MIDI Pattern Transposition

Move a whole pattern while preserving its rhythm.

Name _____ Date _____

Use MIDI note numbers: adding 12 moves up one octave; adding 2 moves up two semitones. This exercise names MIDI 60 as C4. Other apps may use different octave labels.

Event	Pitch / MIDI	Start (beat)	Length (beats)
1	C4 / 60	1	1
2	E4 / 64	2	2
3	G4 / 67	4	1

Use the model above. Write a brief answer for each item.

1. Transpose event 1 up 2 semitones. Give its new MIDI number.

2. Transpose event 2 up 2 semitones. Give its new MIDI number.

3. Transpose event 3 up 2 semitones. Give its new MIDI number.

4. Move original event 1 up one octave. Give its new MIDI number.

5. Move original event 3 down one octave. Give its new MIDI number.

6. After pitch transposition only, when does event 2 start?

7. After pitch transposition, how long is event 2?

8. Events 1 and 2 are 4 semitones apart. Both move up 2 semitones. What is their new distance?

MIDI Duration and Velocity

Separate how long a note lasts from its attack data.

Name _____ Date _____

These are MIDI 1.0 note-on velocities (1-127). Velocity may affect loudness or tone depending on the instrument. Length is in beats; it is not velocity. All notes use the same preset.

Note	Pitch	Length (beats)	Velocity
1	C4	1	48
2	C4	2	48
3	C4	1	96
4	E4	1	72

Use the model above. Write a brief answer for each item.

1. Which two notes have the same pitch and velocity but different lengths?

2. Which C4 note lasts longest?

3. Which two notes differ only in velocity?

4. Which note has the largest velocity value?

5. Set note 2 to 1 beat. Which property changed?

6. Set note 1's velocity from 48 to 72. Does its length change?

7. Is velocity 96 guaranteed to sound twice as loud as 48?

8. For a longer note with the same attack value, edit length or velocity?

Quantization Distance Lab

Choose the nearest beat without changing every property.

Name _____ Date _____

Quantize each start to the nearest whole beat at 100% strength. Move the entire note; preserve its duration and pitch. All positions are in quarter-note beats. None is exactly halfway.

Event	Original start	Length	Target grid
A	1.10	0.50	1, 2, 3, 4, 5
B	1.85	1.00	1, 2, 3, 4, 5
C	3.20	0.50	1, 2, 3, 4, 5
D	3.90	1.00	1, 2, 3, 4, 5

Use the model above. Write a brief answer for each item.

1. What is the new start of A?

2. What is the new start of B?

3. What is the new start of C?

4. What is the new start of D?

5. Which events move earlier?

6. Which event moves farthest, and by how much?

7. What is the new end position of B?

8. Does this operation preserve the original small timing offsets?

Tempo and Project Duration

Calculate elapsed time for a fixed musical length.

Name _____ Date _____

Every project is in 4/4 with a constant quarter-note BPM. Seconds = measures x 4 x 60 / BPM. Count-in, pauses, pickups, and reverb tails are excluded. A calculator is allowed.

Project	Measures	BPM	Extra time
A	4	120	None
B	8	120	None
C	4	60	None
D	8	96	None

Use the model above. Write a brief answer for each item.

1. How many quarter-note beats are in A?

2. How many seconds long is A?

3. How many seconds long is B?

4. How many seconds long is C?

5. How many seconds long is D?

6. A doubles to 240 BPM. What is its new duration?

7. At 120 BPM, how many complete 4/4 measures fit in 10 seconds?

8. Why must an audible reverb tail be checked separately when exporting?

Mono and Stereo Routing

Match recorded channels with the source you intend to capture.

Name _____ Date _____

Mono stores one channel; stereo stores two. Use the listed connected sources only. Panning a mono track changes its left/right playback position; it does not create a second recorded source.

Setup	Connected source	Goal
A	One microphone on input 1	Record that microphone
B	Keyboard L on 1; R on 2	Keep its stereo output
C	Two separate student mics on 1 and 2	Edit each voice separately

Use the model above. Write a brief answer for each item.

1. For A, choose one mono input or a stereo pair.

2. For B, choose mono or stereo to keep L and R.

3. For C, use one mixed track or two separate mono tracks?

4. Which setup needs both channels to preserve its stated stereo output?

5. In A, is input 2 another microphone?

6. Pan A left. Does the recording gain a new source?

7. Does a two-channel file by itself prove two different signals were recorded?

8. For C, which track should use input 2?

Sample-Rate Counting Lab

Count sample values without confusing them with musical beats.

Name _____ Date _____

Sample rate is samples per second PER CHANNEL. 1 kHz = 1,000 Hz. Total sample values = sample rate x seconds x channels. Count sample values, not bytes. A calculator is allowed.

File	Sample rate	Duration	Channels
A	48,000 Hz	2 seconds	1
B	48,000 Hz	2 seconds	2
C	44,100 Hz	1 second	1

Use the model above. Write a brief answer for each item.

1. Write 48 kHz in Hz.

2. How many sample values are in A?

3. How many sample values are in B, across both channels?

4. How many sample values are in C?

5. How many sample values are in one channel of B?

6. How many are in 0.5 second of mono audio at 48 kHz?

7. Does 48 kHz mean 48,000 musical beats per second?

8. A and B have equal duration and rate. Why does B contain twice as many values?

PCM Bit-Depth Lab

Compare amplitude codes in a simplified digital-audio model.

Name _____ Date _____

For integer PCM, N bits allow 2 to the power N distinct amplitude codes per sample. The 2-, 3-, and 4-bit examples are teaching models, not recommended recording settings. Keep sample rate fixed.

Model	Bits per sample	Example code words
A	2	00, 01, 10, 11
B	3	000 through 111
C	4	0000 through 1111

Use the model above. Write a brief answer for each item.

1. How many distinct codes does A allow?

2. How many distinct codes does B allow?

3. How many distinct codes does C allow?

4. Which model has the most amplitude codes?

5. Add one bit. How does the number of possible codes change?

6. Does a higher bit depth mean more samples per second?

7. Does changing an already damaged recording to more bits recover its original missing detail?

8. At the same amplitude range, do more codes mean finer or coarser steps?

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Event	Pitch / MIDI	Start (beat)	Length (beats)
1	C4 / 60	1	1
2	E4 / 64	2	2
3	G4 / 67	4	1

Use the model above. Write a brief answer for each item.

1. Transpose event 1 up 2 semitones. Give its new MIDI number.

62

2. Transpose event 2 up 2 semitones. Give its new MIDI number.

66

3. Transpose event 3 up 2 semitones. Give its new MIDI number.

69

4. Move original event 1 up one octave. Give its new MIDI number.

72

5. Move original event 3 down one octave. Give its new MIDI number.

55

6. After pitch transposition only, when does event 2 start?

Beat 2

7. After pitch transposition, how long is event 2?

2 beats

8. Events 1 and 2 are 4 semitones apart. Both move up 2 semitones. What is their new distance?

4 semitones: 66 - 62 = 4.

MIDI Duration and Velocity

Separate how long a note lasts from its attack data.

Name _____ Date _____

These are MIDI 1.0 note-on velocities (1-127). Velocity may affect loudness or tone depending on the instrument. Length is in beats; it is not velocity. All notes use the same preset.

Note	Pitch	Length (beats)	Velocity
1	C4	1	48
2	C4	2	48
3	C4	1	96
4	E4	1	72

Use the model above. Write a brief answer for each item.

1. Which two notes have the same pitch and velocity but different lengths?

Notes 1 and 2

2. Which C4 note lasts longest?

Note 2: 2 beats

3. Which two notes differ only in velocity?

Notes 1 and 3

4. Which note has the largest velocity value?

Note 3: 96

5. Set note 2 to 1 beat. Which property changed?

Length (duration)

6. Set note 1's velocity from 48 to 72. Does its length change?

No. It remains 1 beat.

7. Is velocity 96 guaranteed to sound twice as loud as 48?

No. The instrument response determines the result.

8. For a longer note with the same attack value, edit length or velocity?

Length; keep velocity unchanged.

Quantization Distance Lab

Choose the nearest beat without changing every property.

Name _____ Date _____

Quantize each start to the nearest whole beat at 100% strength. Move the entire note; preserve its duration and pitch. All positions are in quarter-note beats. None is exactly halfway.

Event	Original start	Length	Target grid
A	1.10	0.50	1, 2, 3, 4, 5
B	1.85	1.00	1, 2, 3, 4, 5
C	3.20	0.50	1, 2, 3, 4, 5
D	3.90	1.00	1, 2, 3, 4, 5

Use the model above. Write a brief answer for each item.

1. What is the new start of A?

Beat 1

2. What is the new start of B?

Beat 2

3. What is the new start of C?

Beat 3

4. What is the new start of D?

Beat 4

5. Which events move earlier?

A and C

6. Which event moves farthest, and by how much?

C: 0.20 beat earlier.

7. What is the new end position of B?

3.00: start 2.00 + length 1.00.

8. Does this operation preserve the original small timing offsets?

No. It removes those offsets by aligning starts to the grid.

Tempo and Project Duration

Calculate elapsed time for a fixed musical length.

Name _____ Date _____

Every project is in 4/4 with a constant quarter-note BPM. Seconds = measures x 4 x 60 / BPM. Count-in, pauses, pickups, and reverb tails are excluded. A calculator is allowed.

Project	Measures	BPM	Extra time
A	4	120	None
B	8	120	None
C	4	60	None
D	8	96	None

Use the model above. Write a brief answer for each item.

1. How many quarter-note beats are in A?

16

2. How many seconds long is A?

8 seconds

3. How many seconds long is B?

16 seconds

4. How many seconds long is C?

16 seconds

5. How many seconds long is D?

20 seconds

6. A doubles to 240 BPM. What is its new duration?

4 seconds

7. At 120 BPM, how many complete 4/4 measures fit in 10 seconds?

5 measures

8. Why must an audible reverb tail be checked separately when exporting?

It may continue after the final musical beat.

Mono and Stereo Routing

Match recorded channels with the source you intend to capture.

Name _____ Date _____

Mono stores one channel; stereo stores two. Use the listed connected sources only. Panning a mono track changes its left/right playback position; it does not create a second recorded source.

Setup	Connected source	Goal
A	One microphone on input 1	Record that microphone
B	Keyboard L on 1; R on 2	Keep its stereo output
C	Two separate student mics on 1 and 2	Edit each voice separately

Use the model above. Write a brief answer for each item.

1. For A, choose one mono input or a stereo pair.

One mono input: input 1.

2. For B, choose mono or stereo to keep L and R.

Stereo: input pair 1 and 2.

3. For C, use one mixed track or two separate mono tracks?

Two separate mono tracks.

4. Which setup needs both channels to preserve its stated stereo output?

B

5. In A, is input 2 another microphone?

No. Only input 1 is connected.

6. Pan A left. Does the recording gain a new source?

No. Its playback position changes.

7. Does a two-channel file by itself prove two different signals were recorded?

No. The channels could contain identical signals.

8. For C, which track should use input 2?

The track for the second student microphone.

Sample-Rate Counting Lab

Count sample values without confusing them with musical beats.

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File	Sample rate	Duration	Channels
A	48,000 Hz	2 seconds	1
B	48,000 Hz	2 seconds	2
C	44,100 Hz	1 second	1

Use the model above. Write a brief answer for each item.

1. Write 48 kHz in Hz.

48,000 Hz

2. How many sample values are in A?

96,000

3. How many sample values are in B, across both channels?

192,000

4. How many sample values are in C?

44,100

5. How many sample values are in one channel of B?

96,000

6. How many are in 0.5 second of mono audio at 48 kHz?

24,000

7. Does 48 kHz mean 48,000 musical beats per second?

No. It counts audio samples per second per channel.

8. A and B have equal duration and rate. Why does B contain twice as many values?

It has two channels instead of one.

PCM Bit-Depth Lab

Compare amplitude codes in a simplified digital-audio model.

Name _____ Date _____

For integer PCM, N bits allow 2 to the power N distinct amplitude codes per sample. The 2-, 3-, and 4-bit examples are teaching models, not recommended recording settings. Keep sample rate fixed.

Model	Bits per sample	Example code words
A	2	00, 01, 10, 11
B	3	000 through 111
C	4	0000 through 1111

Use the model above. Write a brief answer for each item.

1. How many distinct codes does A allow?

4: 2 x 2.

2. How many distinct codes does B allow?

8: 2 x 2 x 2.

3. How many distinct codes does C allow?

16: 2 x 2 x 2 x 2.

4. Which model has the most amplitude codes?

C

5. Add one bit. How does the number of possible codes change?

It doubles.

6. Does a higher bit depth mean more samples per second?

No. Sample rate controls that.

7. Does changing an already damaged recording to more bits recover its original missing detail?

No. More storage precision does not restore lost detail.

8. At the same amplitude range, do more codes mean finer or coarser steps?

Finer steps between representable levels.