792	Open Day 1 assignment	Open Day 2 assignment

PDF upload help. Next, use the same habit in other body systems: name the quantity, show how it was obtained and explain what it means.