Pitch, Frequency, and A440

A hands-on sound investigation connecting vibration, hertz, octaves, and the tuning reference A440.

Find the Note **TEACHER PLAN + STUDENT WORKSHEET**

At a glance

Grade band	Grouping	Prior knowledge	Materials
Grades 6–12	Demonstration, teams, individual	Higher/lower; decimals	Instruments or voices, rubber bands or ruler, calculator, Find the Note

Driving question: What exactly changes in the air when a pitch sounds higher?

Success criteria:

- Define frequency and hertz using a complete sentence.
- Connect faster vibration with higher pitch.
- Explain A440 as a shared reference, not a rule of nature.
- Use doubling and halving to predict octave frequencies.
- Collect and interpret imperfect real-world pitch data.

Launch: make vibration visible (8 minutes)

Pluck a stretched rubber band or ruler. Change the vibrating length and repeat. Students silently show thumbs-up when pitch rises and thumbs-down when it falls.

Ask:

- What did you see change?
- What did you hear change?
- How might we measure the motion?

Define **frequency** as the number of complete vibration cycles per second. One cycle per second is one **hertz (Hz)**.

Teach: from motion to pitch (12 minutes)

Higher frequencies are generally perceived as higher pitches. Lower frequencies are perceived as lower pitches. Frequency is physical and measurable; pitch is the musical perception we assign to that vibration.

Introduce the common reference **A4 = 440 Hz**. Orchestras may tune to slightly different references, but a shared A allows an ensemble to agree on pitch.

Pitch	Predicted frequency	Relationship
A2	110 Hz	Two octaves below A4
A3	220 Hz	One octave below A4
A4	440 Hz	Reference
A5	880 Hz	One octave above A4

One octave up doubles frequency. One octave down halves frequency. The pitch classes feel related because the vibration rates form a 2:1 ratio.

Investigation: can live sound equal exactly 440? (20 minutes)

In teams, collect five readings of A4 or the nearest playable A.

Trial	Frequency	Difference from target	Observation
1			
2			
3			
4			
5			

Protocol:

1. Predict whether the first attempt will be above or below the target.
2. Produce a steady note for at least two seconds.
3. Record a representative reading—not every flicker.
4. Change one variable (air speed, embouchure, finger pressure, vocal placement, or instrument adjustment).
5. Repeat and annotate what changed.

Discuss why readings fluctuate: natural vibrato, breath, tone onset, room noise, competing overtones, and the limits of measurement.

> Scientific data can vary and still be useful. Look for a stable center and a repeatable pattern.

Octave challenge (10 minutes)

Assign each team a starting frequency. Students calculate one octave above and below, then verify with an instrument, keyboard, or detector when the range permits.

Ask advanced students: “If a pitch is 330 Hz, what are its octave partners?” Expected: 165 Hz and 660 Hz.

Differentiate

Support: Use only the A-family table and whole-number arithmetic.

On level: Calculate octave partners for measured frequencies.

Extend: Compare equal-tempered A440 predictions with measured values; investigate why frequency steps between adjacent notes are not equal numbers of hertz.

Misconceptions to catch

- Frequency and loudness are the same. Loudness relates mainly to amplitude.
- A440 means every A is 440 Hz. Only A4 is.
- An octave adds 440 Hz. An octave multiplies frequency by 2.
- A fluctuating reading means the detector is broken. Live sound naturally varies.

Printable student page

Explain

1. Frequency is measured in _____, meaning _____.
2. Faster vibration usually produces a _____ pitch.
3. Why do ensembles agree on a reference pitch?
4. If A4 is 440 Hz, calculate A2, A3, and A5.

Analyze

5. A student records 438.7, 439.4, 440.3, 441.0, and 440.1 Hz. Is the student's A centered reasonably near 440? Use evidence.

6. Which variable would you change first to make the data more reliable?

7. Explain the octave relationship using both musical language and a numerical ratio.

Exit ticket

Complete this causal chain: shorter/faster vibration → _____ frequency → _____ perceived pitch.

Answer key and teacher look-fors

1 hertz; cycles per second. 2. higher. 3. So musicians share a consistent pitch standard. 4. 110, 220, 880 Hz.

2 Yes; the values cluster around 440 with small live-performance variation. Answers should reference the overall center, not demand one perfect trial. 7. Same pitch class one register higher/lower; frequency ratio 2:1.