

So many questions...

- Have you taken a certification exam for wastewater lately?
- Or do you plan to do so soon?
- Did you have trouble passing a Lab exam?
- Did you attend any exam prep training prior to taking an exam?
- Did you know that the whole structure for exam study materials is changing?
- Are you a "trainer" who offers pre-exam review sessions?
- **Did you answer "yes" to any of these?**
If so, you could benefit from this session.



Agenda

- A Brief History of Operator Exams (from there)
- The Process – Study Guides & Exams (to here)
- Lab Exams – Performance Review Time
- Material Content – Out with the Old
- Material Content Focus – BOD
- What are YOU missing?
- Exam Prep – Reading For Comprehension
- Exam Prep – Mnemonic tools
- Final Jeopardy



OpCert Exams: A little history/background



Operator Certification Exams 1995 to 2009

1995 -2008
10 pages
HANDBOOK
Operators must find the info
**INTRODUCTION
TO
LABORATORY**

SUBCLASS J

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
BUREAU OF INTEGRATED SCIENCE SERVICES
P. O. BOX 7821
MADISON, WI 53707

SEPTEMBER 1995 EDITION

Figure 1



Wisconsin Department of Natural Resources

Bureau of Science Services
Operator Certification Program

Study Guide - Introduction to On-site Laboratory
Testing
2008 - ?
106 pages
Including figures
All info an operator needs

ACKNOWLEDGMENTS
This Study Guide is a result of the combined efforts of the following individuals:

George Rowman (WI State Lab of Hygiene)	Kay Curtis (WISCA)	Harrah Foss (WI DNR)
Dana Fugal (WI DNR)	Paul Harris (Croy Laboratories)	Rick Macky (WI DNR)
Jan Shamba (Superior WWTP)	Rich Vogel (Brookfield WWTP)	

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We've come from here...

"Study Guide"

What operators got. They then had to find answers themselves.

15. Explain the proper way to read a water level meniscus.

From here, operators had to seek information about this topic from one of the 13 listed "resource materials".

There was no guarantee that the detail required to answer exam questions could be clearly located in any of these references.



RESOURCES: Fetch!

No longer approved!

1. **A USER'S GUIDE TO LABORATORY SERVICES**. (1989). WDNR. **20 years old!**
2. **CONTROLLING WASTEWATER TREATMENT PROCESSES**. (1984).[book]
3. **HANDBOOK FOR SAMPLING AND SAMPLE PRESERVATION OF WATER AND WASTEWATER**. EPA-600/4-82-029 (1982). **Out of print!**
4. **LABORATORY SAFETY MANUAL**. (Mallinckrodt Chemical Works)
5. **OPERATION OF MUNICIPAL WASTEWATER TREATMENT PLANTS**. Manual of Practice No.11(MOP 11), 2nd Addition (1990), Volumes I,II,andIII. WEF
6. **OPERATION OF WASTEWATER TREATMENT PLANTS**. 3rd Edition (1990), Volumes 1 and 2, Kenneth D. Kerri, California State University,
7. **OPERATION OF WASTEWATER TREATMENT PLANTS**. Manual of Practice No.11 (MOP 11)(1976). Water Pollution Control Federation, (Probably Out-Of-Print, See Reference Number 5).
8. **QUALITY ASSURANCE DOCUMENT FOR A SMALL WASTEWATER LAB**. 2nd Edition (1992). WDNR **Now on 5th ed.**
9. **SIMPLIFIED LABORATORY PROCEDURES FOR WASTEWATER EXAMINATION**. (1985). WEF
10. **STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER**. (17th Edition) (1989), 18th Edition (1992). APHA.AWWA.WEF **@ 21st ed.+ online!**
11. **WIS. ADMIN. CODE, NR 149, LABORATORY CERTIFICATION AND REGISTRATION**.
12. **WIS. ADMIN. CODE, NR 218, METHOD AND MANNER OF SAMPLING**.
13. **WIS. ADMIN. CODE, NR 219, ANALYTICAL TEST METHODS AND PROCEDURES**.



Training Resource (Limited)

The "Instructor Handbook":
What "trainers" got.

Unfortunately, access to this resource was pretty difficult to obtain. There is not even clear documentation of how many people were given access to these documents.

15. Explain the proper way to read a water level meniscus.

WHEN WATER OR LIQUID IS HELD IN A SMALL DIAMETER TUBE SUCH AS A PIPETTE OR BURET, THE WATER LEVEL WILL FORM A CONCAVE CURVED SURFACE. THE LIQUID IN CONTACT WITH THE CONTAINER WALLS WILL RISE SLIGHTLY, LEAVING A LOW POINT IN THE CENTER. WHEN TAKING A MEASUREMENT, THE LOW POINT OF THE CURVE IS CONSIDERED TO BE THE CORRECT MEASURING POINT.



To here (2008):

4.2 Measurement Techniques

4.2.01 Explain the proper way to read a water level meniscus.

See Figure
4.2.01

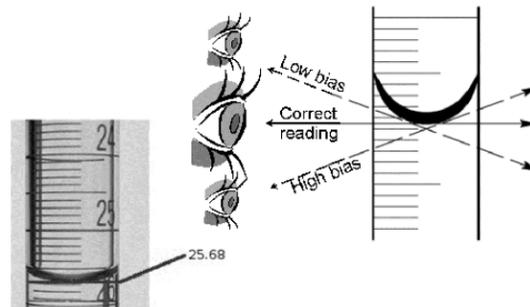
When water or liquid is held in a small diameter tube such as a pipet or buret, the water level will form a concave curved surface. The liquid in contact with the container walls will rise slightly, leaving a low point in the center. When taking a measurement, the low point of the curve is considered to be the correct measuring point.

Always read the meniscus at eye level. If the meniscus is not read at eye level, incorrect readings will result.

Figure No.: 4.2.01

Sub-Objective: Measurement Techniques

How to properly read a meniscus.



Exam Feedback

If an operator got this question wrong:

Which of the following can be done to check the accuracy and precision of weighing in the TSS test?

- A. Running a blank filter through the TSS procedure.
- B. Repeated cooling and drying of the samples.
- C. Drying to a constant weight.
- D. Running duplicate samples.

Their exam score card would indicate that they failed question # "x" and need to study concept "42".

Back to the Study Guide –and square 1– to find that they again need to obtain information on this "concept".

CONCEPT: SOLIDS ANALYSIS (TOTAL AND SUSPENDED) 42.

List the purposes of running a blank filter through the TSS analysis procedure along with the samples.



Giving POSITIVE Feedback

- What kind of feedback is, “Go back and study _____”?
- Who ever had to look up 50 or more things in each of 13 possible resources?
- Instead of telling people that they need to know about something, but not tell them what specifically they need to know about that something...
- Why not tell people exactly what it is they need to know?



Operator
Certification exams
– a new look...a new
approach



Study Guide/Handbook/Exam Foundation

- A series of Microsoft Word Documents
- Manual “links” from exam questions to “Concept #”
- New exams created by cutting questions out, pasting new ones in

This kind of information, with detailed links to other information (“concepts” to questions, questions to answers, answers to “correct” answers) and ability to automatically generate randomized exams is best suited to a relational database.

...so we created a
(Microsoft) Access database.



ACCESS Database Functionality

Individual Tables for

- SubClass & Type
- Objective
- Sub-objective
- Key Knowledge
- Questions
- Answers

ONo	Objective
1	SAFETY
2	SAMPLING & SAMPLE HANDLING
3	LAB EQUIPMENT & INSTRUMENTATION
4	GENERAL LAB PRACTICES
5	LAB ANALYSIS
6	QA/QC (Quality Assurance/Quality Control)
7	DOCUMENTATION & TRACEABILITY

SNo	Sub-Objective
5.1	Definitions
5.2	Biochemical Oxygen Demand (BOD)
5.3	Total Suspended Solids (TSS)
5.4	Ammonia Nitrogen (NH3-N)
5.5	Total Phosphorus (TP)
5.6	Total Residual Chlorine (TRC)
5.7	Process Control (including Dissolved Oxygen)

Key Knowledge	Key Knowledge_Detail
Discuss blank requirements for the BOD test.	At least one dilution water blank must be prepared on each day that samples are prepared. The maximum allowable depletion in a method blank is 0.2 mg/L.



Nuts and bolts of new process

- A single Study Guide. All in one. Key “knowledges” to be learned + the detailed knowledge to understand.
- Tell operators exactly what they need to know. 1 stop shopping.
- Make use of graphics where possible to explain concepts.
- Take exam questions directly from the material in the study guide.
- Ability to create a new exam at any desired frequency.
- Questions chosen randomly based on preferred breakdown.
- Can add/subtract/edit questions quickly.
- Can even quickly change letter of correct answer.
- Trainers complement info in the study guide



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



Using Post-Exam Statistics

What does this graphic tell us?

MATRIX OF RESPONSES BY QUINTILE

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	
Top20%	0	10	0	0	75 - 95% (10)
UpMid20%	0	9	0	0	70 - 72.5% (9)
Mid20%	2	4	2	2	60 - 67.5% (10)
LoMid20%	2	3	3	2	55 - 60% (9)
Bot20%	3	2	2	3	32 - 52.5% (10)
Proportion	0.14	[0.57]	0.14	0.14	

- 57% (~ 6 of 10) got this question right.
- The 3 wrong answers got pretty much equal time.
- Is the question a good question?
- Do we have enough information to answer that?
- What if B and C each had 50% (no one picked A or D)



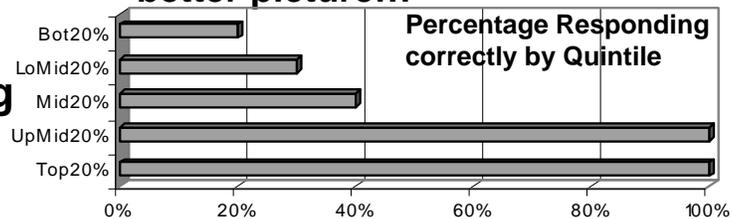
Using Post-Exam Statistics₂

MATRIX OF RESPONSES BY QUINTILE

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	
Top20%	0	10	0	0	75 - 95% (10)
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LoMid20%	2	3	3	2	55 - 60% (9)
Bot20%	3	2	2	3	32 - 52.5% (10)
Proportion	0.14	[0.57]	0.14	0.14	

We now see who is missing the question

The addition of this gives us a better picture...





Exam QA/:QC Using exam results

What if we had THIS question?

What differentiates a TDS analysis from TSS analysis?

- A The letter 'D'.
- B Drying temperature.
- C Use of a different filter.
- D QC requirements.

...and someone actually chose "A".

Was it a joke? (*Did they feel so confident they would "ace" the test that they selected "A" for grins?*)

...or did someone really think that might be the answer?

We have data that can help answer such a question



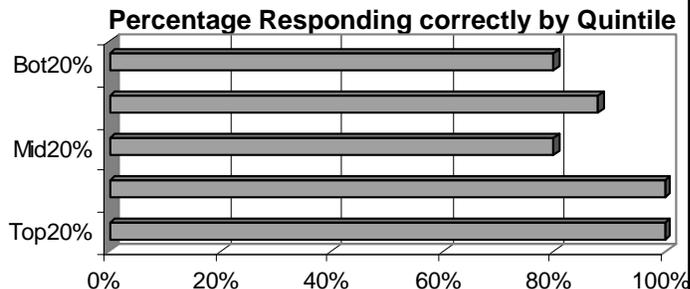
Exam QA/:QC Using exam results

What differentiates a TDS analysis from TSS analysis?

MATRIX OF RESPONSES BY QUINTILE

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	
Top20%	0	10	0	0	75 - 95% (10)
UpMid20%	0	9	0	0	70 - 72.5% (9)
Mid20%	1	8	1	0	60 - 67.5% (10)
LoMid20%	0	8	0	0	55 - 60% (9)
Bot20%	0	8	1	0	32 - 52.5% (10)
Proportion	0.02	[0.90]	0.04	0.04	

Somebody answered (A) [the letter "D"] ... and it wasn't someone who could afford the joke answer.





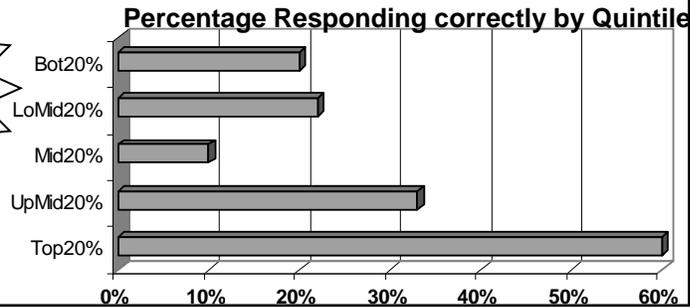
Exam QA/:QC Using exam results

What statistic is used to evaluate a TP calibration?

MATRIX OF RESPONSES BY QUINTILE

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	
Top20%	6	1	2	1	75 - 95% (10)
UpMid20%	3	4	1	1	70 - 72.5% (9)
Mid20%	1	5	3	1	60 - 67.5% (10)
LoMid20%	2	5	1	1	55 - 60% (9)
Bot20%	2	3	3	2	32 - 52.5% (10)
Proportion	[0.29]	0.38	0.21	0.12	

Less than 1/3 know what is used to evaluate a calibration?



Why change the Lab Study Guides

Top 5 INTRO concepts to retire

- List the **personal safety equipment necessary** for the safe operation of a wastewater treatment plant Laboratory.
- **Define** the following terms:
 - A. **Arithmetic Mean.**
- Describe the **characteristics of a good Bench Sheet.**
- Explain the advantages of an **interlab testing program.**
- Discuss the **considerations** that might lead a laboratory to **utilize contract laboratories.**



Why change the Lab Study Guides

Top 5 ADV concepts to retire

- Calculate how much water and how much chemical should be used to obtain a specific **normality** when using a dry chemical reagent.
- Describe how to run a potassium permanganate (**KMnO₄ test**) and interpret the results.
- Describe the **Winkler** Dissolved Oxygen procedure.
- List the purposes of running a **TSS blank filter** through along with the samples.
- Explain why it is recommended to heat a **total solids** sample on a **steam bath** until it appears dry before putting it in a drying oven.



8-yr Performance Summary



Score required to PASS

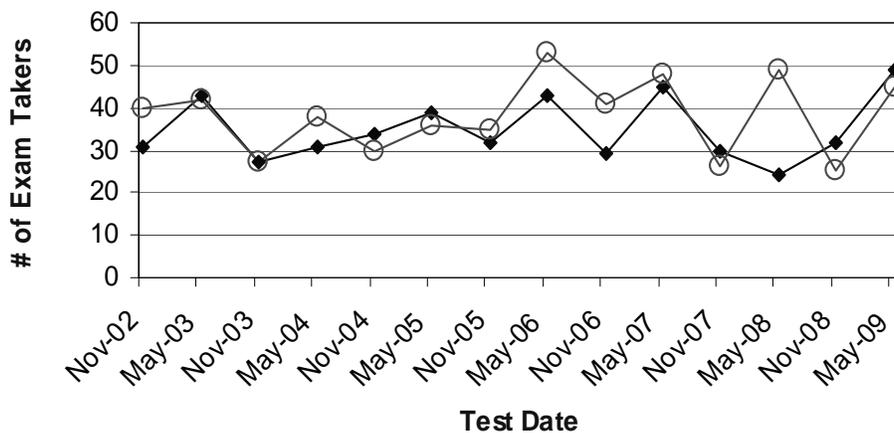
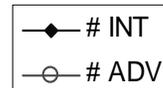
75%

- That's 30 of 40 questions
- You can miss no more than 10 questions



Exam Registration History

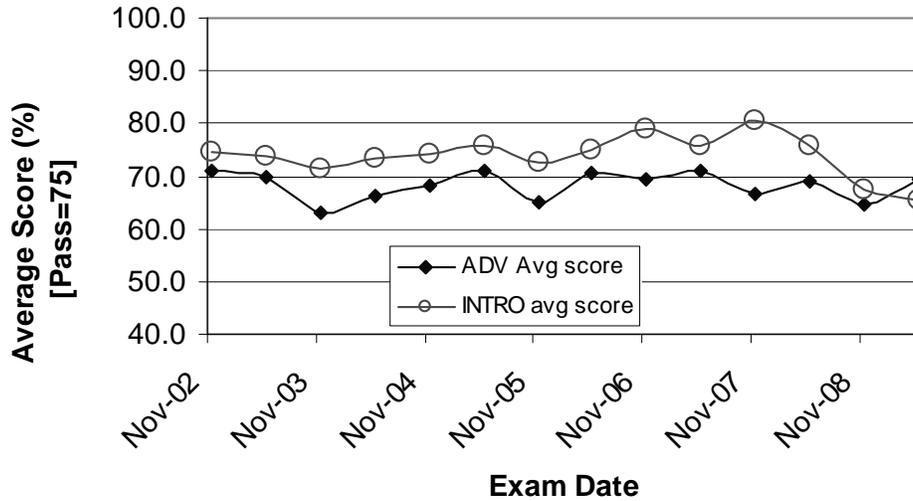
People Taking Lab Exams





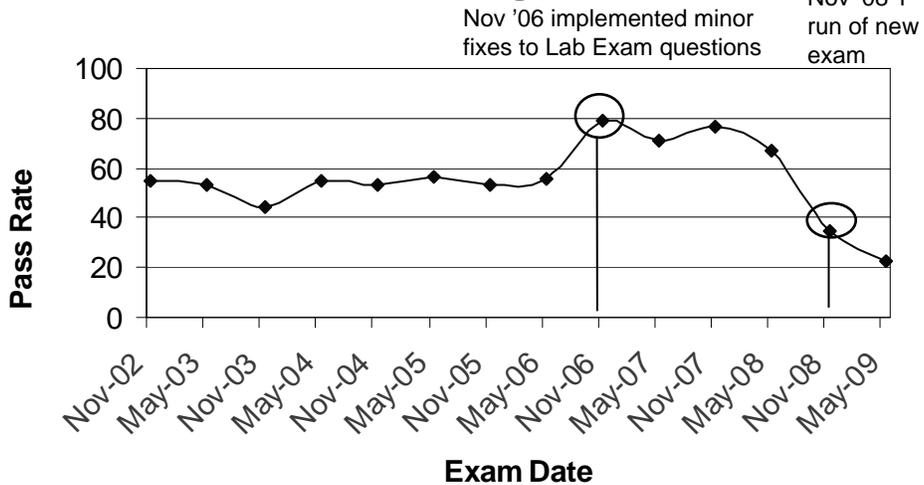
Exam History: Average Scores

All Takers: Lab Exam Average Score



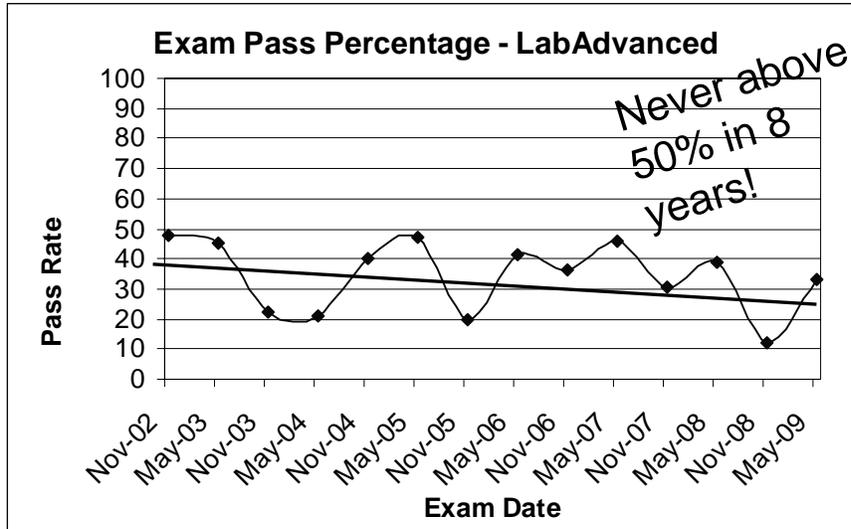
INTRO Lab Exam Pass Rate

Exam Pass Percentage - Lab Intro

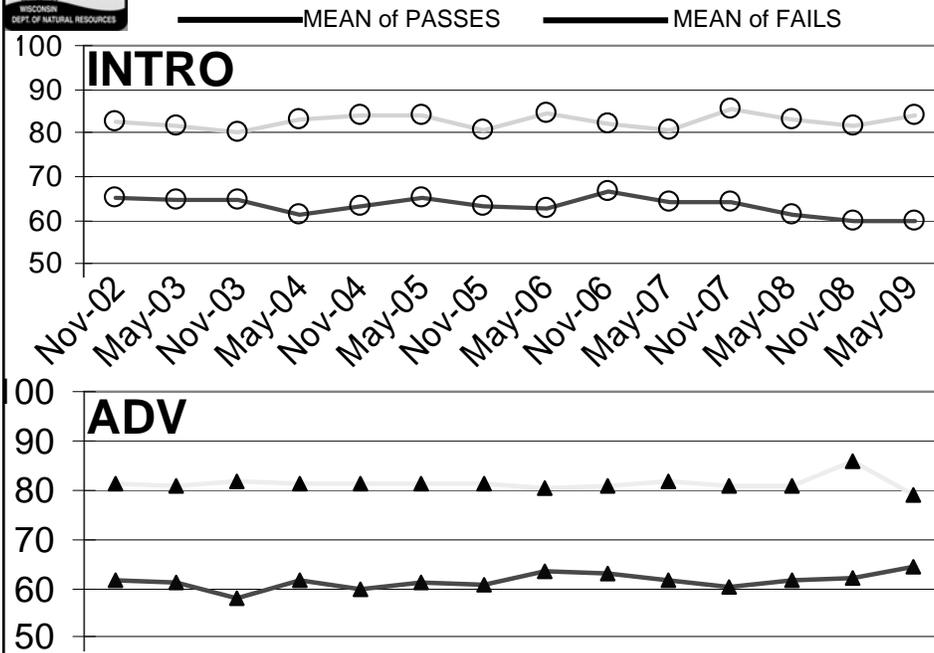




ADVANCED Lab Exam Pass Rate



Mean exam scores by P/F





What's it all add up to?

- It seems that the # of exam takers has not changed much (*maybe slightly increased*)
- The Pass rate has dropped dramatically since the new INTRO exam was offered.
- Our QA review of exam questions indicates that the questions are valid (no tricks) and the answers to any questions can easily be found in the Study Guides.

As Mr. Spock would say, "Logic would dictate..."

- **People are either NOT looking at the Study Guide,**
- **... are not attending Exam Prep sessions, or**
- **Exam Prep sessions are not coordinated to the Study Guides**



Material Content:
INTRO - Old vs. New
ADV - Existing vs. Coming Soon!



OLD Lab Intro 67 concepts

MODULE A: SAFETY AND LABORATORY EQUIPMENT

- Concept: Safety..... 5
- Concept: Laboratory Equipment..... 5

MODULE B: OPERATION AND CHEMICALS

- Concept: Operation..... 14
- Concept: Chemicals..... 1

MODULE C: LABORATORY WATER ANALYSIS & SAMPLING

- Concept: Laboratory Water Analysis..... 4
- Concept: Sampling..... 8

MODULE D: LABORATORY ANALYSIS

- Concept: pH Analysis..... 2
- Concept: DO Analysis..... 9
- Concept: BOD Analysis..... 9
- Concept: TSS Analysis..... 7
- Concept: Laboratory QA..... 3 ~ 5%



NEW INTRO Study Guide has 226 "Key Knowledges"

SAFETY

- 15 Definitions
- 13 General Safety ~ 13%
- 1 Chemical Safety

SAMPLING & SAMPLE HANDLING

- 2 Definitions ~ 3%
- 7 Sample Collection
- 1 Sample Preservation

LAB EQUIPMENT & INSTRUMENTS

- 8 Definitions
- 5 General Labware ~ 12%
- 13 Support Equipment

GENERAL LAB PRACTICES

- 4 Definitions ~ 7%
- 4 Measurement Techniques
- 2 Reagent & Standard Preparation
- 6 Reagent Water

LAB ANALYSIS

- 6 Definitions ~ 46%
- 41 Biochemical Oxygen Demand (BOD)
- 14 Total Suspended Solids (TSS)
- 18 Ammonia Nitrogen (NH₃-N)
- 11 Total Phosphorus (TP)
- 9 Total Residual Chlorine (TRC)
- 5 Process Control (including DO)

QA/QC (Quality Assurance/Quality Control)

- 18 Definitions
- 11 Precision / Accuracy
- 4 Limit of Detection (LOD) ~ 16%
- 2 Corrective Action

DOCUMENTATION & TRACEABILITY

- 2 Definitions
- 1 Standard Operating Procedures (SOP)
- 2 QA Manual ~ 4%
- 4 Traceability
- 1 Records Retention



OLD Lab ADV had 53 concepts



- **MODULE A: LABORATORY EQUIPMENT AND OPERATION**
- Concept: Laboratory Equipment..... 3
- Concept: Operation..... 2 ~ 10%
- **MODULE B: CHEMICALS AND LAB WATER ANALYSIS**
- Concept: Chemicals..... 3 ~ 15%
- Concept: Laboratory Water Analysis..... 5
- **MODULE C: TROUBLESHOOTING AND SAMPLING**
- Concept: Troubleshooting..... 5 ~ 23%
- Concept: Sampling..... 7
- **MODULE D: LABORATORY ANALYSIS**
- Concept: pH Analysis..... 5 ~ 53%
- Concept: Dissolved Oxygen Analysis..... 3
- Concept: BOD Analysis..... 8
- Concept: Solids Analysis..... 3
- Concept: Laboratory Quality Assurance..... 5
- Concept: Laboratory Quality Control..... 4



NEW ADV Study Guide will have 103 "Key Knowledges"

SAFETY

- 4 Definitions ~ 6%
- 2 Chemical Safety

SAMPLING & SAMPLE HANDLING

- 1 Sample Collection
- 2 Sample Preservation ~ 3%

LAB EQUIPMENT & INSTRUMENTS

- 3 Definitions
- 6 General Labware ~ 10%
- 4 Support Equipment

GENERAL LAB PRACTICES

- 2 Definitions ~ 7%
- 2 Measurement Techniques
- 1 Reagent & Standard Preparation
- 2 Reagent Water

LAB ANALYSIS

- 2 Definitions ~ 52%
- 15 Biochemical Oxygen Demand (BOD)
- 3 Total Suspended Solids (TSS)
- 9 Ammonia Nitrogen (NH₃-N)
- 8 Total Phosphorus (TP)
- 3 Total Residual Chlorine (TRC)
- 14 Process Control (including DO)

QA/QC (Quality Assurance/Quality Control)

- 6 Definitions
- 9 Precision / Accuracy ~ 19%
- 1 Limit of Detection (LOD)
- 3 Data Qualification

DOCUMENTATION & TRACEABILITY

- 1 Traceability ~ 1%

**Updated Lab - Advanced exam materials
available soon for the May 2010 exams**



Compare the information for BOD alone in the NEW Study Guide to that of the old.



15 BOD Concepts From OLD Intro

CONCEPT: BIOCHEMICAL OXYGEN DEMAND(BOD)



- 43. Explain the relationship between temperature and dissolved oxygen for the following:**
 - A. Wastewater Treatment Plant Operation.
 - B. When Conducting a D.O. Analysis.
- 44. Describe the following methods of measuring D.O.:**
 - A. Standard Membrane Electrode System and Meter.
 - B. Winkler Titration (An Iodometric Titration).
- 45. Outline how to calibrate a D.O. meter.**
- 46. List some causes for inaccurate D.O. readings when performing the following:**
 - A. If the Winkler Titration Method is being used.
 - B. If a D.O. Meter is being used.
- 47. Identify the reasonable limits of accuracy and precision for a properly operating D.O. meter.**
- 48. List items to consider when inspecting a standard membrane electrode D.O. probe for wear.**



15 BOD Concepts From OLD Intro

49. Define Biochemical Oxygen Demand (BOD).
50. Identify acceptable sample D.O. depletions in a BOD analysis.
51. Define the following analysis, and give an example of an appropriate use of each:
 - A. Total BOD.
 - B. Carbonaceous BOD (CBOD).
 - C. Soluble BOD.
 - D. Nitrogenous BOD (NBOD).
 - E. Chemical Oxygen Demand (COD).
52. List the chemicals used in the preparation of BOD dilution water, and explain their purpose.
53. Describe how to prepare and store BOD dilution water.
54. Outline the BOD analysis procedure.
55. Define and give examples of the toxic effects or interferences in BOD analysis.
56. Given data, calculate the mg/L BOD.
57. Explain what to do if a sample is over or under depleted.



Soluble BOD?
Who cares?



45 BOD Key Knowledges (NEW)

- Define BOD.
- Define carbonaceous BOD (cBOD)
- Define dissolved oxygen
- Define super-saturation.
- Discuss the key considerations associated with the DO meters and probes.
- Discuss maintenance of DO probes
- Identify the critical requirements associated with BOD incubators:
- Identify the critical requirements associated with a barometer:
- Discuss critical equipment to calibrate a DO meter.
- Discuss how to prepare and store BOD dilution water.





45 BOD Key Knowledges (NEW)₂

- Discuss DO probe calibration options.
- Discuss when and how atmospheric pressure and temperature affect DO calibration.
- Discuss under what conditions super-saturation might occur.
- Discuss the significance of the BOD test in wastewater testing.
- Explain how you "seed" samples in the BOD test.
- Discuss the concept of seeding in the BOD test.
- Discuss what is used for seed in the BOD test.
- Discuss situations when seeding is required for wastewater samples.
- Explain the importance of a seed correction factor and how it is calculated.
- Explain how seeding affects BOD calculations.



45 BOD Key Knowledges (NEW)₃

- Discuss the steps involved in BOD testing.
- Explain why BOD bottles need to be rotated.
- Discuss the incubation time, temperature and other criteria for BOD samples.
- Discuss the types of sample pretreatment required for BOD testing.
- Discuss reasons why the time between preparing BOD sample dilutions and initial DO measurement must be minimized.
- Discuss the minimum number of BOD dilutions required.
- Discuss how to determine the proper sample volumes for the BOD test.
- Discuss the smallest sample volume for BOD that can be used without performing a preliminary dilution.
- Discuss how sample volume affects the LOD for BOD.
- Discuss DO depletion requirements for BOD testing.





45 BOD Key Knowledges (NEW)₄

- Discuss when and why additional nutrients must be added to BOD samples.
- Discuss the testing differences between BOD and cBOD.
- Given data, calculate BOD for a sample.
- Given data, calculate BOD for a GGA standard, which requires the application of the seed correction factor.
- Discuss procedures for reporting results when all dilutions under-deplete (fail to deplete at least 2 mg/L).
- Discuss procedures for reporting results when all dilutions over-deplete (final DO less than 1.0 mg/L).
- Discuss procedures for reporting results when data suggest toxicity.



45 BOD Key Knowledges (NEW)₅

- Describe the considerations associated with interpreting BOD results.
- Discuss the QC sample types and frequencies required for BOD testing.
- Discuss factors that would result in excessive DO depletion in blanks.
- Discuss blank requirements for the BOD test.
- Explain the potential reasons why GGA results could be unacceptably high or low.
- Discuss what is meant by nitrification.
- Discuss how BOD results relate to TSS results and how it also might relate to nitrification.
- How to know if toxicity is occurring in the BOD test.





Knowledge is lacking



Exam Review: Good News 1st

Knowledges with >75% Pass Rate

- You know what a reagent is.
- You know when to use a wide-bore pipet.
- You know what to use when recording data.
- You know that data must be free from alteration.
- You know to keep the TSS oven door closed.
- You know your BOD from cBOD.





Now the Not-so-Good News....

Knowledges with 50 - 75% Pass Rate
Percent that don't know...

- 48%: what causes low GGA.
- 45%: relationship b/w NH₃ concentration and electrode stabilize time.
- 43%: how volume affects BOD LOD
- 40%: why outliers need to be excluded before calculating control limits.
- 39%: how long TP color reagent is stable
- 39%: which pipets to "blow out".
- 37%: why, for BOD, we care about N₁/3
- 37%: TSS filter requirements



...and the REALLY not-so-good news

Questions with < 50% Pass Rate
Percentage that...

- **60%** still don't know their Accuracy from their Precision.
- **60%** don't know what LCS or QCS are.
- **60%** don't know what the TRC report limit is.
- **55%** don't know what geomean is used for.
- **57%** don't know when BOD dilution is needed.
- **53%** don't know TSS residue requirements.
- **56%** don't know only variable affecting ISE.
- **56%** don't know when NH₃ must be distilled.



Don't just slap
a bandaid on it!

- DO NOT go study only the concepts just presented!
- Remember: Exams are generated randomly from a bank of questions.
 - There are over 120 questions in the exam bank. Less than 50% have appeared so far.
- There are questions that have yet to appear tied to OTHER knowledges that operators lack.
- READ the Study Guide.
- ...and did we mention...**READ the Study Guide!**



How to
effectively
study/prepare
for an exam:
Reading for
Comprehension



Study? What's THAT?

- How does one “study”?
- For some of us, it has been a long time...
- There are however, some really good basic approaches to “studying” something like these Study Guides.
- Two simple techniques that can help a great deal are:
 - Reading for Comprehension
 - Mnemonic techniques



Reading for Comprehension

- **Underline** important ideas.
- Circle **key terms**.
- Identify the **main point(s)** of the info.
- Can you eliminate certain parts that just seem to be a lot of extra words—like tangential observations — that don't really add anything of particular note other than length to the information as “extraneous” information?
- Look for “telling” words: “always, must, shall”
- Craft a likely study question ...or two



Reading for Comprehension

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 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.



Reading for Comprehension

Your turn.

5.2.10 Discuss the significance of the BOD test in wastewater testing.

BOD is used to assess the relative strength of a waste. It measures the amount of oxygen required to stabilize a waste if it is discharged to a surface water.

BOD is the most commonly required test on WPDES and NPDES discharge permits. It is widely used in facility design planning and is used to gauge the effectiveness of wastewater treatment plants once in operation. The critical function of the BOD test is to provide a means to assess waste loading on surface waters. By looking at the potential for a waste to utilize oxygen, we can evaluate the potential impacts downstream, including fish.



Reading for Comprehension

1. SIMPLIFY: Start by isolating sentences

5.2.10 Discuss the significance of the BOD test in wastewater testing.

- BOD is used to assess the relative strength of a waste.
- It measures the amount of oxygen required to stabilize a waste if it is discharged to a surface water.
- BOD is the most commonly required test on WPDES and NPDES discharge permits.
- It is widely used in facility design planning and is used to gauge the effectiveness of wastewater treatment plants once in operation.
- The critical function of the BOD test is to provide a means to assess waste loading on surface waters.
- By looking at the potential for a waste to utilize oxygen, we can evaluate the potential impacts downstream, including fish.



Reading for Comprehension

Next highlight "critical" words/phrases

5.2.10 Discuss the significance of the BOD test in wastewater testing.

- BOD is used to assess the relative strength of a waste.
- It measures the amount of oxygen required to stabilize a waste if it is discharged to a surface water.
- BOD is the most commonly required test on WPDES and NPDES discharge permits.
- It is widely used in facility design planning and is used to gauge the effectiveness of wastewater treatment plants once in operation.
- The critical function of the BOD test is to provide a means to assess waste loading on surface waters.
- By looking at the potential for a waste to utilize oxygen, we can evaluate the potential impacts downstream, including fish.



Reading for Comprehension

Next summarize & combine

BOD... used to assess the relative strength of a waste.



- measures amount of O₂ required to stabilize a waste
- critical function = provide a means to assess waste loading on surface waters.

critical function = provide a means to:

- assess strength of a waste
- how much DO needed to stabilize waste

- most commonly required test on discharge permits.
- widely used in facility design planning
- Used to gauge the effectiveness of WWTPs.



Remembering detail:

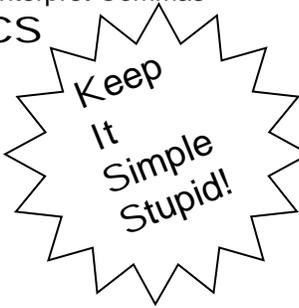
Using Mnemonics



My Nasty Editor Might Occasionally Not Interpret Commas

Mnemonics

- pronounced NUH – MON-ICK
- Typically uses an acronym...
- ...familiar numbers
 - (sports jersey #s)
 - e.g. convert phone #'s to words:
Joe's Burger Joint in Madison could be:
(608) BURGERS = [608.287.4377]
- ...a word association
- ...or a rhyme of sorts
- Basically, anything that will help you remember critical information, lists of things, sequences, etc.



Mnemonics: Acronymns/Acrostics

- **SNAFU**: Military expression which allegedly stands for "Situation Normal, All (Fouled) Up"
- ...and its brother: **TARFU**.
- Or how about **FUBAR**?
- **BYOB**?
- Ford PINTO: Put In New Transmission Often
- **ROY G BIV** = Colors of Rainbow
Red, Orange, Yellow, Green, Blue, Indigo, Violet
- Dumb Kids Playing Chase On Freeway Go Splat.
(Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species.)
- Can't remember whether to use "Affect" or "Effect"?
RAVEN - Remember: Affect=Verb, Effect=Noun



Mnemonics – Rhymes/ Phrases

- “ Righty Tightly; Lefty Lucy ”
- I before E except after C,
and when sounding like "ay" as in
Neighbor or Weigh and "Weird" is just weird
- Planets in order: My Very Energetic Mother
Just Served Us Nine Pizzas
- Rainbows as weather indicators -
Rainbow in the morning: travellers take warning.
Rainbow at night: travellers' delight.
- **Demods**
Buoy numbers **DE**crease **MO**ving **DOW**n**ST**ream.



Mnemonics: Word Association

- Any spelunkers here? Stalactites and Stalagmites...which point down?
- Any big lake/ocean boaters? How are red buoys used to help navigate?
- Color blind? Think “Nun” buoys.
- Mnemonics can even be used to remember complex passwords:
Ex. Jack and Jill went up the hill,” could be used to create the very difficult to guess/break password:
” JaJwuth”

Imagine having to learn the names of the wrist bones:
Scaphoid, Lunate, Triquetral, Pisiform, Hamate, Capitate,
Trapezoid, Trapezium.



Mnemonics for BOD

What do you do if your GGA fails LOW?

- If GGA is failing low; add more seed... pronto!
- If GGA is failing low, seed amount is much too low.
- If GGA is failing low, seed is the source of woe.

What do you do if your GGA fails HIGH?

- If GGA is failing HIGH; the lab may be a pigsty!
- If GGA is failing HIGH; contamination's likely why!
- If GGA is failing high, dirty glassware...ain't no lie.
- If GGA is high as a kite, dilution water tubing may not be right.



Mnemonics for TSS

Simple reminders – no rocket science here!

Filter type required?

- WHAT type? WHATman (934-AH)

TSS Residue amount requirements?

- Capture at least 1 milligram or be in dutch
- But 200 milligrams is TOO much

Filter with or without organic binder?

Science: organics in the sample could dissolve the binder, reducing filter weight

- WithOUT (you throw OUT the filtrate for TSS)
- Filters? We don't need no steenking binder!



Other Lab Mnemonics

Correlation coefficient acceptance criteria?

Try this, sports fans:

- Wayne Gretsky wore #99
- Joltin' Joe Dimaggio wore #5
- So just remember: Gretsky-DiMaggio
- Or, for Packer diehards:
 - Don Davey-Paul Hornung

0.995

NH3 electrode criteria 54 to 60.

Match to packer jerseys or Hall of Fame Greats

- Larry McCarren (54) – Lee Roy Caffey (60)
- (current) Brandon Chillar (54) to Rob Davis (60)
- HOFers Randy White(54) to Chuck Bednarik (60)



Desperate Times

- Mnemonics a tad corny?
- Maybe...
- But desperate times call for desperate measures.
- If only 1 out of 5 people are passing the INTRO exam, something needs to change



WANTED: A Few Good Trainers

Last (*but definitely not least*)attend a training or exam review session offered by one of the many trainer organizations

Having all the required information right in the study guides doesn't eliminate the need for trainers. Supplemental help remains critical.

Trainers should...

- Cover the study guides in detail
- Help with reading for comprehension
- Provide mnemonics where possible
- See if DNR can provide exam feedback. Use it to improve your training sessions.



Study Guides = General Resource

- OpCert study guides...get involved in more than just a May/November relationship.
- The “Lab” version is a general lab resource...
- ... true for other exam guides as well.
- Written from as *“here’s what can go wrong in lab testing and this is what to do about it”* perspective.
- The revised Lab Study Guide is designed to be a complete lab resource offering:
 - background knowledge
 - critical testing information and requirements
 - troubleshooting advice



Where to Obtain Study Guides

- <http://www.dnr.state.wi.us/org/es/science/opcert/water.htm>
- OR
- <http://tinyurl.com/DNR-exams>



Actually only need to type tinyurl.com/DNR-exams in your browser

Which would YOU rather remember?



DNR Study Guides Online

tinyurl.com/DNR-exams

Subclass	Name	Description	Study Guide (pdf)
	General	General	Study Guide
A	Preliminary and Primary Treatment	Primary Settling	Study Guide
B	Trickling Filter/RBC	Trickling filters and rotating biological contactors	Study Guide
C	Activated Sludge	Activated Sludge	Study Guide
D	Ponds and Aereated Lagoons	Stabilization ponds and aerated lagoons	Study Guide
E	Disinfection	Disinfection	Study Guide
F	Anaerobic Digestion	Anaerobic digestion	Study Guide
G	Mechanical Sludge	Mechanical sludge dewatering and treatment	Study Guide
H	Filtration	Filtration (tertiary)	Study Guide
I	Phosphorus Removal	Phosphorus removal	NEW Study Guide [PDF 928 KB]
J	Laboratory	On-site laboratory testing	NEW Lab Intro Study Guide [PDF 1.2 MB] Lab Advanced Study Guide
K	Special K	Special- generally for treatment plants using chemical or physical treatment, or both	Study Guide
L	Electroplating and Metal Finishing	Electroplating and metal finishing	Study Guide



Other Resources

UW Water Library

- <http://aqua.wisc.edu/WaterLibrary/Default.aspx?tabid=178>
- OR
- <http://tinyurl.com/UW-H2O>



University of Wisconsin Sea Grant Institute & University of Wisconsin Water Resources Institute

UW-MADISON LIBRARIES **WISCONSIN'S WATER LIBRARY**

HOME HOURS & LOCATION ASK WATER ABOUT SEARCH

UW FACULTY/STAFF/STUDENTS WISCONSIN RESIDENTS KIDS/PARENTS/TEACHERS

WASTEWATER TREATMENT

Recommended Reading List

In partnership with Wisconsin Department of Natural Resources (WDNR) and the Wisconsin Wastewater Operator's Association (WVWA), Wisconsin's Water Library is making available these technical manuals in support of the educational needs of current and potential wastewater operators around the state.

COLLECTIONS



WI Water Library: Wastewater

- **Call No. 172921 - Mathematics manual for water and wastewater treatment plant operators**
- **Call No. 172922 - Biological nutrient removal (BNR) operation in wastewater treatment plants**
- **Call No. 172923 - Wastewater disinfection**
- **Call No. 172924 - Advanced waste treatment: a field study training program**
- **Call No. 172925 - Operation of municipal wastewater treatment plants**
- **Call No. 172926 - Operation of wastewater treatment plants : a field study training program**
- **Call No. 172927 - Operation of municipal wastewater treatment plants study guide**
- **Call No. 172929 v.1 - Operation of wastewater treatment plants : a field study training program. Vol.1**
- **Call No. 172930 - Handbook of water and wastewater treatment plant operations**



Conclusions

- Lab exam performance has been less than stellar.
- ...yet exam questions were reviewed & found to be valid.
- Theoretically, with retirements, we may have a whole new crop of operators taking exams.
- These operators are not adequately prepared.
- In some cases, it appears they may be reading a question too quickly.
- It definitely appears that many have not even glanced at the new study guide.
- The data indicates some basic conceptual difficulties (e.g., Accuracy vs. Precision)
- Everything you need to know is in the Study Guides.

Summary

- The Concept of OpCert Exam Study Guides has changed
- DOWNLOAD** a copy of the study guides
- READ** the study guides
- USE** the study guides as a resource
- ATTEND** training to supplement the information in the study guides



Acknowledgements

- Thanks to these folks who put in a LOT of time and effort to compile the new Lab Study Guides and Exam database.



Wisconsin Department of Natural Resources

Bureau of Science Services

Operator Certification Program

Study Guide - Introduction to On-site Laboratory Testing

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