

Representing & Compressing Data

Name: _____ Period: _____ Date: _____

Objectives

- Explain how text, images, and analog data are represented with bits (DAT-1.A).
- Describe sampling as a way to approximate analog data digitally (DAT-1.A.10).
- Compare lossless and lossy compression and choose the right one for a context (DAT-1.D).

Directions: Answer each section. Where a question asks you to choose, always justify *why*.

Section 1: Analog vs. Digital & Sampling

1. Define **analog data** and give one real-world example.

2. Define **digital data** and explain how it differs from analog data.

3. **Sampling** approximates analog data digitally. Explain what "sampling" means in one sentence.

4. A recording app measures a sound wave's height 44,100 times per second. If it instead measured only 100 times per second, how would the digital recording change? Would it use more or fewer bits?

5. Why is using digital data to approximate analog data considered an example of **abstraction**?

Section 2: Representing Text and Color

Bits are grouped to represent abstractions such as numbers, characters, and color.

6. A text encoding assigns A=65, B=66, C=67, and so on. What number represents E? What does the byte 01001010 (decimal 74) represent as text?

7. The same byte 01000010 could represent the number 66, the letter B, or part of a color. What determines which meaning is used?

8. In the RGB color model, each of red, green, and blue uses one byte (0–255). How many bits represent one RGB pixel? Show your reasoning.

9. What color is $(R, G, B) = (0, 0, 0)$? What about $(255, 255, 255)$?

Section 3: Compression Concepts

10. Data compression reduces the number of bits. Does "fewer bits" always mean "less information"? Explain.

11. Two files are compressed with the same algorithm; one shrinks a lot and the other barely shrinks. Give one reason the size reduction can differ.

Section 4: A Simple Compression Scheme

Run-length encoding (RLE) replaces runs of repeated symbols with the symbol and a count. Example: AAAABBB → A4B3.

12. Compress WWWWBWWWWW using RLE.

13. Is RLE lossless or lossy? Explain how you know.

14. Give one kind of data where RLE saves a lot of space, and one kind where it might make the file *larger*.

Section 5: Lossless vs. Lossy — Choosing for a Context

For each scenario, choose **lossless** or **lossy** and justify in one sentence.

15. Archiving a legal contract as a text file where every character must be recoverable.

16. Streaming a music video over a slow mobile connection.

17. Storing a program's source code files.

18. Which type of compression can usually reduce size *more*, lossless or lossy?
