Registration Form

WASTEWATER TREATMENT WATER QUALITY CEU COURSE $300.00

48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL $50.00

Start and finish dates: _____
You will have 90 days from this date in order to complete this course

Name_____Signature_____
I have read and understood the disclaimer notice on page 2. Digitally sign XXX

Address: _____

City_____State_____Zip_____

Email_____ Fax (_____) _____

Phone:
Home (_____) _____ Work (_____) _____

Operator ID #_____Exp Date_____

Please circle/check which certification you are applying the course CEU's/PDH's.

Wastewater Collection_____ Pretreatment_____ Wastewater Treatment_____

Other _____

Your certificate will be mailed to you in about two weeks.

Technical Learning College Western Campus
PO Box 420, Payson AZ 85547-0420
Fax (928) 272-0747 Back-up Fax (928) 468-0675
(928) 468-0665 Toll Free (866) 557-1746 info@tlch2o.com

Discover card CCV code on card_____
American Express
Visa or MasterCard #_____Exp. Date_____

If you've paid on the Internet, write your Customer #_____

Invoice me, PO # _____

Include an e-mail address so we can e-mail your certificate of completion.

DISCLAIMER NOTICE
I understand that it is my responsibility to ensure that this CEU course is either approved or accepted in my State for CEU credit. I understand State laws and rules change on a frequent basis and I believe this course is currently accepted in my State for CEU or contact hour credit, if it is not, I will not hold Technical Learning College responsible. I also understand that this type of study program deals with dangerous conditions and that I will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable for any errors or omissions or advice contained in this CEU education training course or for any violation or injury caused by this CEU education training course material. I will call or contact TLC if I need help or assistance and double-check to ensure my registration page and assignment has been received and graded.

State Approval Listing Link, check to see if your State accepts or has pre-approved this course. Not all States are listed. Not all courses are listed. If the course is not accepted for CEU credit, we will give you the course free if you ask your State to accept it for credit.

Professional Engineers; Most states will accept our courses for credit but we do not officially list the States or Agencies. Please check your State for approval.

State Approval Listing URL…
http://www.tlch2o.com/PDF/CEU%20State%20Approvals.pdf

You can obtain a printed version of the course manual from TLC for an additional $79.95 plus shipping charges.

AFFIDAVIT OF EXAM COMPLETION
I affirm that I personally completed the entire text of the course. I also affirm that I completed the exam without assistance from any outside source. I understand that it is my responsibility to file or maintain my certificate of completion as required by the state or by the designation organization.

Grading Information
In order to maintain the integrity of our courses we do not distribute test scores, percentages or questions missed. Our exams are based upon pass/fail criteria with the benchmark for successful completion set at 70%. Once you pass the exam, your record will reflect a successful completion and a certificate will be issued to you.

For security purposes, please fax or e-mail a copy of your driver's license and always call us to confirm we've received your assignment and to confirm your identity.

Thank you…

WWT WQ Answer Key

Name_____

Telephone _____

Please Circle, Underline, Bold or X. One correct answer per question.

1. A B C D E	45. A B C D E	89. A B C D E
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Please e-mail or fax this with your final exam

WASTEWATER TREATMENT
WATER QUALITY CEU COURSE

CUSTOMER SERVICE RESPONSE CARD

NAME: _____

E-MAIL_____PHONE_____

PLEASE COMPLETE THIS FORM BY CIRCLING THE NUMBER OF THE APPROPRIATE ANSWER IN THE AREA BELOW.

1. Please rate the difficulty of your course.
   Very Easy 0 1 2 3 4 5 Very Difficult

2. Please rate the difficulty of the testing process.
   Very Easy 0 1 2 3 4 5 Very Difficult

3. Please rate the subject matter on the exam to your actual field or work.
   Very Similar 0 1 2 3 4 5 Very Different

4. How did you hear about this Course?_____

5. What would you do to improve the Course?

_____

_____

How about the price of the course?

Poor_____ Fair ____ Average ____ Good____ Great_____

How was your customer service?

Poor___ Fair ____ Average ____ Good_____ Great_____

Any other concerns or comments.

_____

_____

_____

Wastewater Treatment Water Quality CEU Assignment

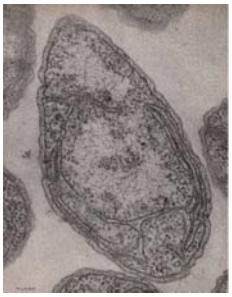
You will have 90 days from the start to have this assignment completed. If you need any assistance, please contact Student Services at (928) 468-0665 or e-mail **info@tlch2o.com.**

This assignment is also available along with Course Support on TLC's Website under the Assignment Page. If you need CEUs or PDHs, return the answers along with the registration form found in the front of this manual. Please e-mail or fax your assignment to TLC.

Bug Identification

Pictures 1-5

A. Thriothrix
B. Nitrosomonas
C. Ciliate
D. Amoeba
E. Water Bear



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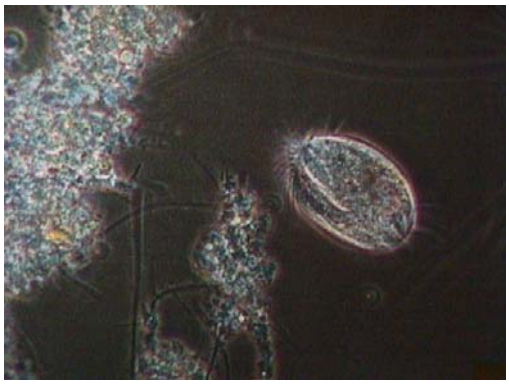

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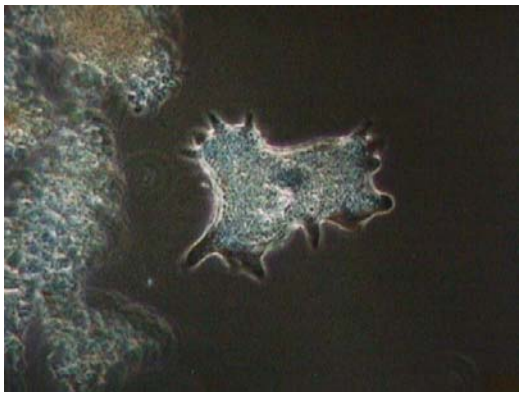

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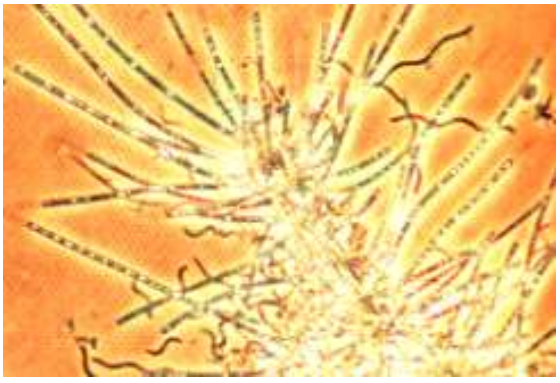
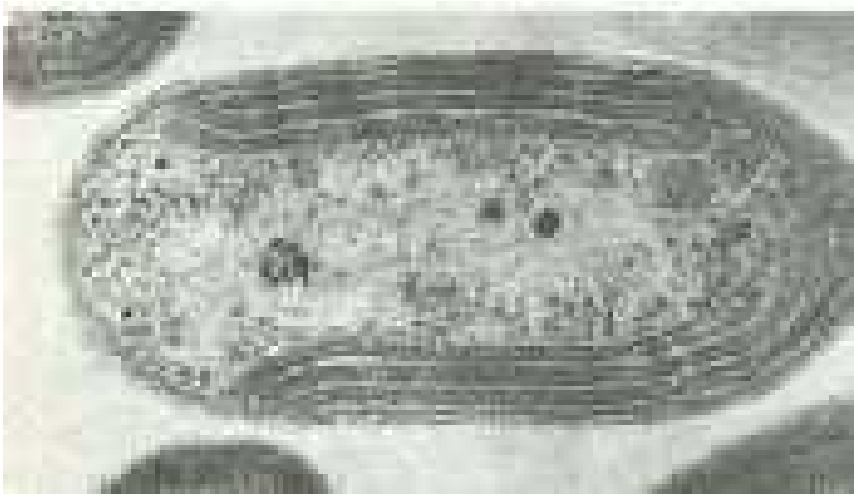


5.

Pictures 6-10

A. Aspidisca
B. Nematode
C. Euglypha
D. Euchlanis
E. Nitrobacter winogradskyi



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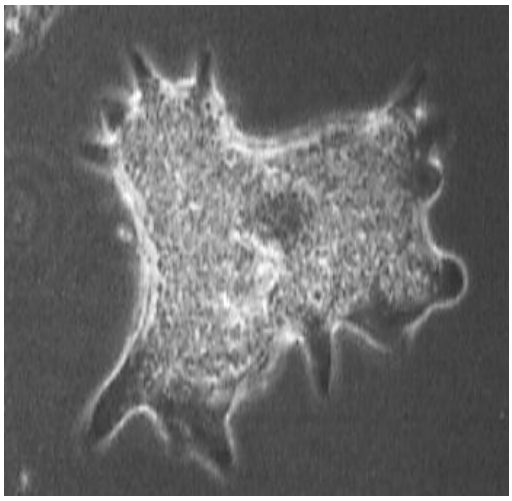

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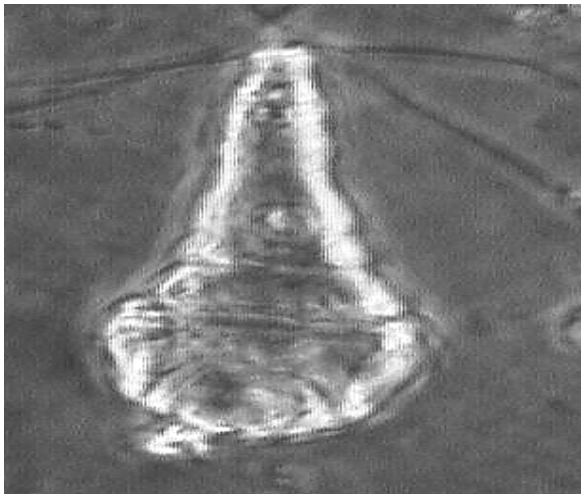

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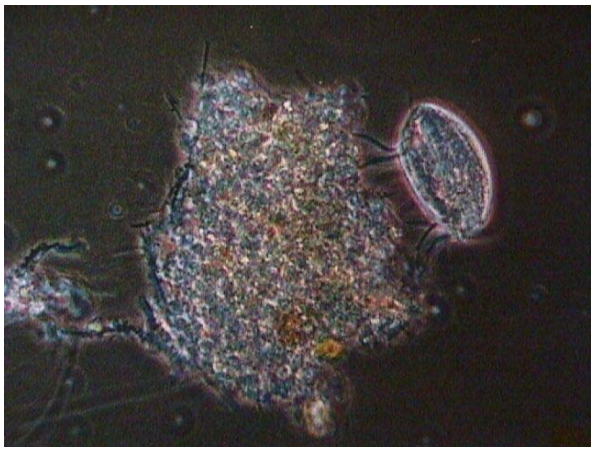

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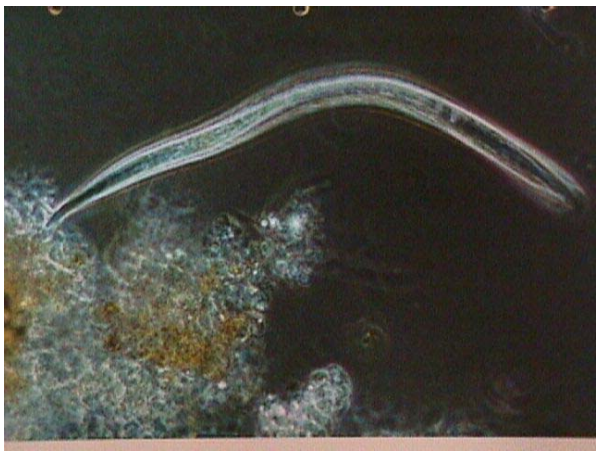
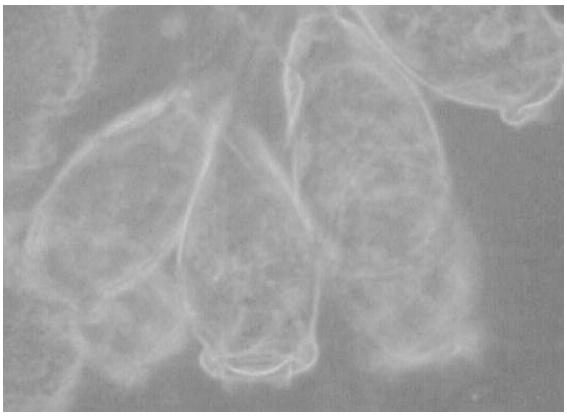


10.

Pictures 11-15

A. Paramecium
B. Vorticella
C. S. natas
D. Microthrix Parvicella
E. Nitrospira gracilis

11.



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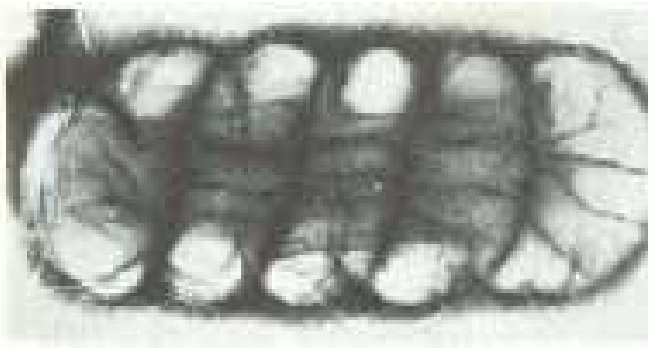

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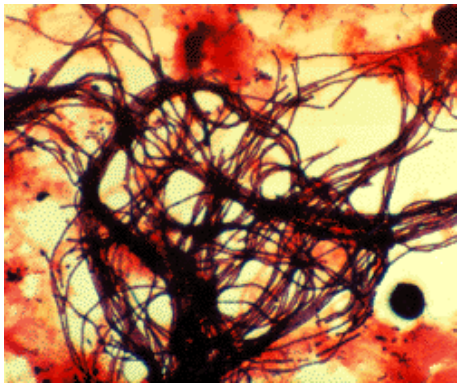

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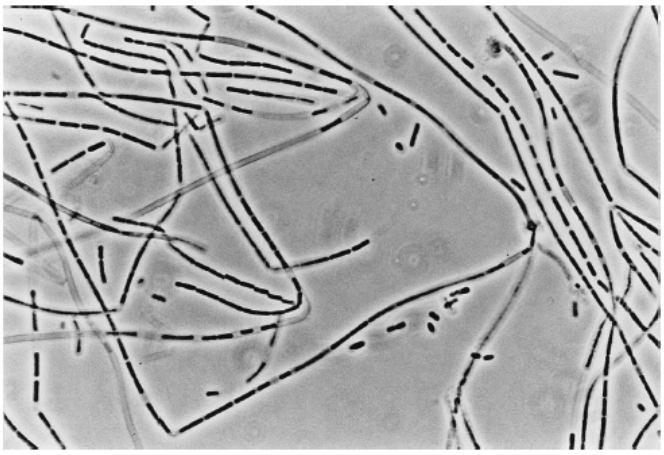
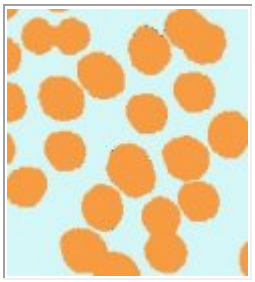
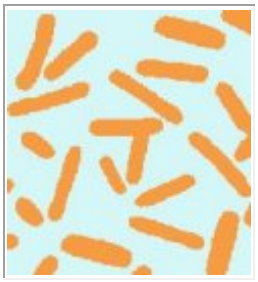
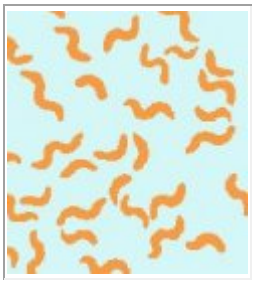


15.

Identify the Bacteria types

			
16.	17.	18.	19.
			
20.	21.	22.	23.

Pictures 16-19
A. Curved Rods
B. Cocci
C. Rods
D. Spira
E. Ovoids

Pictures 20- 23
A. Filamentous
B. Spirochaetes
C. Cocci
D. Ovoids
E. Curved Rods

What is the dark brown foam?
Pictures 24 and 25

24. Heavy build-up of foam during winter.

A. Microthrix
B. Sphaerotilus
C. Nostocoida
D. Thiothrix
E. None of the above

25. On top of an aeration basin

A. Microthrix
B. Sphaerotilus
C. Nostocoida
D. Thiothrix
E. None of the above

Back to the Basics

26. Physical processes were some of the earliest methods to remove solids from wastewater, usually by passing wastewater through screens to remove debris and _____.

A. Oxygen
B. Activated Sludge
C. Bacterial Or Bacteria
D. Solids
E. None of the Above

27. _____ that are heavier than water will settle out from wastewater by gravity.

A. Oxygen
B. Activated Sludge
C. Bacterial Or Bacteria
D. Solids
E. None of the Above

28. Particles with _____ air float to the top of water and can also be removed.

A. Oxygen
B. Activated Sludge
C. Bacterial Or Bacteria
D. Solids
E. None of the Above

29. In nature, _____ and other small organisms in water consume organic matter in sewage, turning it into new bacterial cells, carbon dioxide, and other by-products.
A. Oxygen
B. Activated Sludge
C. Bacterial Or Bacteria
D. Solids
E. None of the Above

30. The _____ normally present in water must have oxygen to do their part in breaking down the sewage. In the 1920s, scientists observed that these natural processes could be contained and accelerated in systems to remove organic material from wastewater.
A. Oxygen
B. Activated Sludge
C. Bacterial Or Bacteria
D. Solids
E. None of the Above

31. With the addition of _____ to wastewater, masses of microorganisms grew and rapidly metabolized organic pollutants. Any excess microbiological growth could be removed from the wastewater by physical processes.
A. Oxygen
B. Activated Sludge
C. Bacterial Or Bacteria
D. Solids
E. None of the Above

32. _____is a suspended growth process for removing organic matter from sewage by saturating it with air and microorganisms that can break down the organic matter.
A. Oxygen
B. Activated Sludge
C. Bacterial Or Bacteria
D. Solids
E. None of the Above

33. _____involves treatment levels beyond secondary treatment.
A. Oxygen
B. Activated Sludge
C. Bacterial Or Bacteria
D. Advanced Treatment
E. None of the Above

34. _____can be used to create changes in pollutants that increase the removal of these new forms by physical processes.
A. Biological processes
B. Iron salts
C. Biosolids
D. Chemicals
E. None of the Above

35. Simple chemicals such as alum, lime or _____can be added to wastewater to cause certain pollutants, such as phosphorus, to floc or bunch together into large, heavier masses which can be removed faster through physical processes.
A. Biological processes
B. Iron salts
C. Biosolids
D. None of the Above

36. The chemical industry has developed synthetic inert chemicals know as _____ to further improve the physical separation step in wastewater treatment.
A. Biological processes
B. Iron salts
C. Biosolids
D. Parasites
E. None of the Above

37. Polymers are often used at the later stages of treatment to improve the settling of excess microbiological growth or _____.
A. Biological processes
B. Iron salts
C. Biosolids
D. Parasites
E. None of the Above

38. Many different types of organisms live in wastewater and some are essential contributors to treatment. A variety of bacteria, protozoa, and worms work to break down certain carbon-based (organic) pollutants in wastewater by consuming them. Through this process, organisms turn wastes into _____, water, or new cell growth.
A. Biological processes
B. Iron salts
C. Biosolids
D. Parasites
E. None of the Above

39. Bacteria and other microorganisms are particularly plentiful in wastewater and accomplish most of the treatment. Most wastewater treatment systems are designed to rely in large part on _____.
A. Biological processes
B. Iron salts
C. Biosolids
D. Parasites
E. None of the Above

40. Many disease-causing viruses, _____, and bacteria also are present in wastewater and enter from almost anywhere in the community.
A. Biological processes
B. Iron salts
C. Biosolids
D. Parasites
E. None of the Above

41. _____ often originate from people and animals who are infected with or are carriers of a disease.
A. Biological processes
B. Iron salts
C. Pathogens
D. Parasites
E. None of the Above

42. _____ and blackwater from typical homes contain enough pathogens to pose a risk to public health. Other likely sources in communities include hospitals, schools, farms, and food processing plants.
A. Gastroenteritis
B. Hepatitis A
C. Cholera
D. Graywater
E. All of the Above

43. _____ can result from a variety of pathogens in wastewater, and cases of illnesses caused by the parasitic protozoa Giardia lambia and Cryptosporidium are not unusual in the U.S.
A. Gastroenteritis
B. Hepatitis A
C. Cholera
D. Graywater
E. All of the Above

44. Other important wastewater-related diseases include hepatitis A, typhoid, polio, _____, and dysentery. Outbreaks of these diseases can occur as a result of drinking water from wells polluted by wastewater, eating contaminated fish, or recreational activities in polluted waters.
A. Gastroenteritis
B. Hepatitis A
C. Cholera
D. Graywater
E. All of the Above

Identify the wastewater treatment effect

45. Increases algal photosynthesis (eutrophication). Increased plant life on surface. Reduces light in lower levels.
A. Effect of TSS
B. Effect of pH
C. Additional Effects of Nitrogen
D. Effects of Phosphorous and Nitrogen
E. None of the Above

46. Organic nitrogen and ammonia are converted to nitrates in water. Nitrates are converted to nitrites in digestive system. Nitrites are assimilated into blood stream where they are converted by respired oxygen to nitrates. May cause suffocation (blue baby syndrome).
A. Effect of TSS
B. Effect of pH
C. Additional Effects of Nitrogen
D. Effects of Phosphorous and Nitrogen
E. None of the Above

47. Organisms are very susceptible to acids and bases. Recommended to have near neutral conditions (6.5 - 8.5).
A. Effect of TSS
B. Effect of pH
C. Additional Effects of Nitrogen
D. Effects of Phosphorous and Nitrogen
E. None of the Above

48. Depletes dissolved oxygen from streams, lakes and oceans. May cause death of aerobic organisms (fish kills, etc.) Increases anaerobic properties of water.
A. Effect of TSS
B. Effect of pH
C. Additional Effects of Nitrogen
D. Effect of BOD
E. None of the Above

49. Increases turbidity: Less light - reduced photosynthesis. Causes fish's gills to get plugged up Increases silting: Reduces lifetime of lakes. Changes benthic (i.e., bottom) ecology.
A. Effect of TSS
B. Effect of pH
C. Additional Effects of Nitrogen
D. Effects of Phosphorous and Nitrogen
E. None of the Above

50. Organic materials are found everywhere in the environment. They are composed of the _____ chemicals that are the building blocks of most living things.
A. Biochemical oxygen demand (BOD)
B. Carbon-based
C. Biodegradable materials
D. Organic
E. None of the Above

51. _____ compounds normally are some combination of carbon, hydrogen, oxygen, nitrogen, and other elements.
A. Biochemical oxygen demand (BOD)
B. Carbon-based
C. Biodegradable materials
D. Organic
E. None of the Above

52. Many _____ are proteins, carbohydrates, or fats and are biodegradable, which means they can be consumed and broken down by organisms.
A. Biochemical oxygen demand (BOD)
B. Carbon-based
C. Biodegradable materials
D. Organic
E. None of the Above

53. Even _____ can cause pollution. In fact, too much organic matter in wastewater can be devastating to receiving waters.
A. Biochemical oxygen demand (BOD)
B. Carbon-based
C. Biodegradable materials
D. Organic
E. None of the Above

54. Large amounts of _____are dangerous to lakes, streams, and oceans, because organisms use dissolved oxygen in the water to break down the wastes. This can reduce or deplete the supply of oxygen in the water needed by aquatic life, resulting in fish kills, odors, and overall degradation of water quality.
A. Biochemical oxygen demand (BOD)
B. Carbon-based
C. Biodegradable materials
E. None of the Above

55. The amount of oxygen organisms need to break down wastes in wastewater is referred to as the _____and is one of the measurements used to assess overall wastewater strength.
A. Biochemical oxygen demand (BOD)
B. Carbon-based
C. Biodegradable materials
D. Organic
E. None of the Above

56. Some _____ compounds are more stable than others and cannot be quickly broken down by organisms, posing an additional challenge for treatment. This is true of many synthetic organic compounds developed for agriculture and industry.
A. Biochemical oxygen demand (BOD)
B. Carbon-based
C. Biodegradable materials
D. Organic
E. None of the Above

57. In addition, certain _____ organics are highly toxic. Pesticides and herbicides are toxic to humans, fish, and aquatic plants and often are disposed of improperly in drains or carried in stormwater. In receiving waters, they kill or contaminate fish, making them unfit to eat. They also can damage processes in treatment plants.
A. Biochemical oxygen demand (BOD)
B. Carbon-based
C. Biodegradable materials
D. Synthetic
E. None of the Above

58. Benzene and toluene are two toxic organic compounds found in some solvents, pesticides, and other products. New _____ are being developed all the time, which can complicate treatment efforts.
A. Potassium
B. Oils and greases or Greases
C. Fatty organic materials
D. Synthetic organic compounds
E. None of the Above

59. _____ from animals, vegetables, and petroleum also are not quickly broken down by bacteria and can cause pollution in receiving environments.
A. Potassium
B. Oils and greases or Greases
C. Fatty organic materials
D. Synthetic organic compounds
E. None of the Above

60. When large amounts of _____ are discharged to receiving waters from community systems, they increase BOD and they may float to the surface and harden, causing aesthetically unpleasing conditions.
A. Potassium
B. Oils and greases or Greases
C. Fatty organic materials
D. Synthetic organic compounds
E. None of the Above

61. Oils and greases can trap trash, plants, and other materials, causing foul odors, attracting flies and mosquitoes and other disease vectors. In some cases, too much _____ causes septic conditions in ponds and lakes by preventing oxygen from the atmosphere from reaching the water.
A. Potassium
B. Oils and greases or Greases
C. Fatty organic materials
D. Synthetic organic compounds
E. None of the Above

62. Onsite systems also can be harmed by too much _____, which can clog onsite system drainfield pipes and soils, adding to the risk of system failure. Excessive grease also adds to the septic tank scum layer, causing more frequent tank pumping to be required. Both possibilities can result in significant costs to homeowners.
A. Potassium
B. Oils and greases or Greases
C. Fatty organic materials
D. Synthetic organic compounds
E. None of the Above

63. _____ used for motors and industry are considered hazardous waste and should be collected and disposed of separately from wastewater.
A. Potassium
B. Oils and greases or Greases
C. Fatty organic materials
D. Petroleum-based waste oils
E. None of the Above

64. Inorganic minerals, metals, and compounds, such as sodium, _____, calcium, magnesium, cadmium, copper, lead, nickel, and zinc are common in wastewater from both residential and nonresidential sources.
A. Potassium
B. Oils and greases or Greases
C. Fatty organic materials
D. Synthetic organic compounds
E. None of the Above

65. The above minerals can originate from a variety of sources in the community including industrial and commercial sources, stormwater, and inflow and infiltration from cracked pipes and leaky manhole covers. Most _____are relatively stable, and cannot be broken down easily by organisms in wastewater.
A. Oxygen
B. Nitrogen
C. Inorganic substances
D. Nutrients
E. None of the Above

66. Large amounts of many _____can contaminate soil and water. Some are toxic to animals and humans and may accumulate in the environment.
A. Oxygen
B. Nitrogen
C. Inorganic substances
D. Nutrients
E. None of the Above

67. _____that are discharged with many types of industrial wastewaters, are difficult to remove by conventional treatment methods. Although acute poisonings from heavy metals in drinking water are rare in the U.S., potential long-term health effects of ingesting small amounts of some inorganic substances over an extended period of time are possible.
A. Oxygen
B. Nitrogen
C. Inorganic substances
D. Nutrients
E. None of the Above

68. Wastewater often contains large amounts of the nutrients _____ and phosphorus in the form of nitrate and phosphate, which promote plant growth.
A. Oxygen
B. Nitrogen
C. Inorganic substances
D. Nutrients
E. None of the Above

69. Organisms only require small amounts of _____ in biological treatment, so there normally is an excess available in treated wastewater.
A. Oxygen
B. Nitrogen
C. Inorganic substances
D. Nutrients
E. None of the Above

70. In severe cases, excessive _____ in receiving waters cause algae and other plants to grow quickly depleting oxygen in the water.
A. Oxygen
B. Nitrogen
C. Inorganic substances
D. Nutrients
E. None of the Above

71. Deprived of _____, fish and other aquatic life die, emitting foul odors.
A. Oxygen
B. Nitrogen
C. Inorganic substances
D. Nutrients
E. None of the Above

72. Nutrients from wastewater have also linked to ocean "_____" that poison fish and cause illness in humans.
A. Oxygen
B. Nitrogen
C. Inorganic substances
D. Nutrients
E. None of the Above

73. _____ in drinking water may contribute to miscarriages and is the cause of a serious illness in infants called methemoglobinemia or "blue baby syndrome."
A. Oxygen
B. Nitrogen
C. Inorganic substances
D. Nutrients
E. None of the Above

74. Solid materials in wastewater can consist of organic and/or inorganic materials and _____.
A. Organisms
B. Settleable solids
C. Suspended solids
D. Dissolved solids
E. None of the Above

75. The _____ must be significantly reduced by treatment or they can increase BOD when discharged to receiving waters and provide places for microorganisms to escape disinfection.
A. Organisms
B. Settleable solids
C. Suspended solids
D. Solids
E. None of the Above

76. Certain substances, such as sand, grit, and heavier organic and inorganic materials settle out from the rest of the wastewater stream during the preliminary stages of treatment. On the bottom of settling tanks and ponds, organic material makes up a biologically active layer of sludge that aids in treatment.
A. Organisms
B. Settleable solids
C. Suspended solids
D. Dissolved solids
E. None of the Above

77. Materials that resist settling may remain suspended in wastewater.
A. Organisms
B. Settleable solids
C. Suspended solids
D. Dissolved solids
E. None of the Above

78. _____ in wastewater must be treated, or they will clog soil absorption systems or reduce the effectiveness of disinfection systems.
A. Organisms
B. Settleable solids
C. Suspended solids
D. Dissolved solids
E. None of the Above

79. Small particles of certain wastewater materials can dissolve like salt in water.
A. Organisms
B. Settleable solids
C. Suspended solids
D. Dissolved solids
E. None of the Above

80. Some dissolved materials are consumed by microorganisms in wastewater, but others, such as heavy metals, are difficult to remove by _____.
A. Asphyxiation hazards
B. Potentially dangerous
C. Adverse effects
D. Conventional treatment
E. None of the Above

81. Excessive amounts of dissolved solids in wastewater can have _____on the environment.
A. Asphyxiation hazards
B. Potentially dangerous
C. Adverse effects
D. Conventional treatment
E. None of the Above

82. Certain gases in wastewater can cause odors, affect treatment, or are _____.
A. Asphyxiation hazards
B. Potentially dangerous
C. Adverse effects
D. Conventional treatment
E. None of the Above

83. Methane gas, for example, is a byproduct of anaerobic biological treatment and is highly combustible. _____need to be taken near septic tanks, manholes, treatment plants, and other areas where wastewater gases can collect.
A. Asphyxiation hazards
B. Potentially dangerous
C. Adverse effects
D. Special precautions
E. None of the Above

84. The gases hydrogen sulfide and ammonia can be toxic and pose _____.
A. Asphyxiation hazards
B. Potentially dangerous
C. Adverse effects
D. Conventional treatment
E. None of the Above

85. Organic matter and ammonia are "_____" substances.
A. Chief nutrients
B. Break down process
C. Oxygen-demanding
D. Secondary biological treatment processes
E. None of the Above

86. _____substances are contributed by domestic sewage and agricultural and industrial wastes of both plant and animal origin, such as those from food processing, paper mills, tanning, and other manufacturing processes.
A. Chief nutrients
B. Break down process
C. Oxygen-demanding
D. Secondary biological treatment processes
E. None of the Above

87. These substances are usually destroyed or converted to other compounds by bacteria if there is sufficient oxygen present in the water, but the dissolved oxygen needed to sustain fish life is used up in this _____.
A. Chief nutrients
B. Break down process
C. Oxygen-demanding
D. Secondary biological treatment processes
E. None of the Above

88. Carbon, nitrogen, and phosphorus are essential to living organisms and are the _____ present in natural water.
A. Chief nutrients
B. Break down process
C. Oxygen-demanding
D. Secondary biological treatment processes
E. None of the Above

89. Conventional _____do not remove the phosphorus and nitrogen to any substantial extent -- in fact, they may convert the organic forms of these substances into mineral form, making them more usable by plant life.
A. Chief nutrients
B. Break down process
C. Oxygen-demanding
D. Secondary biological treatment processes
E. None of the Above

90. When an excess of these nutrients overstimulates the growth of water plants, the result causes unsightly conditions, interferes with drinking water treatment processes, and causes unpleasant and _____and odors in drinking water.
A. Chief nutrients
B. Break down process
C. Disagreeable tastes
D. Secondary biological treatment processes
E. None of the Above

91. The release of large amounts of _____, primarily phosphorus but occasionally nitrogen, causes nutrient enrichment which results in excessive growth of algae.
A. Nutrients
B. Break down process
C. Oxygen-demanding
D. Secondary biological treatment processes
E. None of the Above

92. Uncontrolled algae growth blocks out sunlight and chokes aquatic plants and animals by depleting _____in the water at night.
A. Ecology
B. Cooling
C. Dissolved oxygen
D. Nutrients
E. None of the Above

93. The release of _____ in quantities that exceed the affected waterbody's ability to assimilate them results in a condition called eutrophication or cultural enrichment.
A. Ecology
B. Cooling
C. Dissolved oxygen
D. Nutrients
E. None of the Above

94. _____ reduces the capacity of water to retain oxygen.
A. Ecology
B. Cooling
C. Dissolved oxygen
D. Heat
E. None of the Above

95. In some areas, water used for _____ is discharged to streams at elevated temperatures from power plants and industries. Even discharges from wastewater treatment plants and storm water retention ponds affected by summer heat can be released at temperatures above that of the receiving water, and elevate the stream temperature.
A. Ecology
B. Cooling
C. Dissolved oxygen
D. Nutrients
E. None of the Above

96. Unchecked discharges of waste heat can seriously alter the _____ of a lake, a stream, or estuary.
A. Ecology
B. Cooling
C. Dissolved oxygen
D. Nutrients
E. None of the Above

97. The initial stage in the treatment of domestic wastewater is known as _____.
A. Primary treatment or Primary
B. Secondary stage or Secondary
C. Coarse Screening process
D. Preliminary Treatment
E. None of the Above

98. Coarse solids are removed from the wastewater in the _____ of treatment.
A. Primary treatment or Primary
B. Secondary stage or Secondary
C. Coarse Screening process
D. Preliminary Treatment
E. None of the Above

99. In some treatment plants, _____ and secondary stages may be combined into one basic operation. At many wastewater treatment facilities, influent passes through preliminary treatment units before primary and secondary treatment begins.
A. Primary treatment or Primary
B. Secondary stage or Secondary
C. Coarse Screening process
D. Preliminary Treatment
E. None of the Above

100. In the _____, solids are allowed to settle and removed from wastewater.
A. Primary treatment or Primary
B. Secondary stage or Secondary
C. Coarse Screening process
D. Preliminary Treatment
E. None of the Above

101. The _____uses biological processes to further purify wastewater.
A. Primary treatment or Primary
B. Secondary stage or Secondary
C. Coarse Screening process
D. Preliminary Treatment
E. None of the Above

102. The _____is purely physical stage consisting of Coarse Screening, Raw Influent Pumping, Static Fine Screening, Grit Removal, and Selector Tanks.
A. Primary treatment or Primary
B. Secondary stage or Secondary
C. Coarse Screening process
D. Preliminary Treatment
E. None of the Above

103. The raw wastewater enters from the collection system into the _____. After the wastewater has been screened, it may flow into a grit chamber where sand, grit, cinders, and small stones settle to the bottom.
A. Primary treatment or Primary
B. Secondary stage or Secondary
C. Coarse Screening process
D. Preliminary Treatment
E. None of the Above

104. Removing the grit and gravel that washes off streets or land during storms is very important, especially in cities with _____.
A. Primary treatment or Primary
B. Secondary stage or Secondary
C. Coarse Screening process
D. Preliminary Treatment
E. None of the Above

105. Large amounts of grit and sand entering a treatment plant can cause serious operating problems, such as excessive wear of pumps and other equipment, _____, or taking up capacity in tanks that is needed for treatment.
A. Primary treatment or Primary
B. Secondary stage or Secondary
C. Coarse Screening process
D. Preliminary Treatment
E. None of the Above

106. In some plants, another finer screen is placed after the _____to remove any additional material that might damage equipment or interfere with later processes.
A. Grit
B. Grit chamber
C. Incinerated
D. Coarse Screening
E. None of the Above

107. The grit and screenings removed by these processes must be periodically collected and trucked to a landfill for disposal or are _____.
A. Grit
B. Grit chamber
C. Incinerated
D. Coarse Screening
E. None of the Above

108. The _____consists of a basket shaped bar screen which collects larger debris (several inches in diameter) prior to the Raw Influent Pumping. This debris is removed and placed into a dumpster for disposal into the landfill.
A. Grit
B. Grit chamber
C. Incinerated
D. Coarse Screening
E. None of the Above

109. With the screening completed and the grit removed, wastewater still contains dissolved organic and inorganic constituents along with _____.
A. Grit
B. Grit chamber
C. Incinerated
D. Suspended solids
E. None of the Above

110. The _____consist of minute particles of matter that can be removed from the wastewater with further treatment such as sedimentation or gravity settling, chemical coagulation, or filtration.
A. Grit
B. Grit chamber
C. Incinerated
D. Suspended solids
E. None of the Above

111. _____ that are dissolved or are very fine and remain suspended in the wastewater are not removed effectively by gravity settling. When the wastewater enters a sedimentation tank, it slows down and the suspended solids gradually sink to the bottom.
A. Grit
B. Grit chamber
C. Incinerated
D. Pollutants
E. None of the Above

112. This mass of solids is called primary sludge. Various methods have been devised to remove _____from the tanks.
A. 90 percent
B. Secondary treatment
C. Oxidation Ditches
D. Secondary Clarification
E. None of the Above

113. Newer plants have some type of mechanical equipment to remove the settled solids from _____. Some plants remove solids continuously while others do so at intervals.
A. 90 percent
B. Secondary treatment
C. Oxidation Ditches
D. Secondary Clarification
E. None of the Above

114. After the wastewater has been through Primary Treatment processes, it flows into the next stage of treatment called _____.
A. 90 percent
B. Secondary treatment
C. Oxidation Ditches
D. Secondary Clarification
E. None of the Above

115. Secondary treatment processes can remove up to _____of the organic matter in wastewater by using biological treatment processes.
A. 90 percent
B. Secondary treatment
C. Oxidation Ditches
D. Secondary Clarification
E. None of the Above

116. The two most common conventional methods used to achieve _____are attached growth processes and suspended growth processes.
A. 90 percent
B. Secondary treatment
C. Oxidation Ditches
D. Secondary Clarification
E. None of the Above

117. The Secondary Treatment stage consists of a biological process, Oxidation Ditches and a physical process, _____.
A. 90 percent
B. Secondary treatment
C. Oxidation Ditches
D. Secondary Clarification
E. None of the Above

118. The _____stage removed as much solids as possible using physical processes, however, very fine solids are still present that cannot be removed physically.
A. 90 percent
B. Preliminary treatment
C. Oxidation Ditches
D. Secondary Clarification
E. None of the Above

119. The wastewater enters from Preliminary Treatment into the _____process which is a biological process consisting of two large oval shaped basins which are capable of removing these finer solids.
A. 90 percent
B. Secondary treatment
C. Oxidation Ditches
D. Secondary Clarification
E. None of the Above

120. This is accomplished by maintaining a population of microorganisms within the _____which consume the very fine solids (which are primarily organic) and also adhere to the solids themselves. By consuming and adhering to these finer solids they form larger and heavier aggregates that can by physically separated.
A. 90 percent
B. Secondary treatment
C. Oxidation Ditches
D. Secondary Clarification
E. None of the Above

121. After this process has taken place within the Oxidation Ditches Process the wastewater then enters _____process which can provide this physical separation.
A. 90 percent
B. Secondary treatment
C. Oxidation Ditches
D. Secondary Clarification
E. None of the Above

122. The _____process usually consists of four rectangular tanks which provide quiescent (or calm) conditions which allow the larger aggregates of solids and microorganisms to settled out for collection.
A. 90 percent
B. Secondary treatment
C. Oxidation Ditches
D. Secondary Clarification
E. None of the Above

123. The clear overflow (or upper layer) is collected at the end of the tank and passed onto the _____process for additional treatment.
A. Tertiary Filtration
B. Return Sludge
C. Solids Handing
D. Fixed film
E. None of the Above

124. The majority of microorganism-rich underflow (or lower layer) is re-circulated to Selector Tanks as _____to help sustain the microorganism population in the Oxidation Ditches process.
A. Tertiary Filtration
B. Return Sludge
C. Solids Handing
D. Fixed film
E. None of the Above

125. However, if all the underflow was returned the plant would soon become overloaded with solids, therefore, a small portion of this mixture termed Waste Sludge, is removed from the system for disposal. The Waste Sludge is transported into the _____process for disposal.
A. Tertiary Filtration
B. Return Sludge
C. Solids Handing
D. Fixed film
E. None of the Above

126. _____systems grow microorganisms on substrates such as rocks, sand or plastic. The wastewater is spread over the substrate, allowing the wastewater to flow past the film of microorganisms fixed to the substrate.
A. Tertiary Filtration
B. Return Sludge
C. Solids Handing
D. Fixed film
E. None of the Above

127. As organic matter and nutrients are absorbed from the wastewater, the film of microorganisms grows and thickens. _____, rotating biological contactors, and sand filters are examples of fixed film systems.
A. Tertiary Filtration
B. Return Sludge
C. Solids Handing
D. Trickling filters
E. None of the Above

128. _____stir and suspend microorganisms in wastewater.
A. Tertiary Filtration
B. Return Sludge
C. Suspended film systems
D. Fixed film
E. None of the Above

129. As the microorganisms absorb _____and nutrients from the wastewater they grow in size and number. After the microorganisms have been suspended in the wastewater for several hours, they are settled out as a sludge.
A. Lagoon systems
B. Seed
C. Organic matter
D. Turbidity
E. None of the Above

130. Some of the sludge is pumped back into the incoming wastewater to provide "_____" microorganisms. The remainder is wasted and sent on to a sludge treatment process.
A. Lagoon systems
B. Seed
C. Organic matter
D. Turbidity
E. None of the Above

131. _____, extended aeration, oxidation ditch, and sequential batch reactor systems are all examples of suspended film systems.
A. Lagoon systems
B. Seed
C. Organic matter
D. Activated sludge
E. None of the Above

132. _____are shallow basins which hold the waste-water for several months to allow for the natural degradation of sewage. These systems take advantage of natural aeration and microorganisms in the wastewater to renovate sewage.
A. Lagoon systems
B. Seed
C. Organic matter
D. Turbidity
E. None of the Above

133. In addition to the many substances found in wastewater, there are other characteristics system designers and operators use to evaluate wastewater. For example, the color, odor, and _____of wastewater give clues about the amount and type of pollutants present and treatment necessary.
A. Lagoon systems
B. Seed
C. Organic matter
D. Turbidity
E. None of the Above

134. The best temperatures for wastewater treatment probably range from 77 to 95 degrees Fahrenheit. In general, biological treatment activity _____ in warm temperatures and slows in cool temperatures, but extreme hot or cold can stop treatment processes altogether.
A. Alkalinity
B. Accelerates
C. Aquatic life
D. Protect organisms
E. None of the Above

135. Wastewater temperature also affects receiving waters. Hot water, for example, which is a byproduct of many manufacturing processes, can be a pollutant. When discharged in large quantities, it can raise the temperature of receiving streams locally and disrupt the natural balance of _____.
A. Alkalinity
B. Accelerates
C. Aquatic life
D. Protect organisms
E. None of the Above

136. The acidity or _____ of wastewater affects both treatment and the environment.
A. Alkalinity
B. Accelerates
C. Aquatic life
D. Protect organisms
E. None of the Above

137. Low pH indicates increasing acidity, while a high pH indicates increasing _____ (a pH of 7 is neutral).
A. Alkalinity
B. Accelerates
C. Aquatic life
D. Protect organisms
E. None of the Above

138. The pH of wastewater needs to remain between 6 and 9 to _____.
A. Alkalinity
B. Accelerates
C. Aquatic life
D. Protect organisms
E. None of the Above

139. Acids and other substances that alter pH can _____ treatment processes when they enter wastewater from industrial or commercial sources.
A. Alkalinity
B. Accelerates
C. Aquatic life
D. Inactivate
E. None of the Above

140. Water is a good solvent and picks up impurities easily. Pure water -- tasteless, colorless, and odorless -- is often called the _____.
A. Total solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

141. _____ refer to any minerals, salts, metals, cations or anions dissolved in water.
A. Total solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

142. _____comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulfates) and some small amounts of organic matter that are dissolved in water.
A. Total solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

143. The _____concentration is the sum of the cations (positively charged) and anions (negatively charged) ions in the water.
A. Total solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

144. The _____test provides an qualitative measure of the amount of dissolved ions, but does not tell us the nature or ion relationships.
A. Total solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

145. In addition, the test does not provide us insight into the specific water quality issues, such as: _____, Salty Taste, or Corrosiveness.
A. Total solids
B. Total dissolved solids
C. Universal solvent
D. Elevated Hardness
E. None of the Above

146. The _____test is used as an indicator test to determine the general quality of the water. The sources of total dissolved solids can include all of the dissolved cations and anions.
A. Total solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

147. The term "_____" refers to matter suspended or dissolved in water or wastewater, and is related to both specific conductance and turbidity.
A. Total solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

148. _____ (also referred to as total residue) is the term used for material left in a container after evaporation and drying of a water sample.
A. Total solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

149._____includes both total suspended solids, the portion of total solids retained by a filter and total dissolved solids, the portion that passes through a filter.
A. Total solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

150. _____can be measured by evaporating a water sample in a weighed dish, and then drying the residue in an oven at 103 to 105° C. The increase in weight of the dish represents the total solids. Instead of total solids, laboratories often measure total suspended solids and/or total dissolved solids.
A. Total solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

151. _____are solids in water that can be trapped by a filter.
A. Total Suspended Solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

152. _____ can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life.
A. Total Suspended Solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

153. High _____ can block light from reaching submerged vegetation. As the amount of light passing through the water is reduced, photosynthesis slows down.
A. Total Suspended Solids
B. Total dissolved solids
C. Universal solvent
D. Dissolved solids
E. None of the Above

154. Reduced rates of photosynthesis causes less dissolved _____ to be released into the water by plants. If light is completely blocked from bottom dwelling plants, the plants will stop producing oxygen and will die.
A. Oxygen
B. Suspended solids
C. Bacteria
D. Sediment particles
E. None of the Above

155. As the plants are decomposed, bacteria will use up even more _____ from the water.
A. Oxygen
B. Suspended solids
C. Bacteria
D. Sediment particles
E. None of the Above

156. Low dissolved _____ can lead to fish kills. High TSS can also cause an increase in surface water temperature, because the suspended particles absorb heat from sunlight.
A. Oxygen
B. Suspended solids
C. Bacteria
D. Sediment particles
E. None of the Above

157. When _____settle to the bottom of a water body, they can smother the eggs of fish and aquatic insects, as well as suffocate newly hatched insect larvae. Settling sediments can fill in spaces between rocks which could have been used by aquatic organisms for homes.
A. Oxygen
B. Suspended solids
C. Bacteria
D. Sediment particles
E. None of the Above

158. High TSS in a water body can often mean higher concentrations of _____, nutrients, pesticides, and metals in the water.
A. Oxygen
B. Suspended solids
C. Bacteria
D. Sediment particles
E. None of the Above

159. These pollutants may attach to _____on the land and be carried into water bodies with storm water. In the water, the pollutants may be released from the sediment or travel farther downstream.
A. Oxygen
B. Suspended solids
C. Bacteria
D. Sediment particles
E. None of the Above

160. High TSS can cause problems for industrial use, because the solids may clog or _____and machinery.
A. Oxygen
B. Suspended solids
C. Bacteria
D. Scour pipes
E. None of the Above

161. To measure _____, the water sample is filtered through a pre-weighed filter. The residue retained on the filter is dried in an oven at 103 to 105° C until the weight of the filter no longer changes. The increase in weight of the filter represents the total suspended solids.
A. Total suspended solids
B. Total dissolved solids
C. Total solids
D. None of the Above

162. _____ can also be measured by analyzing for total solids and subtracting total dissolved solids.
A. Total suspended solids
B. Total dissolved solids
C. Total solids
D. None of the Above

163. _____are solids in water that can pass through a filter (usually with a pore size of 0.45 micrometers). TDS is a measure of the amount of material dissolved in water.
A. Total suspended solids
B. Total dissolved solids
C. Total solids
D. None of the Above

164. This material can include carbonate, bicarbonate, chloride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, organic ions, and other ions. A certain level of these ions in water is necessary for _____.
A. Total suspended solids
B. Total dissolved solids
C. Total solids
D. None of the Above

165. Changes in TDS concentrations can be harmful because the density of the water determines the flow of water into and out of an organism's cells. However, if _____ concentrations are too high or too low, the growth of many aquatic life can be limited, and death may occur.
A. Total suspended solids
B. Total dissolved solids
C. Total solids
D. None of the Above

166. Similar to _____, high concentrations of TDS may also reduce water clarity, contribute to a decrease in photosynthesis, combine with toxic compounds and heavy metals, and lead to an increase in water temperature.
A. Total suspended solids
B. Total dissolved solids
C. Total solids
D. None of the Above

167. TDS is used to estimate the quality of drinking water, because it represents the amount of ions in the water. Water with high TDS often has a bad taste and/or high water hardness, and could result in a _____.
A. Total suspended solids
B. Total dissolved solids
C. Total solids
D. None of the Above

168. To measure _____, the water sample is filtered, and then the filtrate (the water that passes through the filter) is evaporated in a pre-weighed dish and dried in an oven at 180° C, until the weight of the dish no longer changes. The increase in weight of the dish represents the total dissolved solids, and is reported in milligrams per liter (mg/l).
A. Total suspended solids
B. Total dissolved solids
C. Total solids
D. None of the Above

169. The TDS concentration of a water sample can be estimated from specific conductance if a linear correlation between the two parameters is first established. Depending on the chemistry of the water, TDS (in mg/l) can be estimated by multiplying _____ (in micromhos/cm) by a factor between 0.55 and 0.75.
A. Total suspended solids
B. Total dissolved solids
C. Total solids
D. None of the Above

170._____can also be determined by measuring individual ions and adding them up.
A. Total suspended solids
B. Total dissolved solids
C. Total solids
D. None of the Above

171. Each wastewater stream is unique, and so too are the community of microorganisms that process it. _____is the preferred methodology in wastewater treatment affecting the efficiency of biological nutrient removal.
A. Laboratory-prepared bugs
B. Application-specific microbiology
C. Advanced treatment
D. Application specific bacterial cultures
E. None of the Above

172. The right _____are more efficient in organics removal-if they have the right growth environment.
A. Laboratory-prepared bugs
B. Application-specific microbiology
C. Advanced treatment
D. Application specific bacterial cultures
E. None of the Above

173. This efficiency is multiplied if microorganisms are allowed to grow as a layer-a biofilm-on specifically designed support media. In this way, optimized biological processing of a waste stream can occur. To reduce the start up phase for growing a mature biofilm one can also purchase "_____" from appropriate microbiology vendors.
A. Laboratory-prepared bugs
B. Application-specific microbiology
C. Advanced treatment
D. Application specific bacterial cultures
E. None of the Above

174. Treatment levels beyond secondary are called _____.
A. Laboratory-prepared bugs
B. Application-specific microbiology
C. Advanced treatment
D. Application specific bacterial cultures
E. None of the Above

175. _____technologies can be extensions of conventional secondary biological treatment to further stabilize oxygen-demanding substances in the wastewater, or to remove nitrogen and phosphorus.
A. Laboratory-prepared bugs
B. Application-specific microbiology
C. Advanced treatment
D. Application specific bacterial cultures
E. None of the Above

176. _____may also involve physical-chemical separation techniques such as adsorption, flocculation/precipitation, membranes for advanced filtration, ion exchange, and reverse osmosis.
A. Laboratory-prepared bugs
B. Application-specific microbiology
C. Advanced treatment
D. Application specific bacterial cultures
E. None of the Above

177. In various combinations, these processes can achieve any degree of _____ desired.
A. Laboratory-prepared bugs
B. Application-specific microbiology
C. Advanced treatment
D. Pollution control
E. None of the Above

178. As wastewater is purified to higher and higher degrees by such _____ processes, the treated effluents can be reused for urban, landscape, and agricultural irrigation, industrial cooling and processing, recreational uses and water recharge, and even indirect augmentation of drinking water supplies.
A. Laboratory-prepared bugs
B. Application-specific microbiology
C. Advanced treatment
D. Application specific bacterial cultures
E. None of the Above

179. _____ in one form or another is present in municipal wastewater and is usually not removed by secondary treatment.
A. Ammonia
B. Nitrogen
C. Nitrate
D. Phosphorus
E. None of the Above

180. If discharged into lakes and streams or estuary waters, _____ in the form of ammonia can exert a direct demand on oxygen or stimulate the excessive growth of algae.
A. Ammonia
B. Nitrogen
C. Nitrate
D. Phosphorus
E. None of the Above

181. _____ in wastewater effluent can be toxic to aquatic life in certain instances. By providing additional biological treatment beyond the secondary stage, nitrifying bacteria present in wastewater treatment can biologically convert ammonia to the non-toxic nitrate through a process known as nitrification.
A. Ammonia
B. Nitrogen
C. Nitrate
D. Phosphorus
E. None of the Above

182. The nitrification process is normally sufficient to remove the toxicity associated with ammonia in the effluent. Since _____ is also a nutrient, excess amounts can contribute to the uncontrolled growth of algae.
A. Ammonia
B. Nitrogen
C. Nitrate
D. Phosphorus
E. None of the Above

183. The conversion of _____ to nitrogen gas is accomplished by bacteria in a process known as denitrification.
A. Ammonia
B. Nitrogen
C. Nitrate
D. Phosphorus
E. None of the Above

184. Effluent with nitrogen in the form of nitrate is placed into a tank devoid of oxygen, where carbon-containing chemicals, such as methanol, are added or a small stream of raw wastewater is mixed in with the nitrified effluent. In this oxygen free environment, bacteria use the oxygen attached to the nitrogen in the _____ form releasing nitrogen gas.
A. Ammonia
B. Nitrogen
C. Nitrate
D. Phosphorus
E. None of the Above

185. Because nitrogen comprises almost 80 percent of the air in the earth's atmosphere, the release of _____ into the atmosphere does not cause any environmental harm.
A. Ammonia
B. Nitrogen
C. Nitrate
D. Phosphorus
E. None of the Above

186. _____ is also a necessary nutrient for the growth of algae.
A. Ammonia
B. A & C
C. Nitrate
D. Phosphorus
E. None of the Above

187. _____ reduction is often needed to prevent excessive algal growth before discharging effluent into lakes, reservoirs and estuaries..
A. Ammonia
B. Alum
C. Nitrate
D. Phosphorus
E. None of the Above

188. Some biological treatment processes called biological nutrient removal (BNR) can also achieve nutrient reduction, removing both _____ and phosphorus.
A. Ammonia
B. Nitrogen
C. Nitrate
D. Alum
E. None of the Above

189. Most of the BNR processes involve modifications of suspended growth treatment systems so that the bacteria in these systems also convert nitrate nitrogen to inert nitrogen gas and trap _____ in the solids that are removed from the effluent.
A. Ammonia
B. Nitrogen
C. Nitrate
D. Phosphorus
E. None of the Above

190. A process known as chemical _____is used to increase the removal of solids from effluent after primary and secondary treatment.
A. Carbon adsorption technology
B. Coagulation-sedimentation
C. Iron salts
D. Concentration
E. None of the Above

191. _____than water settle out of wastewater by gravity. With the addition of specific chemicals, solids can become heavier than water and will settle.
A. Carbon adsorption technology
B. Coagulation-sedimentation
C. Iron salts
D. Concentration
E. None of the Above

192. Alum, lime, or _____are chemicals added to the wastewater to remove phosphorus. With these chemicals, the smaller particles 'floc' or clump together into large masses.
A. Carbon adsorption technology
B. Coagulation-sedimentation
C. Iron salts
D. Concentration
E. None of the Above

193. The larger masses of particles will settle faster when the effluent reaches the next step--the sedimentation tank. This process can reduce the _____ of phosphate by more than 95 percent.
A. Carbon adsorption technology
B. Coagulation-sedimentation
C. Iron salts
D. Concentration
E. None of the Above

194. _____can remove organic materials from wastewater that resist removal by biological treatment.
A. Carbon adsorption technology
B. Coagulation-sedimentation
C. Iron salts
D. Concentration
E. None of the Above

195. _____consists of passing the wastewater effluent through a bed or canister of activated carbon granules or powder which remove more than 98 percent of the trace organic substances.
A. Carbon adsorption
B. Coagulation-sedimentation
C. Iron salts
D. Concentration
E. None of the Above

196. The substances adhere to the carbon surface and are removed from the water. To help reduce the cost of the procedure, the _____can be cleaned by heating and used again.
A. Carbon adsorption technology
B. Coagulation-sedimentation
C. Iron salts
D. Concentration
E. None of the Above

197. Biosolids are processed wastewater solids ("sewage sludge") that meet rigorous standards allowing safe reuse for beneficial purposes. Currently, more than half of the _____by municipal wastewater treatment systems is applied to land as a soil conditioner or fertilizer and the remaining solids are incinerated or landfilled.
A. Carbon adsorption technology
B. Coagulation-sedimentation
C. Iron salts
D. Concentration
E. None of the Above

198. _____include drying beds, belt filter presses, plate and frame presses, and centrifuges. To improve dewatering effectiveness, the solids can be pretreated with chemicals such as lime, ferric chloride, or polymers to produce larger particles which are easier to remove.
A. Aerobic treatment
B. Effluent discharge
C. Digestion
D. Dewatering processes
E. None of the Above

199. _____ is a form of stabilization where the volatile material in the wastewater solids can decompose naturally and the potential for odor production is reduced.
A. Aerobic treatment
B. Effluent discharge
C. Digestion
D. Stabilization
E. None of the Above

200. _____ without air in an enclosed tank (anaerobic solids digestion) has the added benefit of producing methane gas which can be recovered and used as a source of energy.
A. Aerobic treatment
B. Effluent discharge
C. Digestion
D. Stabilization
E. None of the Above

201. _____of solids may also be accomplished by composting, heat treatments, drying or the addition of lime or other alkaline materials. After stabilization, the biosolids can be safely spread on land.
A. Aerobic treatment
B. Effluent discharge
C. Digestion
D. Stabilization
E. None of the Above

202. _____units are also used to provide onsite wastewater treatment. They are similar to septic tanks, except that air is introduced and mixed with the wastewater inside the tank.
A. Aerobic treatment
B. Effluent discharge
C. Digestion
D. Stabilization
E. None of the Above

203. Aerobic (requiring oxygen) bacteria consume the organic matter in the sewage. As with the typical septic system, the _____from an aerobic system is typically released through a sub-surface distribution system or may be disinfected and discharged directly to surface water.
A. Aerobic treatment
B. Effluent discharge
C. Digestion
D. Stabilization
E. None of the Above

204. _____units also require the removal and proper disposal of solids that accumulate in the tank.
A. Aerobic treatment
B. Effluent discharge
C. Digestion
D. Stabilization
E. None of the Above

205. The _____directs EPA to develop criteria for water quality that accurately reflect the latest scientific knowledge about the effects of pollutants on aquatic life and human health. In developing these criteria, EPA examines the effects of specific pollutants on plankton, fish, shellfish, wildlife, plant life, aesthetics, and recreation in any body of water.
A. Adverse effects of pollution
B. Clean Water Act
C. Concentration and dispersal
D. Human health and aquatic life criteria
E. None of the Above

206. This includes specific information on the _____of pollutants through biological, physical, and chemical processes as well as the effects of pollutants on biological communities as a whole.
A. Adverse effects of pollution
B. Clean Water Act
C. Concentration and dispersal
D. Human health and aquatic life criteria
E. None of the Above

207. States may use the criteria that are developed by EPA to help set water quality standards that protect the uses of their waters or they may develop their own water quality criteria. EPA publishes _____and is currently developing sediment and biological criteria.
A. Adverse effects of pollution
B. Clean Water Act
C. Concentration and dispersal
D. Human health and aquatic life criteria
E. None of the Above

208. These criteria are complementary: each is designed to protect specific types of living organisms or ecological systems from the _____.
A. Adverse effects of pollution
B. Clean Water Act
C. Concentration and dispersal
D. Human health and aquatic life criteria
E. None of the Above

209. In a healthy _____ community, sediments provide a habitat for many living organisms. Worms, plants, and tiny micro-organisms living in or on the sediment sustain the fish and shellfish that, in turn, nourish larger fish, wildlife, and man.
A. Adverse effects of pollution
B. Clean Water Act
C. Concentration and dispersal
D. Aquatic
E. None of the Above

210. Controlling the _____of pollutants in the sediment helps to protect bottom dwelling species and prevents harmful toxins from moving up the food chain and accumulating in the tissue of animals at progressively higher levels.
A. Adverse effects of pollution
B. Clean Water Act
C. Concentration
D. Human health and aquatic life criteria
E. None of the Above

211. This is particularly important at the lower levels of the food chain because the _____ of many pollutants may increase at each link in the food chain.
A. Adverse effects of pollution
B. Clean Water Act
C. Concentration
D. Human health and aquatic life criteria
E. None of the Above

212. A pollutant level in the sediment that does not harm _____ of small fish may bioaccumulate in the food chain and become very harmful to larger fish, birds, mammals, wildlife, and people.
A. Dynamic environment
B. Ciliates
C. Aquatic life
D. Snails
E. None of the Above

213. A water body in its natural condition is free from the harmful effects of pollution, habitat loss, and other negative stressors. It is characterized by a particular biological diversity and abundance of organisms. This biological integrity--or natural structure and function of _____--can be dramatically different in various types of water bodies in different parts of the country.
A. Dynamic environment
B. Ciliates
C. Aquatic life
D. Snails
E. None of the Above

214. Swimming and gliding _____ engulf bacteria or other prey.
A. Dynamic environment
B. Ciliates
C. Aquatic life
D. Snails
E. None of the Above

215. Stalked _____ attach to the biomass and vortex suspended bacteria into their gullets, while crawlers break bacteria loose from the floc surface.
A. Dynamic environment
B. Ciliates
C. Aquatic life
D. Snails
E. None of the Above

216. Predators feed mostly on stalked and swimming _____. The omnivores, such as most rotifers, eat whatever is readily available, while the worms feed on the floc or prey on larger organisms.
A. Dynamic environment
B. Ciliates
C. Aquatic life
D. Snails
E. None of the Above

217. _____are directly affected by their treatment environment.
A. Dynamic environment
B. Ciliates
C. Aquatic life
D. Microorganisms
E. None of the Above

218. Changes in food, dissolved oxygen, temperature, pH, total dissolved solids, sludge age, presence of toxins, and other factors create a _____for the treatment organisms.
A. Dynamic environment
B. Ciliates
C. Aquatic life
D. Snails
E. None of the Above

219. Food (organic loading) regulates microorganism numbers, diversity, and species when other factors are not limiting. The _____and occurrence of organisms at different loadings can reveal why some organisms are present in large numbers while others are absent.
A. Activated sludge
B. Relative abundance
C. Oxidize organic carbon
D. Floc-forming bacteria
E. None of the Above

220. The aerobic bacteria that occur are similar to those found in other treatment processes such as activated sludge. Three functional groups occur: freely dispersed, single bacteria_____; and filamentous bacteria.
A. Activated sludge
B. Relative abundance
C. Oxidize organic carbon
D. Floc-forming bacteria
E. None of the Above

221. All function similarly to _____ (BOD) to produce CO_2 and new bacteria (new sludge).
A. Activated sludge
B. Relative abundance
C. Oxidize organic carbon
D. Floc-forming bacteria
E. None of the Above

222. Many bacterial species that _____grow as single bacteria dispersed in the wastewater.
A. Activated sludge
B. Relative abundance
C. Oxidize organic carbon
D. Floc-forming bacteria
E. None of the Above

223. Although these readily _____, they do not settle and hence often leave the lagoon system in the effluent as solids (TSS). These tend to grow in lagoons at high organic loading and low oxygen conditions.
A. Activated sludge
B. Relative abundance
C. Oxidize BOD
D. Floc-forming bacteria
E. None of the Above

224. More important are the _____, those that grow in a large aggregate (floc) due to exocellular polymer production (the glycocalyx).
A. Activated sludge
B. Relative abundance
C. Oxidize organic carbon
D. Floc-forming bacteria
E. None of the Above

225. This growth form is important as these flocs degrade BOD and settle at the end of the process, producing a low _____.
A. Activated sludge
B. Relative abundance
C. Oxidize organic carbon
D. TSS effluent
E. None of the Above

226. A number of _____occur in lagoons, usually at specific growth environments.
A. Activated sludge
B. Relative abundance
C. Oxidize organic carbon
D. TSS effluent
E. None of the Above

227. _____generally do not cause any operational problems in lagoons, in contrast to activated sludge where filamentous bulking and poor sludge settling is a common problem.
A. BOD
B. Nitrosomonas europaea
C. Nitrifying bacteria
D. Filamentous bacteria
E. None of the Above

228. Most heterotrophic bacteria have a wide range in environmental tolerance and can function effectively in _____ removal over a wide range in pH and temperature.
A. BOD
B. Nitrosomonas europaea
C. Nitrifying bacteria
D. Filamentous bacteria
E. None of the Above

229. Aerobic _____ removal generally proceeds well from pH 6.5 to 9.0 and at temperatures from 3-4^{o}C to 60- 70°C (mesophilic bacteria are replaced by thermophilic bacteria at temperatures above 35°C).
A. BOD
B. Nitrosomonas europaea
C. Nitrifying bacteria
D. Filamentous bacteria
E. None of the Above

230. _____ removal generally declines rapidly below 3-4°C and ceases at 1-2°C.
A. BOD
B. Nitrosomonas europaea
C. Nitrifying bacteria
D. Filamentous bacteria
E. None of the Above

231. A very specialized group of bacteria occurs to some extent in lagoons (and other wastewater treatment systems) that can oxidize ammonia via nitrite to nitrate, termed _____.
A. BOD
B. Nitrosomonas europaea
C. Nitrifying bacteria
D. Filamentous bacteria
E. None of the Above

232. It was once thought that only two bacteria were involved in nitrification: _____, which oxidizes ammonia to nitrite, and Nitrobacter winogradskyi, which oxidizes nitrite to nitrate. It is now known that at least 5 genera of bacteria oxidize ammonia and at least three genera of bacteria oxidize nitrite.
A. BOD
B. Nitrosomonas europaea
C. Nitrifying bacteria
D. Filamentous bacteria
E. None of the Above

233. Besides oxygen, these _____require a neutral pH (7-8) and substantial alkalinity (these autotrophs use CO_2 as a carbon source for growth). This indicates that complete nitrification would be expected at pond pH values between pH 7.0 and 8.5.
A. BOD
B. Nitrosomonas europaea
C. Nitrifying bacteria
D. Filamentous bacteria
E. None of the Above

234. Nitrification ceases at pH values above pH 9 and declines markedly at pH values below 7. This results from the growth inhibition of the _____.
A. BOD
B. Nitrosomonas europaea
C. Nitrifying bacteria
D. Filamentous bacteria
E. None of the Above

235. Nitrification, however, is not a major pathway for nitrogen removal in lagoons. _____exists in low numbers in lagoons. They prefer attached growth systems and/or high MLSS sludge systems.
A. BOD
B. Nitrosomonas europaea
C. Nitrifying bacteria
D. Filamentous bacteria
E. None of the Above

236. Anaerobic, _____that commonly occur in lagoons are involved in methane formation (acid-fonning and methane bacteria) and in sulfate reduction (sulfate reducing bacteria).
A. BOD
B. Nitrosomonas europaea
C. Nitrifying bacteria
D. Heterotrophic bacteria
E. None of the Above

237. _____formation involves three different groups of anaerobic bacteria that function together to convert organic materials to methane via a three step process.
A. Stuck digester
B. Acid-forming bacteria
C. Anaerobic methane
D. Anaerobic bacteria
E. None of the Above

238. General anaerobic degraders - many genera of _____hydrolyze proteins, fats, and poly saccharides present in wastewater to amino acids, short-chain peptides, fatty acids, glycerol, and mono- and di-saccharides. These have a wide environmental tolerance in pH and temperature.
A. Stuck digester
B. Acid-forming bacteria
C. Anaerobic methane
D. Anaerobic bacteria
E. None of the Above

239. _____- this diverse group of bacteria converts products from above under anaerobic conditions to simple alcohols and organic acids such as acetic, propionic, and butyric. These bacteria are hardy and occur over a wide pH and temperature range.
A. Stuck digester
B. Acid-forming bacteria
C. Anaerobic methane
D. Anaerobic bacteria
E. None of the Above

240. _____- these bacteria convert formic acid, methanol, methylamine, and acetic acid under anaerobic conditions to methane. Methane is derived in part from these compounds and in part from CO_2 reduction. Methane bacteria are environmentally sensitive and have a narrow pH range of 6.5- 7.5 and require temperatures > 14^o C. Note that the products of the acid formers (principally acetic acid) become the substrate for the methane producers.
A. Stuck digester
B. Acid-forming bacteria
C. Anaerobic methane
D. Methane forming bacteria
E. None of the Above

241. A problem at times exists where the acid formers overproduce organic acids, lowering the pH below where the methane bacteria can function (a pH < 6.5). This can stop methane formation and lead to a buildup of sludge in a lagoon with a low pH. In an anaerobic fernmenter, this is called a **"** _____**"**.
A. Stuck digester
B. Acid-forming bacteria
C. Anaerobic methane
D. Anaerobic bacteria
E. None of the Above

242. _____ceases at cold temperature, probably not occurring in most lagoons in the wintertime in cold climates. A number of anaerobic bacteria 14 genera reported to date called sulfate reducing bacteria can use sulfate as an electron acceptor, reducing sulfate to hydrogen sulfide. This occurs when BOD and sulfate are present and oxygen is absent.
A. Anaerobic sulfur bacteria
B. Sulfate Reducing or Reduction
C. Microaerophilic
D. Chromatium
E. None of the Above

243. _____is a major cause of odors in ponds.
A. Anaerobic sulfur bacteria
B. Sulfate Reducing or Reduction
C. Microaerophilic
D. Chromatium
E. None of the Above

244. Anaerobic_____occur in all lagoons and are the predominant photo-synthetic organisms in anaerobic lagoons.
A. Anaerobic sulfur bacteria
B. Sulfate Reducing or Reduction
C. Microaerophilic
D. Chromatium
E. None of the Above

245. The _____, generally grouped into the red and green sulfur bacteria and represented by about 28 genera, oxidize reduced sulfur compounds (H_2S) using light energy to produce sulfur and sulfate.
A. Anaerobic sulfur bacteria
B. Sulfate Reducing or Reduction
C. Microaerophilic
D. Chromatium
E. None of the Above

246. Here, H_2S is used in place of H_2O as used by algae and green plants, producing $S0_4$- instead of O_2. All are either strict anaerobes or _____.
A. Anaerobic sulfur bacteria
B. Sulfate Reducing or Reduction
C. Microaerophilic
D. Chromatium
E. None of the Above

247. Most common are _____, Thiocystis, and Thiopedia, which can grow in profusion and give a lagoon a pink or red color. Finding them is most often an indication of organic overloading and anaerobic conditions in an intended aerobic system.
A. Anaerobic sulfur bacteria
B. Sulfate Reducing or Reduction
C. Microaerophilic
D. Chromatium
E. None of the Above

248. Conversion of odorous sulfides to sulfur and sulfate by these sulfur bacteria is a significant odor control mechanism in facultative and _____, and can be desirable.
A. Anaerobic sulfur bacteria
B. Sulfate Reducing or Reduction
C. Anaerobic lagoons
D. Chromatium
E. None of the Above

249. Algae are _____that are photosynthetic and grow with simple inorganic compounds CO_2, NH_3, NO_3-, and PO_4--) using light as an energy source.
A. Anaerobic sulfur bacteria
B. Sulfate Reducing or Reduction
C. Aerobic organisms
D. Chromatium
E. None of the Above

250. _____during the daylight hours and consume oxygen at night.
A. Anaerobic sulfur bacteria
B. Sulfate Reducing or Reduction
C. Algae produce oxygen
D. Chromatium
E. None of the Above

251. Algae are desirable in lagoons as they _____needed by bacteria for waste stabilization.
A. Anaerobic sulfur bacteria
B. Sulfate Reducing or Reduction
C. Generate oxygen
D. Chromatium
E. None of the Above

252. Three major groups occur in lagoons, based on their _____: brown algae (diatoms), green algae, and red algae.
A. Algae
B. Bacteria
C. Chlorophyll type
D. Oxygen status
E. None of the Above

253. The predominant algal species at any given time is dependent on growth conditions, particularly temperature, organic loading, _____, nutrient availability, and predation pressures.
A. Algae
B. Bacteria
C. Chlorophyll type
D. Oxygen status
E. None of the Above

254. A fourth type of "algae" common in lagoons is the _____or blue-green bacteria.
A. Algae
B. Bacteria
C. Chlorophyll type
D. Cyano-bacteria
E. None of the Above

255. These organisms grow much as the true _____, with the exception that most species can fix atmospheric nitrogen. Blue-green bacteria often bloom in lagoons and some species produce odorous and toxic by-products.
A. Algae
B. Bacteria
C. Chlorophyll type
D. Oxygen status
E. None of the Above

256. Blue-green _____appear to be favored by poor growth conditions including high temper-ature, low light, low nutrient availability (many fix nitrogen) and high predation pressure.
A. Algae
B. Bacteria
C. Chlorophyll type
D. Oxygen status
E. None of the Above

257. Common blue-green _____in waste treatment systems include Aphanothece, Microcystis, Oscillatoria and Anabaena.
A. Algae
B. Bacteria
C. Chlorophyll type
D. Oxygen status
E. None of the Above

258. _____can bloom in lagoons at any time of the year (even under the ice); however, a succession of algal types occurs over the season. There is also a shift in the algal species present in a lagoon through the season, caused by temperature and rotifer and Daphnia predation.
A. Algae
B. Bacteria
C. Chlorophyll type
D. Oxygen status
E. None of the Above

259. _____ usually predominate in the wintertime at temperatures <60°F. In the early spring when predation is low and lagoon temperatures increase above 60°F, green algae such as Chlorella, Chlamydomonas, and Euglena often predominate in waste treatment lagoons.
A. Algal growth
B. Algae
C. Green algae
D. Diatoms
E. None of the Above

260. The predominant _____change to species with spikes or horns such as Scenesdesmus, Micractinium, and Ankistrodesmus later in the season when Rotifers and Daphnia are active (these species survive predation better).
A. Algal growth
B. Algae
C. Green algae
D. Diatoms
E. None of the Above

261. _____ grow at warmer temperature, longer detention time, and when inorganic minerals needed for growth are in excess.
A. Algal growth
B. Algae
C. Green algae
D. Diatoms
E. None of the Above

262. Alkalinity (inorganic carbon) is the only nutrient likely to be limiting for _____in lagoons.
A. Algal growth
B. Algae
C. Green algae
D. Diatoms
E. None of the Above

263. Substantial sludge accumulation in a lagoon may become soluble upon warming in the spring, releasing algal growth nutrients and causing an algal bloom. Sludge resolution of nutrients is a major cause of high _____in a lagoon, requiring sludge removal from the lagoon for correction.
A. Algal growth
B. Algae
C. Green algae
D. Diatoms
E. None of the Above

264. The pH at a _____is determined by the various chemical species of alkalinity that are present. The main species present are carbon dioxide (CO_2, bicarbonate ion (HCO_3), and carbonate ion (CO_3=).
A. Algal growth
B. Algae
C. Treatment lagoon
D. Diatoms
E. None of the Above

265. _____ and pH can affect which species will be present. High amounts of CO_2 yield a low lagoon pH, while high amounts of CO_3= yield a high lagoon pH.
A. Algal growth
B. Algae
C. Bacterial growth
D. Alkalinity
E. None of the Above

266. _____on BOD releases CO_2 which subsequently dissolves in water to yield carbonic acid (H_2CO_3). This rapidly dissociates to bicarbonate ion, increasing the lagoon alkalinity . Bacterial oxidation of BOD causes a decrease in lagoon pH due to CO_2 release.
A. Algal growth
B. Algae
C. Bacterial growth
D. Alkalinity
E. None of the Above

267. Algal growth in lagoons has the opposite effect on lagoon pH, raising the pH due to algal use for growth of inorganic carbon (CO_2 and HCO_3). Algal growth reduces the lagoon alkalinity which may cause the pH to increase if the lagoon _____ (pH buffer capacity) is low.
A. Algal growth
B. Algae
C. Bacterial growth
D. Alkalinity
E. None of the Above

268. _____ can grow to such an extent in lagoons (a bloom) that they consume for photosynthesis all of the CO_2 and HCO3-present, leaving only carbonate (CO_3=) as the pH buffering species.
A. Algal growth
B. Algae
C. Bacterial growth
D. Alkalinity
E. None of the Above

269. This causes the pH of the lagoon to become alkaline. pH values of 9.5 or greater are common in lagoons during algal blooms, which can lead to lagoon effluent pH violations (in most states this is pH = 9). It should be noted that an increase in the lagoon pH caused by _____can be beneficial. Natural disinfection of pathogens is enhanced at higher pH.
A. Algal growth
B. Algae
C. Bacterial growth
D. Alkalinity
E. None of the Above

270. _____by natural chemical precipitation is greatly enhanced at pH values greater than pH = 8.5. In addition, ammonia stripping to the atmosphere is enhanced at higher pH values (NH_3 is strippable, not NH_4+).
A. Algal growth
B. Algae
C. Bacterial growth
D. Phosphorus removal
E. None of the Above

271. Many higher life forms (animals) develop in lagoons. These include protozoans and microinvertebrates such as rotifers, _____, annelids, chironomids (midge larvae), and mosquito larvae (often termed the zooplankton).
A. Algal growth
B. Daphnia
C. Bacterial growth
D. None of the Above

272. These organisms playa role in waste purification by feeding on _____ and algae and promoting flocculation and settling of particulate material.
A. Algal growth
B. Algae
C. Bacteria
D. Alkalinity
E. None of the Above

273. Protozoans are the most common higher life forms in lagoons with about 250 species identified in lagoons to date. _____ and daphnia are particularly important in controlling algal overgrowth and these often **"**bloom**"** when algal concentrations are high.
A. Suctoria
B. Rotifers
C. Mosquito
D. Ciliates
E. None of the Above

274. These microinvertebrates are relatively slow growing and generally only occur in systems with a detention time of >10 days. _____ grow in lagoons where shoreline vegetation is not removed and these may cause a nuisance and public health problem.
A. Suctoria
B. Rotifers
C. Mosquito
D. Ciliates
E. None of the Above

275. _____, the vector of Western Equine Encephalitis in the western U.S., grows well in wastewater lagoons. The requirement for a minimum lagoon bank slope and removal of shoreline vegetation by most regulatory agencies is based on the public health need to reduce mosquito vectors.
A. Suctoria
B. Rotifers
C. Mosquito
D. Ciliates
E. None of the Above

276. Four (4) groups of bugs do most of the **"eating"** in the activated sludge process. The first group is the bacteria which eat the dissolved organic compounds. The second and third groups of bugs are microorganisms known as the free-swimming and stalked _____. These larger bugs eat the bacteria and are heavy enough to settle by gravity.
A. Suctoria
B. Rotifers
C. Mosquito
D. Ciliates
E. None of the Above

277. The fourth group is a microorganism, known as _____, which feed on the larger bugs and assist with settling.
A. Suctoria
B. Rotifers
C. Mosquito
D. Ciliates
E. None of the Above

278. The interesting thing about the bacteria that eat the dissolved organics, is that they have no mouth. The bacteria have an interesting property, their "_____" is stored on the outside of their body. This fat layer is sticky and is what the organics adhere to.
A. Bacteria-eating-bugs
B. Contacted
C. Fat reserve
D. Enzyme
E. None of the Above

279. Once the bacteria have **"**_____**"** their food, they start the digestion process. A chemical enzyme is sent out through the cell wall to break up the organic compounds.
A. Bacteria-eating-bugs
B. Contacted
C. Fat reserve
D. Enzyme
E. None of the Above

280. This _____, known as hydrolytic enzyme, breaks the organic molecules into small units which are able to pass through the cell wall of the bacteria.
A. Bacteria-eating-bugs
B. Contacted
C. Fat reserve
D. Enzyme
E. None of the Above

281. In wastewater treatment, this process of using _____in the presence of oxygen to reduce the organics in water is called activated sludge.
A. Bacteria-eating-bugs
B. Contacted
C. Fat reserve
D. Enzyme
E. None of the Above

282. The first step in the process, the contact of the bacteria with the _____, takes about 20 minutes.
A. Bacteria-eating-bugs
B. Contacted
C. Fat reserve
D. Organic compounds
E. None of the Above

283. The second step is the breaking up, _____processes, which takes four (4) to 24 hours.
A. Paramecium
B. Ingestion and digestion
C. Bump
D. Mixed liquor
E. None of the Above

284. The fat storage property of the bacteria is also an asset in settling. As the bugs "_____" into each other, the fat on each of them sticks together and causes flocculation of the non-organic solids and biomass.
A. Paramecium
B. Ingestion and digestion
C. Bump
D. Mixed liquor
E. None of the Above

285. From the aeration tank, the wastewater, now called _____, flows to a secondary clarification basin to allow the flocculated biomass of solids to settle out of the water. The solids biomass, which is the activated sludge, contains millions of bacteria and other microorganisms, is used again by returning it to the influent of the aeration tank for mixing with the primary effluent and ample amounts of air.
A. Paramecium
B. Ingestion and digestion
C. Bump
D. Mixed liquor
E. None of the Above

286. _____ is a medium size to large (100-300 m) swimming ciliate, commonly observed in activated sludge, sometimes in abundant numbers.
A. Paramecium
B. Ingestion and digestion
C. Bump
D. Mixed liquor
E. None of the Above

287. The body of the _____ is either foot-shaped or cigar-shaped, and somewhat flexible.
A. Paramecium
B. Euglypha
C. Swarmer
D. Vorticella
E. None of the Above

288. _____ is uniformly ciliated over the entire body surface with longer cilia tufts at the rear of the cell.
A. Paramecium
B. Euglypha
C. Swarmer
D. Vorticella
E. None of the Above

289. Paramecium swims with a smooth gliding motion. It may also be seen paired up with another _____ which makes a good diagnostic key.
A. Paramecium
B. Euglypha
C. Swarmer
D. Vorticella
E. None of the Above

290. The cell has either one or two large water cavities which are also identification tools. This swimmer moves freely in the water column as it engulfs suspended bacteria. It has a large feeding groove used to trap bacteria and form the food cavities that move throughout the body as _____ occurs.
A. Paramecium
B. Digestion
C. Bump
D. Mixed liquor
E. None of the Above

291. Paramecium is described as a filter-feeding _____because its cilia move and filter bacteria from the water.
A. Paramecium
B. Euglypha
C. Swarmer
D. Ciliate
E. None of the Above

292. Vorticella is a stalked _____.
A. Paramecium
B. Euglypha
C. Swarmer
D. Ciliate
E. None of the Above

293. There are at least a dozen species found in activated sludge ranging in length from about 30 to 150 microns. These organisms are oval to round shaped, have a contractile _____, a domed feeding zone, and a water vacuole located near the terminal end of the feeding cavity. One organism is found on each stalk except during cell division.
A. Vorticella
B. Amoebas
C. Stalk
D. Vortex
E. None of the Above

294. After reproducing, the offspring develops a band of swimming cilia and goes off to form its own _____. The evicted organism is called a "swarmer."
A. Vorticella
B. Amoebas
C. Stalk
D. Vortex
E. None of the Above

295. Vorticella feeds by producing a _____ with its feeding cilia.
A. Vorticella
B. Amoebas
C. Stalk
D. Vortex
E. None of the Above

296. The _____ draws bacteria into its gullet. Vorticella's principal food source is suspended bacteria.
A. Vorticella
B. Amoebas
C. Stalk
D. Vortex
E. None of the Above

297. The contracting _____ provides some mobility to help the organism capture bacteria and avoid predators.
A. Vorticella
B. Amoebas
C. Stalk
D. Vortex
E. None of the Above

298. The stalk resembles a coiled spring after its rapid contraction. Indicator: If treatment conditions are bad, for example low DO or toxicity, _____will leave their stalks. Therefore, a bunch of empty stalks indicates poor conditions in an activated sludge system.
A. Vorticella
B. Amoebas
C. Stalk
D. Vortex
E. None of the Above

299. _____are present when the plant effluent quality is high.
A. Vorticella
B. Amoebas
C. Stalk
D. Vortex
E. None of the Above

300. Euglypha is a shelled (testate) _____.
A. Vorticella
B. Amoeba
C. Stalk
D. Vortex
E. None of the Above

301. _____ have jelly-like bodies. Motion occurs by extending a portion of the body (pseudopodia) outward.
A. Vorticella
B. Amoebas
C. Stalk
D. Vortex
E. None of the Above

302. Shelled _____ have a rigid covering which is either secreted or built from sand grains or other extraneous materials.
A. Vorticella
B. Amoebas
C. Stalk
D. Vortex
E. None of the Above

303. The secreted shell of this _____. consists of about 150 oval plates.
A. Vorticella
B. Amoebas
C. Stalk
D. Euglypha
E. None of the Above

304. Its spines project backward from the lower half of the shell. _____ spines may be single or in groups of two or three. The shell has an opening surrounded by 8-11 plates that resemble shark teeth under very high magnification.
A. Vorticella
B. Amoebas
C. Stalk
D. Euglypha
E. None of the Above

305. The shell of Euglypha is often transparent, allowing the hyaline (watery) body to be seen inside the shell. The pseudopodia extend outward in long, thin, rays when feeding or moving. _____ primarily eats bacteria.
A. Vorticella
B. Amoebas
C. Stalk
D. Euglypha
E. None of the Above

306. Shelled _____ are common in soil, treatment plants, and stream bottoms where decaying organic matter is present. They adapt to a wide range of conditions and therefore are not good indicator organisms.
A. Vorticella
B. Amoebas
C. Stalk
D. Vortex
E. None of the Above

307. Euchlanis is a swimmer, using its foot and cilia for locomotion. In common with other rotifers, it has a head rimmed with _____, a transparent body, and a foot with two strong swimming toes.
A. Vorticella
B. Amoebas
C. Cilia
D. Vortex
E. None of the Above

308. The head area, called the "_____," has cilia that beat rhythmically producing a strong current for feeding or swimming.
A. Mastax
B. Corona
C. Euchlanis
D. Rotifers
E. None of the Above

309. _____ is an omnivore meaning that its varied diet includes detritus, bacteria, and small protozoa.
A. Mastax
B. Morona
C. Euchlanis
D. Rotifers
E. None of the Above

310. _____ has a glassy shell secreted by its outer skin. The transparent body reveals the brain, stomach, intestines, bladder, and reproductive organs.
A. Mastax
B. Morona
C. Euchlanis
D. Rotifers
E. None of the Above

311. A characteristic of rotifers is their _____, which is a jaw-like device that grinds food as it enters the stomach. At times the action of the mastax resembles the pulsing action of a heart.
A. Mastax
B. Morona
C. Euchlanis
D. Rotifers
E. None of the Above

312. _____, however, have no circulatory system.
A. Mastax
B. Morona
C. Euchlanis
D. Rotifers
E. None of the Above

313. _____ is commonly found in activated sludge when effluent quality is good. It requires a continual supply of dissolved oxygen, evidence that aerobic conditions have been sustained.
A. Mastax
B. Morona
C. Euchlanis
D. Rotifers
E. None of the Above

314. Aeration and _____are the key operational parameters that contribute to the efficient degradation of organic matter (BOD/COD removal).
A. Mastax
B. Morona
C. Euchlanis
D. Rotifers
E. None of the Above

315. Over time the application specific bacteria become site specific as the _____and matures and is even more efficient in treating that site-specific waste stream.
A. Mastax
B. Corona
C. Euchlanis
D. Rotifers
E. None of the Above

316. Most of the bacteria that absorb the organic material in a wastewater treatment system are _____in nature. This means they are adaptable to survive and multiply in either anaerobic or aerobic conditions.
A. Metabolism
B. Metamorphosis
C. Facultative
D. Reproduce
E. None of the Above

317. The nature of individual bacteria is dependent upon the environment in which they live. Usually, _____ bacteria will be anaerobic unless there is some type of mechanical or biochemical process used to add oxygen to the wastewater.
A. Metabolism
B. Metamorphosis
C. Facultative
D. Reproduce
E. None of the Above

318. When bacteria are in the process of being transferred from one environment to the other, the _____ from anaerobic to aerobic state (and vice versa) takes place within a couple of hours.
A. Metabolism
B. Metamorphosis
C. Facultative
D. Reproduce
E. None of the Above

319. Anaerobic bacteria live and _____ in the absence of free oxygen.
A. Metabolism
B. Metamorphosis
C. Facultative
D. Reproduce
E. None of the Above

320. They utilize compounds such as sulfates and nitrates for energy and their _____ is substantially reduced. In order to remove a given amount of organic material in an anaerobic treatment system, the organic material must be exposed to a significantly higher quantity of bacteria and/or detained for a much longer period of time.
A. Metabolism
B. Metamorphosis
C. Facultative
D. Reproduce
E. None of the Above

321. Anaerobic _____ release hydrogen sulfide as well as methane gas, both of which can create hazardous conditions. Even as the anaerobic action begins in the collection lines of a sewer system, deadly hydrogen sulfide or explosive methane gas can accumulate and be life threatening.
A. Metabolism
B. Metamorphosis
C. Facultative
D. Bacteria
E. None of the Above

322. Aerobic bacteria live and _____ in the presence of free oxygen.
A. Metabolism
B. Metamorphosis
C. Facultative
D. Multiply
E. None of the Above

323. _____ bacteria always achieve an aerobic state when oxygen is present. While the name "aerobic" implies breathing air, dissolved oxygen is the primary source of energy for aerobic bacteria.
A. Metabolism
B. Metamorphosis
C. Facultative
D. Reproduce
E. None of the Above

324. The _____ of aerobes is much higher than for anaerobes. This increase means that 90% fewer organisms are needed compared to the anaerobic process, or that treatment is accomplished in 90% less time.
A. Metabolism
B. Metamorphosis
C. Facultative
D. Reproduce
E. None of the Above

325. This provides a number of advantages including a higher percentage of organic removal. The by-products of aerobic _____ are carbon dioxide and water.
A. Metabolism
B. Metamorphosis
C. Facultative
D. Bacteria
E. None of the Above

326. Aerobic bacteria live in _____ called floc and are kept in suspension by the mechanical action used to introduce oxygen into the wastewater.
A. Metabolism
B. Metamorphosis
C. Facultative
D. Colonial structures
E. None of the Above

327. Following digestion, a gravity clarifier separates and settles out the _____. Because of the mechanical nature of the aerobic digestion process, maintenance and operator oversight are required.
A. Floc
B. Septic tank
C. Gravity clarifier
D. Filamentous
E. None of the Above

328. _____in a healthy state are referred to as activated sludge.
A. Aerobic floc
B. Septic tank
C. Gravity clarifier
D. Filamentous
E. None of the Above

329. While _____has a metabolic rate approximately ten times higher than anaerobic sludge, it can be increased even further by exposing the bacteria to an abundance of oxygen.
A. Aerobic floc
B. Septic tank
C. Gravity clarifier
D. Filamentous
E. None of the Above

330. Compared to a _____, which takes several days to reduce the organic material, an activated sludge tank can reduce the same amount of organic material in approximately 4-6 hours. This allows a much higher degree of overall process efficiency.
A. Aerobic floc
B. Septic tank
C. Gravity clarifier
D. Filamentous
E. None of the Above

331. The majority of _____ organisms are bacteria, although some of them are classified as algae, fungi or other life forms.
A. Aerobic floc
B. Septic tank
C. Gravity clarifier
D. Filamentous
E. None of the Above

332. There are a number of types of filamentous bacteria which proliferate in the activated sludge process. _____organisms perform several different roles in the process, some of which are beneficial and some of which are detrimental.
A. Aerobic floc
B. Septic tank
C. Gravity clarifier
D. Filamentous
E. None of the Above

333. When filamentous organisms are in low concentrations in the process, they serve to strengthen the _____. This effect reduces the amount of shearing in the mechanical action of the aeration tank and allows the floc particles to increase in size.
A. Floc Particles
B. Septic tank
C. Gravity clarifier
D. Filamentous
E. None of the Above

334. _____particles are more readily settled in a clarifier.
A. Aerobic floc
B. Septic tank
C. Gravity clarifier
D. Larger floc
E. None of the Above

335. _____particles settling in the clarifier also tend to accumulate smaller particulates (surface adsorption) as they settle, producing an even higher quality effluent.
A. Aerobic floc
B. Septic tank
C. Gravity clarifier
D. Larger floc
E. None of the Above

336. If the filamentous organisms reach too high a concentration, they can extend dramatically from the floc particles and tie one floc particle to another (interfloc bridging) or even form a _____ mat of extra large size.
A. Aerobic floc
B. Septic tank
C. Gravity clarifier
D. Filamentous
E. None of the Above

337. Due to the increased surface area without a corresponding increase in mass, the activated sludge will not _____.
A. Aerobic floc
B. Settle well
C. Gravity clarifier
D. Filamentous
E. None of the Above

338. This results in less solids separation and may cause a washout of solid material from the system. In addition, air bubbles can become trapped in the mat and cause it to float, resulting in a _____.
A. Floating scum mat
B. Higher percentage
C. Floc formation
D. Next higher life form
E. None of the Above

339. Due to the high surface area of the filamentous bacteria, once they reach an excess concentration, they can absorb a _____of the organic material and inhibit the growth of more desirable organisms.
A. Floating scum mat
B. Higher percentage
C. Floc formation
D. Next higher life form
E. None of the Above

340. In a wastewater treatment system, the _____above bacteria is protozoans.
A. Floating scum mat
B. Higher percentage
C. Floc formation
D. Next higher life form
E. None of the Above

341. These single-celled animals perform _____in the activated sludge process.
A. Floating scum mat
B. Higher percentage
C. Floc formation
D. Next higher life form
E. None of the Above

342. These include _____, cropping of bacteria and the removal of suspended material.
A. Floating scum mat
B. Higher percentage
C. Floc formation
D. Next higher life form
E. None of the Above

343. _____ are also indicators of biomass health and effluent quality.
A. Protozoans
B. Macroinvertebrates
C. Metazoans
D. Colloidal
E. None of the Above

344. Because _____ are much larger in size than individual bacteria, identification and characterization is readily performed.
A. Protozoans
B. Macroinvertebrates
C. Metazoans
D. Colloidal
E. None of the Above

345. Metazoans are very similar to _____ except that they are usually multi-celled animals.
A. Protozoans
B. Macroinvertebrates
C. Metazoans
D. Colloidal
E. None of the Above

346. _____ such as nematodes and rotifers are typically found only in a well developed biomass.
A. Protozoans
B. Macroinvertebrates
C. Metazoans
D. Colloidal
E. None of the Above

347. The presence of protozoans and _____ and the relative abundance of certain species can be a predictor of operational changes within a treatment plant.
A. Protozoans
B. Macroinvertebrates
C. Metazoans
D. Colloidal
E. None of the Above

348. An operator is able to make adjustments and minimize negative operational effects simply by observing changes in the _____ and metazoan population.
A. Protozoans
B. Macroinvertebrates
C. Metazoans
D. Colloidal
E. None of the Above

349. Dispersed growth is material suspended within the activated sludge process that has not been adsorbed into the floc particles. This material consists of very small quantities of _____ (too small to settle out) bacteria as well as organic and inorganic particulate material.
A. Protozoans
B. Macroinvertebrates
C. Metazoans
D. Colloidal
E. None of the Above

350. While a small amount of dispersed growth in between the _____is normal, excessive amounts can be carried through a secondary clarifier. When discharged from the treatment plant, dispersed growth results in higher effluent solids.
A. Protozoans
B. Macroinvertebrates
C. Metazoans
D. Floc particles
E. None of the Above

351. Taxonomy is the science of _____forms according to their characteristics.
A. Genus
B. Subspecies
C. Categorizing life
D. Categories
E. None of the Above

352. Eighteen different _____ are used to define life forms from the broadest down to the most specific.
A. Genus
B. Subspecies
C. Categorizing life
D. Categories
E. None of the Above

353. They are: Kingdom, Phylum, Subphylum, Superclass, Class, Subclass, Cohort, Superorder, Order, Suborder, Superfamily, Family, Subfamily, Tribe, Genus, Subgenus, Species and _____.
A. Genus
B. Subspecies
C. Categorizing life
D. Categories
E. None of the Above

354. Identifying the _____ is usually specific enough to determine the role of the organisms found in a wastewater treatment system.
A. Genus
B. Subspecies
C. Categorizing life
D. Categories
E. None of the Above

355. Following taxonomic identification, _____ and evaluation of the characteristics of the various organisms and structures present in a wastewater sample, the information can be used to draw conclusions regarding the treatment process.
A. Genus
B. Subspecies
C. Categorizing life
D. Enumeration
E. None of the Above

356. A _____indicates immature floc, as would be found during start-up or a process recovery.
A. Intermediate health
B. Mature floc particle
C. Spherical floc particle
D. Dispersed growth
E. None of the Above

357. A _____of irregular shape indicates the presence of a beneficial quantity of filamentous organisms and good quality effluent.
A. Intermediate health
B. Mature floc particle
C. Spherical floc particle
D. Dispersed growth
E. None of the Above

358. An excess of _____could indicate a very young sludge, the presence of toxic material, excess mechanical aeration or an extended period of time at low dissolved oxygen levels.
A. Intermediate health
B. Mature floc particle
C. Spherical floc particle
D. Dispersed growth
E. None of the Above

359. Certain protozoans, such as amoebae and flagellates dominate during a _____.
A. Intermediate health
B. Mature floc particle
C. Spherical floc particle
D. System start-up
E. None of the Above

360. Free swimming ciliates are indicative of a sludge of _____and an effluent of acceptable or satisfactory quality.
A. Intermediate health
B. Mature floc particle
C. Spherical floc particle
D. Dispersed growth
E. None of the Above

361. A predominance of crawling ciliates, stalked ciliates and metazoans is an indicator of sludge with _____and an effluent of high quality.
A. Excellent health
B. Mature floc particle
C. Spherical floc particle
D. Dispersed growth
E. None of the Above

Filamentous Bacteria Section, please identify Positive or Negative aspects

362. They can interfere with separation and compaction of activated sludge and cause bulking when predominant.
A. Positive Aspect
B. Negative Aspect

363. They add a backbone or rigid support network to the floc structure.
A. Positive Aspect
B. Negative Aspect

364. Helps the floc structure to filter out fine particulate matter that will improve clarifier efficiency.
A. Positive Aspect
B. Negative Aspect

365. They help the floc to settle if in small amounts.
A. Positive Aspect
B. Negative Aspect

366. They reduce the amount of "pin" floc.
A. Positive Aspect
B. Negative Aspect

367. They are very good BOD removers
A. Positive Aspect
B. Negative Aspect

Filamentous Bacteria True or False Section

368. They cannot affect the sludge volume index (SVI).
A. True
B. False

369. They can cause good settling if dominant.
A. True
B. False

370. They can fill up a clarifier and make it hard to settle, causing TSS carryover.
A. True
B. False

371. They can decrease polymer consumption.
A. True
B. False

372. They can decrease solids production and cause solids handling costs to decrease significantly.
A. True
B. False

373. Filamentous Identification should be used as a tool to monitor the health of the biomass when a filament problem is suspected.
A. True
B. False

374. Filamentous Identification is used to determine the type of filaments present so that a cause can be found and corrections can be made to the system to alleviate future problems.
A. True
B. False

375. All filamentous bacteria usually have a process control variation associated with the type of filament present that can be implemented to change the environment present and select out for floc forming bacteria instead.
A. True
B. False

376. Killing the filaments with chlorine or peroxide will permanently remove the filaments. A process change does not need to made because the filaments will not return with time eventually. Find out what filaments are present, find out the cause associated with them and make a process change for a lasting fix to the problems.
A. True
B. False

377. Filaments can be internally or externally and they can be free of the floc structures or found intertwined in the floc. Most labs think that filaments need to be extending from the floc in order to be a problem.
A. True
B. False

378. External filaments can cause more problems than internal filaments.
A. True
B. False

379. Think of internal filaments causing a structure like a sponge. It will retain water easily and be harder to dewater, will be hard to compress and will take up more space, thereby increasing solids handling costs.
A. True
B. False

380. Filaments present in the system always have to mean a problem. Some filaments are bad if they form a strong backbone and add a rigid network to the floc.
A. True
B. False

381. They help give the floc more structure and settle faster. Filaments are good BOD degraders also. They are only a problem when they become dominant. If filament abundance is in the abundant or excessive range, having a Filamentous Identification performed is recommended.
A. True
B. False

382. A problem that often frustrates the performance of activated sludge is bulking sludge due to the growth of filamentous bacteria.
A. True
B. False

383. Sludge bulking can often be solved by careful process modifications.
A. True
B. False

384. However, different filamentous bacteria such as Microthrix, Sphaerotilus, Nostocoida, Thiothrix or "Type 021N" and others will reduce bulking for different reasons.
A. True
B. False

385. All filamentous species have been given a scientific name yet. Consequently, in order to make the right kind of process modification, knowledge to identify them and much experience with the process ecology are not required. The potential for instability with activated sludge is not an acute problem when strict demands on treatment performance are in place.
A. True
B. False

386. If you ever experienced an overgrowth of Microthrix parvicella in your activated sludge plant, you will be aware that it can be very simple to either eradicate or control.
A. True
B. False

387. Microthrix is the least common cause of bulking and foaming in activated sludge plants, and it appears either essentially together with the company of other filaments.
A. True
B. False

388. Microthrix fits into the filamentous bacterial classification of low F/M, which means that it tends to appear in plants with long sludge ages.
A. True
B. False

389. Modern plants incorporating denitrification and/or phosphorus removal are obvious candidates for bulking and foaming due to Microthrix.
A. True
B. False

390.The design of plants can play a significant part in the proliferation of scums and foams and there are many common mistakes in plant design which assist organisms like Microthrix by retaining floating masses in dead areas of the plant which have very high MCRT values and continuously reseed the biomass.
A. True
B. False

391. Similarly poor mixing, poorly designed and inadequate aeration systems, _____ and low process D.O. levels can contribute to the creation of anoxic and anaerobic zones in what are supposed to be aeration basins.
A. Cyclic overloading
B. Ozone and peroxide
C. Biomass SVIs
D. Low F/M filaments
E. None of the Above

392. While chlorine use was the most effective, it was reported to damage the _____ and cause difficulties in the P removal process when dosed at high levels, while ozone and peroxide were less effective in treating settling problems but less of a problem to the biomass.
A. Cyclic overloading
B. Ozone and peroxide
C. Biomass
D. Low F/M filaments
E. None of the Above

393. In recent times the introduction of selectors has been hailed as a major initiative in the control and elimination of filamentous bacteria (bulking and foaming) and the maintenance of moderate _____
A. Cyclic overloading
B. Ozone and peroxide
C. Biomass SVIs
D. Low F/M filaments
E. None of the Above

394. Evidence on the performance of selectors in controlling low F/M filaments has been described as both controversial and ambiguous and, in the Netherlands, despite incorporating over 80 selectors in full-scale plants, the percentage of plants with bulking associated with _____was unchanged.
A. Cyclic overloading
B. Ozone and peroxide
C. Biomass SVIs
D. Microthrix parvicella
E. None of the Above

395. Mamais examined the effect of factors such as temperature, substrate type (easily biodegradable in the form of acetate and slowly biodegradable in the form of oleic acid) on _____growth using complete mix with and without selectors (anoxic and anaerobic) and plug flow reactors.
A. Cyclic overloading
B. Ozone and peroxide
C. Biomass SVIs
D. Microthrix parvicella
E. None of the Above

396. The results indicate that low temperatures and substrates in the form of long chain fatty acids favor the growth of _____
A. Cyclic overloading
B. Plug flow configuration
C. Biomass SVIs
D. Microthrix parvicella
E. None of the Above

397. The _____was shown to be quite effective in controlling the growth of M. parvicella and producing a sludge with good settling characteristics, while the presence of a selector, either anoxic or anaerobic, had no significant effect on the growth of M. parvicella.
A. Cyclic overloading
B. Plug flow configuration
C. Biomass SVIs
D. Low sludge ages
E. None of the Above

398. Maintenance of _____ (5) days has also been reported to eliminate M. parvicella because it is a slow growing organism, but this is not always operationally possible.
A. Cyclic overloading
B. Plug flow configuration
C. Biomass SVIs
D. Low sludge ages
E. None of the Above

399. While it is often convenient to group filaments together, it does appear the Microthrix has received special attention because of its ability to _____. More selective investigation of Microthrix has indicated that it has quite well defined requirements.
A. Cyclic overloading
B. Long chain fatty acids
C. Proliferate
D. Low sludge ages
E. None of the Above

400. The nature of Microthrix is such that it has the capability of using _____ (oleic acid) and their esters (triglycerides of palmitic and stearic acid) (fats and oils) as sources of carbon and energy.
A. Cyclic overloading
B. Long chain fatty acids
C. Proliferate
D. Low sludge ages

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