What’s in store today

- We have copies of study guides.
- Highlighters and pens for all.
- We’d like to share some approaches to learning and studying.
- Go over some challenging “knowledges” and show to extract key info.
- Then you try some.
- Please ask questions as they strike you.
**Historical exam performance**

- Made a few tweaks to the exam

**Exam Pass Percentage - Lab Intro**

- New Intro

**Pass Rate**

- May-04
- May-05
- May-06
- May-07
- May-08
- May-09
- May-10
- May-11
- May-12
- May-13

**Exam Date**

- Pass Rate: 32% (Nov-13), 40% (May-14), 37% (Nov-14)
10 yrs...and twice above 50%

Exam Pass Percentage - Lab Advanced

Made a few tweaks to the exam

New Adv.

Exam prep offered

Nov-13

Nov-14

May-13

May-14

Pass Rate

May-04

May-05

May-06

May-07

May-08

May-09

May-10

May-11

May-12

May-13

Exam Date

33%

46%

29%
EPIC FAIL
Seriously, how the heck did you manage that?
Evaluating Corrective Action
52 took the exam, 21 passed = 40% pass rate.
Average score = 69.8

Those who attended the April 2014 training
10 of 12 taking passed (83%), 48% of all passed

Average score = 81.5 (12 pts better than all)

Those that took exam previously & attended April training:
1 person doubled their previous test score.
73 took the exam, 27 passed = 37% pass rate. Average score = 66.6

Those who attended the October 2014 training
12 of 13 taking passed (92%), 44% of all passed
Average score = 80.2 (13.6 pts better than all)

Pass rate of those NOT attending training:
15 of 59 passed or 25.4%

1 person doubled their previous test score.
ADVANCED MAY 2014

48 took the exam, 22 passed = **46% pass rate**.
Average score = **69.4%**

Those who attended the April 2014 training
14 of 18 taking passed (**78%**), **64% of all passed**
average score= **80.3 (11 pts better** than all

Those that took exam previously & attended Apr’14:

3 people scored 90% or better.
Overall, a **27 point improvement in scores** from
the previous attempt (**about 11 questions**).
52 took the exam, 16 passed = 29% pass rate.
Average score = 68.9%

Those who attended the October 2014 training
11 of 12 taking passed (92%), 69% of all passed
average score= 82.3 (13.4 pts better than all)
7 people scored 85% or better.

Pass rate of those NOT attending training:
5 of 40 passed or 12.5%
### Bimodal population scan

#### Good question

<table>
<thead>
<tr>
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Either chose A or B

#### Tough question?

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#### Guessing?

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**Quintile review**

**DEPARTMENT OF NATURAL RESOURCES**

**QUINTILE SCORE GROUPS**

<table>
<thead>
<tr>
<th>QUINTILE</th>
<th>SAMPLE SIZE</th>
<th>PROPORTION</th>
<th>SCORE RANGE</th>
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<tr>
<td>5</td>
<td>10</td>
<td>0.19</td>
<td>77.50 - 95.00</td>
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<tr>
<td>4</td>
<td>11</td>
<td>0.21</td>
<td>72.50 - 77.50</td>
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<tr>
<td>3</td>
<td>10</td>
<td>0.19</td>
<td>65.00 - 72.50</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>0.21</td>
<td>57.50 - 65.00</td>
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<tr>
<td>1</td>
<td>10</td>
<td>0.19</td>
<td>42.50 - 57.50</td>
</tr>
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</table>

Break down exams scores into 5 groups of equal numbers based on score.

**Good question**

**Tough question?**

**PERCENT RESPONDING CORRECTLY BY QUINTILE**

<table>
<thead>
<tr>
<th>5TH:</th>
<th>4TH:</th>
<th>3RD:</th>
<th>2ND:</th>
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<tr>
<td>0</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
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</table>
| 50       | 60       | 70       | 80       | 90       | 100
WHY are people failing this exam?

• What’s hard about it?
• Did you look at the Study Guide first?
• Did you take a prep class?
• If you took a class…do you think it helped?
• No different than corrective action in the lab
• Gun analogy…is it you, the ammo, or the rifle?
• Can we rule out things one at a time?
• But if you repeat the same process, you should expect the same results.
• If it’s not you or the rifle…maybe switch ammo
Insanity is doing the same thing over and over again and expecting different results.

- Albert Einstein

Note to Self: Einstein was right.
Operator X

- What corrective action did Operator X take over 8 exam cycles for the Adv. Lab Exam?

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<td>02-May-12</td>
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<tr>
<td>07-Nov-12</td>
<td>55</td>
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<tr>
<td>01-May-13</td>
<td>57.5</td>
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<tr>
<td>06-Nov-13</td>
<td>75</td>
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</table>
MYTH: One needs to pass the Lab Exam BEFORE one does any lab testing.

REALITY:
Exam Review: Good News 1st

INTRO Knowledges with >75% Pass

- 100% can define BOD!
- 99% can explain the function of a desiccator.
- 97% understand proper handling of weights.
- 95% know conditions that affect drying ovens.
- 95% know how and why records need to be permanent.
- 94% know when seeding is required for BOD.
- 92% understand super-saturation. BUT...
- 91% know when to use wide-bore pipets.
Now the Not-so-Good News....

INTRO Knowledges with 50 - 75% Pass

• 60%: Know what bias and precision are.
• 59%: Understand the concept of seeding BOD.
• 57%: Know the acceptance criteria for ISE
• 56%: Know the difference between arithmetic and geometric mean.
• 53%: Understand why, with ISE, samples and standards must be at the same temperature.
• 52%: Understand how sample dilution volume affects the LOD for BOD.
• 51%: Given sample data, can calculate BOD.
...and the REALLY not-so-good news

INTRO Questions with < 50% Pass…

• 56% still don’t know the purpose of NaOH buffer for ammonia by ISE.
• 60% don’t know requirements for certified weights.
• 60% don’t know the best concentration to determine LODs.
• 62% don’t know the required LOD for TSS.
• 74% don’t know about balances.
• 82% don’t know understand LOD/LOQ.
• 85% don’t know calibration requirements for TP.
• 86% don’t know critical conditions for TP color development.
Exam Review: Good News 1st

ADV Knowledges with >75% Pass

- You know about MSDS and Chemical Hygiene plans.
- You know about Beer-Lambert’s law.
- You know how to re-certify balance weights.
- You know about reducers.
- You know how to use the C1V1=C2V2 formula.
- You know how oil&grease affects TSS.
Now the Not-so-Good News....

ADV Knowledges with 50 - 75% Pass

- 63%: Understand how incubator temperature affects BOD results.
- 61%: Know when the fill-hole on a pH electrode must be open.
- 60%: Understand deionization & reagent water
- 59%: Can explain what causes slow phosphorus color development..
- 59%: Know how to improve pipeting accuracy.
- 52%: Understand over-dechlorination & BOD.
- 51%: Understand what dictates whether a sample exceeds the calibration range.
...and the REALLY not-so-good news

ADV Questions with < 50% Pass Rate

• 56% still don’t how an ISE works.
• 57% don’t how what causes low GGA.
• 61% don’t how how to determine the best volume for BOD.
• 61% don’t understand sample pres. Temp.
• 65% don’t understand linear regression.
• 69% don’t know how TKN and NO3+NO2 reused in process control.
• 73% don’t how required blanks for TP testing.
• 85% don’t how causes of reduced color (TP).
Post-Exam QA/QC

• We DO look at Exam results!
• A Quality Assurance review to ensure that the exam is properly measuring operator knowledge.
• Ask the questions:
  – Is the passing rate acceptable?
  – Particular question(s) too easy?
  – Particular question(s) too difficult?
  – Is there more than one perceived correct answer?
• Additionally, review operator comments/concerns about the exams
READ the Study Guides!

• READ the Study Guides.
• …and …don’t be like Sherby!
READ THE STUDY GUIDES!

• **Kaffee**: You gotta trust me, Sherby, you read the Study Guide and your chances of passing the exam increase by a factor of 10
How to effectively study/prepare for an exam:

Reading for Comprehension
Reading for Comprehension

- **Highlight** important ideas.
- Circle or bracket **key terms**.
- Identify the **main point(s)** of the info.
- Can you eliminate “extraneous” information?
- Look for “telling” words: “always, must, require”
- What question(s) would YOU create?
5.1.04 Define super-saturation.

• Supersaturation **means** that the water contains more DO than it **SHOULD** contain according to physical tables.

• **According to tables,** the saturation point of oxygen in water at 20° and 760 mm pressure -which is standard temperature and pressure at sea level- is 9.06 mg/L. So, yes, at sea level and 20°C, anything over 9.06 mg/L represents supersaturation.

• The method kind of “defines” super-saturation as anything above 9.0 mg/L. **However,** in reality saturation will vary with temperature and pressure. Consult a DO saturation table.
Multiple Choice Test Taking Tips

• Read the question before you look at the answer.

• Come up with the answer in your head before looking at the possible answers, this way the choices given on the test won't throw you off or trick you.

• Eliminate answers you know aren't right.

• Read all the choices before choosing your answer.

• Don't keep on changing your answer, usually your first choice is the right one, unless you misread the question.
Many multiple choice answers have a dichotomy, or branching, to them. It’s almost like a fork in the road and at the end of each fork are two doors.
Good precision can be defined as closeness of:

- A. Agreement between repeated measurements; some systematic/ random error
- B. Agreement between repeated measurements; no systematic/ random error
- C. Measurement to the true value; some systematic/ random error
- D. Measurement to the true value; no systematic/ random error
Good precision can be defined as closeness of....

Or come at it from the other direction

- Some systematic and random error
  - A measurements to the true value
  - B agreement between repeated values

- No systematic or random error
  - C measurements to the true value
  - D Agreement between repeated values
Let’s look at some sample Lab related questions from other exam sources
PHOSPHORUS

Between the pH range of 8.0 - 9.6 s.u., the indicator phenolphthalein undergoes what color change with increasing pH?

- A. Colorless to blue
- B. Colorless to red
- C. Red to blue
- D. Blue to colorless

- Break this question down to its basics.
- 3 of the 4 answers involve the color blue
- Does phenolphthalein ever give a blue color?
- If so, then at least you’ve eliminated 25% of the choices
- If not, then you’ve identified the correct answer
Phenolphthalein color change with increasing pH (8-9.6)

- INITIAL COLOR
- FINAL COLOR

<table>
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<tr>
<th>Color Change</th>
<th>Initial Color</th>
<th>Final Color</th>
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<tbody>
<tr>
<td>Colorless</td>
<td>Colorless</td>
<td>Red</td>
</tr>
<tr>
<td></td>
<td>Colorless</td>
<td>Blue</td>
</tr>
<tr>
<td>RED</td>
<td>Blue</td>
<td>Blue</td>
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</table>
Phenolphthalein

From Wikipedia, the free encyclopedia

"phph" redirects here. For Ph-Ph, see biphenyl.

Phenolphthalein /ˈfiːnəlfəˈθeɪliːn/ is a chemical compound with the formula C_{20}H_{14}O_{4} and is often written as "Hln" or "phph" in shorthand notation. Often used in titrations, it turns colorless in acidic solutions and pink in basic solutions. If the concentration of indicator is particularly strong, it can appear purple. In strongly basic solutions, phenolphthalein's pink color undergoes a rather slow fading reaction and becomes colorless again. The molecule has four forms:

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<th>ln(OH)^{3-}</th>
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<td>strongly basic</td>
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<tr>
<td>Color</td>
<td>colorless</td>
<td>pink to fuchsia</td>
<td>colorless</td>
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</table>

Thanks,
Wikipedia

<8.2 colorless
8.2-12 pink
>12 colorless
Calibration

When calibrating an instrument that uses a linear curve, what is the minimum number of concentrations that must be used?

- A. One
- B. Two
- C. Three
- D. Five

- Read carefully! Do not leap to conclusion or decide on the answer without reading the question fully.
- It says calibrate…not CHECK the calibration.
- MINIMUM…not how many standards YOU use in your lab.
How do you preserve a sample for ammonia if it cannot be analyzed when collected?

1. Temperature

   Cool to $\leq 10^\circ C$

   Add NaOH to pH $> 11$

   Add H2SO4 to pH $< 2$

2. Acid? Or Base

   Cool to $\leq 6^\circ C$

   Add NaOH to pH $> 11$

   Add H2SO4 to pH $< 2$
Agitating a sample before measuring DO for BOD...

a. Decreases the DO.
b. Increases the DO.
c. Decreases the SS.
d. Increases the SS.

Example of a bad question...why?
The BOD of wastewater determines the milligrams per liter of oxygen required...

a. During stabilization of decomposable organic matter by aerobic bacterial action.

b. To produce an equilibrium between the oxygen of the wastewater and atmospheric oxygen.

c. To unite chemically with the inorganic matter present in the sample.

d. For the oxidation of sulfites and thiosulfates to sulfates.

Minimal rewording of answers
The BOD of wastewater determines the milligrams per liter of oxygen required...

- Bacterial action on organic matter
- Equalize wastewater Oxygen with air
- Bond with inorganic matter
- Oxidize sulfites and thiosulfates

Minimal rewording of answers
BOD incubation is at:

- a. 37° C.
- b. 98° F.
- c. 20° F.
- d. 20° C.

- 37 °C equals about 98 °F…so since both can’t be right, neither is!

- Where would you prefer to incubate? At 20 °F or 20 °C?
You’re guessing!

The temperature preservation requirement for most wastewater tests is that they not be frozen and must be stored at:

- A. \( \leq 4 \, ^\circ C \) [10% chose this]
- B. \( 4 \pm 2 \, ^\circ C \) [45% chose this]
- C. \( \leq 6 \, ^\circ C \) [43% chose this]
- D. \( 6 \pm 2 \, ^\circ C \) [2% chose this]

Retired ADVANCED question
Creating Flashcards

• Summarize the CRITICAL information from the study guide and copy to index cards.
• Use THESE to study

**Writing your own questions**

• If you were quizzing someone on the topic, what questions would you ask?
• Writing the question and correct answer is the easy part.
• Coming up with 3 “wrong” answers without using all-none of the above and not being too tricky is a challenge!
5.4.10 Explain why temperature is so critical when using the ion-selective electrode.

- Ammonia electrodes function according to the physical constraints of the Nernst equation, and in that equation temperature is the only variable. Each one degree (°C) change in temperature is associated with a 1-2% error due to changes in the electrode slope. Therefore, calibration standards and samples must be at the same temperature.
How about these....

• What is the principle that governs electrode operation: the Nernst equation.

• What is the only variable in the Nernst equation: Temperature

• 1 degree C temp change = 1-2% error.

• Standards & samples must be: same temp.
Study Guide Review...
where the knowledge detail expands considerably.
But stick to your tactical approach!

Identify “buzz” words:
shall, must, require, only always, every, however

Take note of any numbers/values (criteria)

Ignore extraneous words

Find the point(s) being made.

Try to separate informative but non-critical info

Create flashcards

Write your own questions