Notes with gaps: An approach to active lectures

Katie L. Peterson
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Why notes with gaps?

An active lecture format that balances content coverage and the addition of active learning.

Helps alleviate the problems of students “checking out” during lecture and poor handwriting (by the instructor and students).
Setting the gaps

• Lecture notes as handouts
• Write out straightforward stuff
  – Definitions, facts, equations
• Leave gaps - blank space - for students to fill in more challenging information
  – Examples, diagrams, solutions
Filling the gap

GAP

Lecture through, fill the gap

Ask students to:

Read content
Check comprehension

Fill in the gap

Individual, partners, group

Complete gap outside of class

Review as class.
Display key concepts, correct answers
Applications and Examples

The GAP

- Additional notes
- Student developed content
- Examples
- Answers to questions
- Steps to solve a problem
- Solve math problems
- Drawings
- Concept maps

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Ex: Notes

**Measurement** = quantitative observation

Ex. 440 ft

- REMEMBER UNITS!

Making a measurement:

1. Record digits that are certain.
2. Estimate the next (uncertain) digit.

Uncertainty in last digit is ±1

Note: green text in this presentation would be handwritten annotations.
Ex: Examples and practice problems

Making measurements

Examples

Instructor leads examples, then students practice.

With each ruler, estimate the last place.

Practice

2.3 cm

2.35 cm
SI Units

<table>
<thead>
<tr>
<th>Unit</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>meter</td>
</tr>
<tr>
<td>Mass</td>
<td>kilogram</td>
</tr>
<tr>
<td>Volume</td>
<td>liter</td>
</tr>
</tbody>
</table>

- Volume is derived from length:
  - One milliliter (mL) contains 1 cubic centimeter (cm³)

Is the mass of an object the same as its weight? Are these terms the same?
- Mass = quantity of matter; gram
- Weight = force matter experiences from gravity
Ex. Drawing

Accuracy and Precision

• **Accuracy**: agreement with accepted value

• **Precision**: agreement among several measurements (reproducibility)

What would it look like to be precise, but not accurate?
Ex: Working a problem

Converting between units: Factor-label method

Use conversion factors to transition from “old” to “new” units

Ex. Convert 10.936 yd = _______ m

Steps
1. Determine calculation path and find conversion factors.
2. Set up conversion, starting with given info.
3. Use conversion factor(s) to cancel units.
4. Do the math and cancel units.
   Units as expected? If not, calc is wrong!
5. Sig Figs and rounding.
6. Check. Answer reasonable?

\[
\frac{10.936 \text{ yd}}{1.094 \text{ yd}} \cdot \frac{1 \text{ m}}{1 \text{ m}} = 9.996 \text{ m}
\]
### Ex: Worked example

#### Problem and work

How many hours are in 2.0 years?

#### Steps

- **Calculation map**
- **Find conversion factors**
- **Set up conversion** (Use conversion factors to cancel units.)
- **Calculate.**
- **Sig figs and rounding**
- **Check.**

#### Conversion Factors

<table>
<thead>
<tr>
<th>Step</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 yr</td>
<td>365 days</td>
</tr>
<tr>
<td>1 day</td>
<td>24 hours</td>
</tr>
</tbody>
</table>

#### Calculation

\[
2.0 \text{ yr} \left( \frac{365 \text{ days}}{1 \text{ yr}} \right) \left( \frac{24 \text{ hours}}{1 \text{ day}} \right) = 18,000 \text{ hours}
\]
Ex: Practice problem

Would a car traveling at 65 km/h violate a 45 mi/h speed limit? Note: there are 5280 ft in 1 mile.

\[
\frac{65 \text{ km}}{h} \left( \frac{1000 \text{ m}}{1 \text{ km}} \right) \left( \frac{1.094 \text{ yd}}{1 \text{ mi}} \right) \left( \frac{3 \text{ ft}}{1 \text{ yd}} \right) \left( \frac{1 \text{ mi}}{5280 \text{ ft}} \right) = \left( \frac{2.133 \times 10^5 \text{ mi}}{5280 \text{ h}} \right) = 40.4 \frac{\text{mi}}{h} \rightarrow 40. \frac{\text{mi}}{h}
\]

A. Yes
B. No
C. I’m confused.

Can couple with a student response system or live audience polling.
Ex. Definitions and examples

Students read definitions and come up with examples

**Matter** – takes up space and has mass

Definitions for classes of matter:

**Atoms** – smallest unit of matter

**Elements** – cannot be subdivided by chemical or physical means (made of identical atoms)

**Pure substances** – fixed composition, can’t purify

**Molecules** – 2 or more atoms the same or different elements joined (bonded) chemically

**Compounds** – different elements united in fixed ratios

**Mixtures** – combination of 2 or more pure substances

**Homogeneous matter** – uniform composition

**Heterogeneous matter** – non-uniform composition

**Example:**

- Hydrogen, Carbon
- Water, Gold
- Oxygen gas
- Water, Sucrose
- Salt water
- Chicken noodle soup
Ex: Concept map

Draw a diagram or flow chart that illustrates the relationships among pure substances, mixtures, elements, compounds, mixtures, homo- and heterogeneous matter.

- **Matter**: anything that occupies space and has mass

  - **Pure substances**: fixed composition; cannot be further purified
  - **Mixtures**: a combination of two or more pure substances

  - **Elements**: cannot be subdivided by chemical or physical means
  - **Compounds**: elements united in fixed ratios
  - **Homogeneous matter**: uniform composition throughout
  - **Heterogeneous matter**: nonuniform composition

Image appears by animation after students attempt to draw their own.
Which of these atomic and/or molecular views represent pure substances?

A. I and III  
B. I and IV  
C. I, II, and IV  
D. II, III, and IV

Use a student response system or live audience polling.
Benefits

- Active!
- Facilitates notetaking.
- Increases student engagement and focus.
  - Students “own” the notes.
    (They develop some content.)
- Increases attendance (maybe).
- Increases student performance.
  - On application questions, not factual/definition questions.
- **Balance content coverage and active learning.**
Reflect... and Apply?

How could you apply “notes with gaps” in your class?

What are the benefits or limitations of this approach?
References


