

# Standards Correlations for Aquaculture Infusion Units

## AIU

| Task No.                                    | Task  | Task Definition  | Process/Skill Questions  | SOL Correlations   | AFNR Correlations                  |
|---|---|--|--|--|------------------------------------|
| <b>Introducing the Aquaculture Industry</b> |   |  |  |  |                                    |
| AIU-1                                       | Investigate the history and development of the aquaculture industry.  | Investigation should include <ul style="list-style-type: none"> <li>definition of <i>aquaculture</i></li> <li>origin of aquaculture (e.g., Chinese, Egyptian, and Roman aquaculture)</li> <li>international aquaculture</li> <li>the aquaculture industry in the United States (U.S.) and Virginia</li> <li>development of the aquaculture industry within agriculture</li> <li>types of aquaculture               <ul style="list-style-type: none"> <li>freshwater</li> <li>marine (saltwater)</li> <li>warm water</li> <li>cold water.</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>Why is the aquaculture industry a necessity?</li> <li>What is the difference between fish-culture and capture/commercial fisheries?</li> <li>What is the history of aquaculture?</li> </ul>   | English: 6.4, 6.6, 7.4, 7.6, 8.4, 8.6, 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5<br><br>History and Social Sciences: Govt 9, 14, 15 | CS.01.01.01.a                      |
| AIU-2                                       | Describe the importance of developing a sustainable aquaculture industry in terms of economics and its effect on the environment. | Description should include the economic and environmental purposes of a sustainable aquaculture industry in Virginia, in the United States, and worldwide: <ul style="list-style-type: none"> <li>Food production for human consumption</li> <li>Rebuilding of populations of threatened and endangered species</li> <li>Habitat restoration</li> <li>Wild stock enhancement</li> <li>Production of baitfish</li> </ul>  | <ul style="list-style-type: none"> <li>What is <i>sustainability</i>?</li> <li>What are five strategies for sustainable fish farming?</li> <li>What are the economic implications of the aquaculture industry?</li> <li>What would happen if the aquaculture industry did not</li> </ul> | English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5<br><br>History and Social Sciences: Govt 9, 14, 15                                       | CS.02.02.03.b<br><br>CS.03.02.02.b |

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|          |  | <ul style="list-style-type: none"> <li>Fish culture for zoos and aquariums</li> </ul> <p>Description should also include the major aquatic species in Virginia and the United States and their economic importance.</p>   | exist?  | Science: BIO.8  |  |
| AIU-3    | Explain state, federal, and international agencies' laws and regulations as they apply to aquaculture. | <p>Explanation should include the role of</p> <ul style="list-style-type: none"> <li>federal, state, and local laws and regulations with respect to <ul style="list-style-type: none"> <li>invasive species</li> <li>environmental degradation</li> <li>unintended consequences</li> <li>the effects of effluent</li> <li>ground water usage</li> </ul> </li> <li>U.S. Department of Agriculture (USDA) <ul style="list-style-type: none"> <li>Natural Resources Conservation Service (NRCS)</li> </ul> </li> <li>U.S. Food and Drug Administration (FDA)</li> <li>Environmental Protection Agency (EPA)</li> <li>U.S. Fish and Wildlife Service (USFWS)</li> <li>U.S. Army Corps of Engineers (USACE)</li> <li>Virginia Occupational Safety and Health (VOSH) program safety laws and regulations</li> <li>riparian rights.</li> </ul> | <ul style="list-style-type: none"> <li>What Virginia regulatory agencies oversee aquatic life?</li> <li>How do regulatory laws work to protect the environment?</li> <li>How does a non-native species affect the environment?</li> <li>What are the legal consequences for violating the law?</li> </ul> | <p>English: 6.4, 6.6, 7.4, 7.6, 8.4, 8.6, 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5</p> <p>History and Social Sciences: Govt 9, 14, 15</p> <p>Science: BIO.8</p> | <p>CS.03.04.03.a</p> <p>NRS.02.01.02.a</p> |
| AIU-4    | Explain the importance of managing water quality.  | <p>Explanation should include</p> <ul style="list-style-type: none"> <li>dissolved gases and oxygen</li> <li>aeration</li> <li>carbon dioxide (CO2)</li> <li>testing</li> <li>alkalinity</li> <li>clarification</li> </ul>  | <ul style="list-style-type: none"> <li>Why is it important to consider water quality as a whole rather than as a sum of its various parts?</li> <li>How do temperature and salinity affect dissolved oxygen?</li> </ul>   | <p>English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5</p> <p>Science: BIO.8, CH.4, CH.1</p>  | AS.08.02.01.a                              |

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|----------|--|--|---|---|-------------------|
|          |  | <ul style="list-style-type: none"> <li>• hardness</li> <li>• water source disinfection               <ul style="list-style-type: none"> <li>○ ozone</li> <li>○ ultraviolet (UV) light</li> </ul> </li> <li>• oxygen enhancement</li> <li>• nitrogen forms such as               <ul style="list-style-type: none"> <li>○ ammonia (NH<sub>3</sub>)</li> <li>○ ammonium (NH<sub>4</sub>)</li> <li>○ nitrite (NO<sub>2</sub>)</li> <li>○ nitrate (NO<sub>3</sub>)</li> <li>○ nitrogen gas (N<sub>2</sub>)</li> <li>○ sulfuric acid (H<sub>2</sub>SO<sub>4</sub>)</li> </ul> </li> <li>• phosphorous</li> <li>• total dissolved solids (dissolved solids and wastes)</li> <li>• temperature</li> <li>• salinity and specific gravity</li> <li>• pH (alkalinity, acidity)</li> <li>• dissolved oxygen (DO) cycle</li> <li>• ammonia cycle (N)</li> <li>• carbon dioxide (CO<sub>2</sub>) cycle</li> <li>• pH cycle</li> <li>• system-specific water management practices (avoid overfeeding, monitor DO, control unwanted organisms, prevent runoff from entering facility, add water to improve quality)</li> <li>• stress caused by diminished water quality (shock, chronic, acute stress).</li> </ul> |   |   |                   |
| AIU-5    | Identify hazards associated with the aquaculture industry. | Identification should include <ul style="list-style-type: none"> <li>• explaining the importance of personal protective equipment (PPE)</li> </ul>   | <ul style="list-style-type: none"> <li>• What might be a hazard associated with handling fish (e.g., getting “finned”)?</li> <li>• What are chemical hazards</li> </ul> | English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5 | CS.03.03.03.a     |

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|--------------------------------------|---|---|--|--|------------------------------------|
|                                      |   | <ul style="list-style-type: none"> <li>demonstrating the use of PPE</li> <li>describing hazards in a wet environment               <ul style="list-style-type: none"> <li>falls</li> <li>drowning</li> <li>electrical hazards</li> </ul> </li> <li>comparing heat and cold hazards</li> <li>identifying dehydration</li> <li>identifying work-related neck and upper-limb disorders</li> <li>identifying respiratory problems</li> <li>identifying allergies</li> <li>listing parasites</li> <li>summarizing zoonotic diseases</li> <li>explaining chemical hazards.</li> </ul> | <ul style="list-style-type: none"> <li>in an aquaculture lab?</li> <li>Why is it important to be able to identify zoonotic diseases?</li> </ul>  | Science: CH.1  |                                    |
| AIU-6                                | Explore careers in the aquaculture industry.                            | Exploration should include <ul style="list-style-type: none"> <li>supplies and service</li> <li>production</li> <li>inspection and monitoring (e.g., lab support)</li> <li>marketing</li> <li>research and development</li> <li>feed and supplies</li> <li>construction</li> <li>consulting</li> <li>training and education</li> <li>entrepreneurship.</li> </ul>   | <ul style="list-style-type: none"> <li>What level of education is needed for various career opportunities in aquaculture?</li> <li>What types of skills are needed in an aquaculture business?</li> <li>What aquaculture careers are available locally?</li> </ul> | English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5<br><br>History and Social Sciences: Govt 9, 14, 15 | CS.01.01.01.a<br><br>CS.05.01.01.a |
| <b>Identifying Aquaculture Crops</b> |   |   |  |  |                                    |
| AIU-7                                | Identify the characteristics of aquatic animal species (vertebrates and | Identification should include environmental requirements of various species including <ul style="list-style-type: none"> <li>marine</li> <li>freshwater</li> </ul>  | <ul style="list-style-type: none"> <li>How are freshwater and marine species similar? How are they different?</li> <li>What are the environmental requirements for warm-</li> </ul>  | English: 6.4, 6.6, 7.4, 7.6, 8.4, 8.6, 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5              |                                    |

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|          | invertebrates).   | <ul style="list-style-type: none"> <li>○ warm-water</li> <li>○ cold-water</li> <li>• aquatic reptiles (alligators, turtles)</li> <li>• mollusks               <ul style="list-style-type: none"> <li>○ bivalves (clams, mussels, oysters, scallops)</li> <li>○ gastropods (snails, conches, abalones)</li> </ul> </li> <li>• arthropods               <ul style="list-style-type: none"> <li>○ crustaceans (lobsters, crabs)</li> </ul> </li> <li>• echinoderms (sea urchins, sea cucumbers)</li> <li>• annelids               <ul style="list-style-type: none"> <li>○ worms (leeches).</li> </ul> </li> </ul> | <p>water vs. cold-water species?</p> <ul style="list-style-type: none"> <li>• What characteristics make certain species appropriate for cultivation?</li> </ul>  | Science: BIO.4, BIO.8  |                   |
| AIU-8    | Identify the characteristics of aquatic plant species.              | <p>Identification should include environmental requirements of various species including</p> <ul style="list-style-type: none"> <li>• aquatic plants (algae and macrophytes)               <ul style="list-style-type: none"> <li>○ saltwater</li> <li>○ brackish water</li> <li>○ cool and warm freshwater</li> <li>○ algae</li> <li>○ ornamentals.</li> </ul> </li> </ul>   | <ul style="list-style-type: none"> <li>• How are freshwater and marine species similar? How are they different?</li> <li>• What are the environmental requirements for warm-water vs. cold-water species?</li> <li>• What characteristics make certain species appropriate for cultivation?</li> </ul> | <p>English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5</p> <p>Science: BIO.4, BIO.8</p>                                |                   |
| AIU-9    | Diagram the anatomical parts of finfish, crustaceans, and mollusks. | <p>Diagramming should include</p> <ul style="list-style-type: none"> <li>• morphology, anatomy, and physiology of aquaculture organisms</li> <li>• anatomical features by species               <ul style="list-style-type: none"> <li>○ internal                   <ul style="list-style-type: none"> <li>▪ skeletal</li> <li>▪ muscular</li> <li>▪ digestive</li> </ul> </li> </ul> </li> </ul>   | <ul style="list-style-type: none"> <li>• What are the differences between morphology and physiology?</li> <li>• What are the differences between scientific names and common names?</li> <li>• What are the external anatomical parts and their functions?</li> </ul>                                  | <p>English: 6.4, 6.6, 7.4, 7.6, 8.4, 8.6, 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5</p> <p>Science: BIO.4</p> |                   |

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|--|--|---|--|---|-------------------|
|  |  | <ul style="list-style-type: none"> <li>▪ excretory</li> <li>▪ respiratory</li> <li>▪ circulatory</li> <li>▪ nervous</li> <li>▪ sensory</li> <li>▪ reproductive</li> <li>○ external (finfish) <ul style="list-style-type: none"> <li>▪ mouth</li> <li>▪ nares</li> <li>▪ operculum</li> <li>▪ gills</li> <li>▪ pelvic fin</li> <li>▪ pectoral fin</li> <li>▪ anal fin</li> <li>▪ caudal fin</li> <li>▪ dorsal fin</li> <li>▪ lateral line</li> <li>▪ eye</li> <li>▪ vent</li> </ul> </li> <li>• scientific names</li> <li>• common names</li> <li>• life cycle.</li> </ul> | <ul style="list-style-type: none"> <li>• What are the differences between a vertebrate and an invertebrate?</li> </ul>   |   |                   |
| <b>Comparing Types of Aquaculture Operations</b> |  |   |  |   |                   |
| AIU-10   | Explain the types of aquaculture operations. | <p>Explanations should include the purpose and function of</p> <ul style="list-style-type: none"> <li>• hatcheries <ul style="list-style-type: none"> <li>○ spawning facilities</li> <li>○ egg management</li> <li>○ brood fish (brood stock) management</li> <li>○ fry and fingerling management</li> <li>○ phases of fingerling production</li> </ul> </li> </ul>   | <ul style="list-style-type: none"> <li>• What are the advantages and disadvantages of each type of aquaculture operation?</li> <li>• What are brood fish?</li> <li>• Why is it important to maintain a continuous stock of high quality brood fish?</li> </ul> | English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5 |                   |

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|          |      | <ul style="list-style-type: none"> <li>grow-out facilities               <ul style="list-style-type: none"> <li>species selection</li> <li>water quality</li> <li>water oxygenation</li> <li>disease prevention</li> <li>feeding</li> <li>regulations</li> <li>discharge of effluent/environmental concerns</li> </ul> </li> <li>harvesting (topping, total)</li> <li>marketing               <ul style="list-style-type: none"> <li>assembling</li> <li>grading</li> <li>hauling</li> <li>processing (e.g., minimal, medium, value added)</li> <li>packaging</li> <li>storing</li> <li>wholesaling</li> <li>retailing</li> <li>advertising</li> <li>change of ownership</li> </ul> </li> <li>available markets               <ul style="list-style-type: none"> <li>personal use</li> <li>recreation</li> <li>food</li> <li>processors</li> <li>live haulers</li> <li>fee fishing</li> <li>direct to restaurants</li> <li>aquarist trade</li> </ul> </li> <li>baitfish industry</li> <li>ornamental fish production and management.</li> </ul> | <ul style="list-style-type: none"> <li>What is effluent?</li> <li>What is a therapeutant?</li> <li>What are some factors that determine species selection?</li> </ul> |                  |                   |

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|----------|--|--|--|--|-----------------------------------|
| AIU-11   | Identify the types of aquatic structures and equipment used in aquaculture operations. | <p>Identification should include</p> <ul style="list-style-type: none"> <li>• ponds</li> <li>• cages</li> <li>• flow-through systems (raceway)</li> <li>• recirculating systems.</li> </ul>  | <ul style="list-style-type: none"> <li>• What are the advantages and disadvantages of each system?</li> <li>• Why are specific aquatic structures selected for a particular species?</li> </ul>  | English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5  |                                   |
| AIU-12   | Explain pond culture.  | <p>Explanation should include</p> <ul style="list-style-type: none"> <li>• types of ponds (e.g., watershed, levee, excavated)</li> <li>• site selection water sources/availability <ul style="list-style-type: none"> <li>○ soil characteristics (clay content)</li> <li>○ climate</li> <li>○ topography (drainage, flooding)</li> <li>○ runoff</li> </ul> </li> <li>• source and materials</li> <li>• engineering/construction requirements <ul style="list-style-type: none"> <li>○ address given formulas and case situation</li> <li>○ determine the size for a fish pond including acreage, shape, capacity, and depth maintenance</li> <li>○ address dam inspection and repair</li> <li>○ address the repair and maintenance of plant cover and clean water</li> <li>○ address best practices for pond fertilization</li> </ul> </li> <li>• species selection/suitability for pond culture <ul style="list-style-type: none"> <li>○ catfish</li> <li>○ striped bass</li> <li>○ crawfish</li> <li>○ drum</li> <li>○ carp</li> <li>○ shrimp</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• What could happen if a pond were constructed in a flood zone?</li> <li>• What are the consequences of poor site selection?</li> <li>• Why use a pond over another aquatic system?</li> <li>• Why is maintenance important?</li> <li>• What are some causes of crop loss in ponds?</li> <li>• What are some preventative measures for reducing crop loss in ponds?</li> <li>• How are fish acclimated to a new aquatic environment?</li> <li>• What are the consequences of not following BMPs?</li> <li>• What are some forms of stress fish might experience (e.g., physical, chemical, perceived stressors)?</li> <li>• Why is record keeping and training personnel</li> </ul> | <p>English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5</p> <p>Math: 6.7, 6.13. 7.2, 7.3, 7.4, 7.11, 7.12, 8.6, 8.9, 8.10, 8.14, 8.17, A.1, G.9, G.13, G.14</p> <p>Science: ES.8, ES.7, CH.4, BIO.8</p> | <p>AS.01.02.</p> <p>AS.02.01.</p> |



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|----------|-----------------------|---|---|---|----------------------------|
|          |                       | <ul style="list-style-type: none"> <li>preventive controls/biosecurity               <ul style="list-style-type: none"> <li>best management practices (BMPs) for ponds</li> </ul> </li> <li>advantages of ponds</li> <li>disadvantages of ponds</li> <li>stocking densities based on species and pond size               <ul style="list-style-type: none"> <li>communication                   <ul style="list-style-type: none"> <li>delivery</li> <li>buyer</li> <li>management</li> </ul> </li> <li>water quality awareness/requirements                   <ul style="list-style-type: none"> <li>temperature</li> <li>pH</li> </ul> </li> <li>importance of recording pond maintenance</li> <li>necessary supplies for harvesting                   <ul style="list-style-type: none"> <li>nets</li> <li>buckets</li> <li>truck-to-pond</li> </ul> </li> <li>access to a pond and the necessary equipment to prepare the pond for stocking according to BMPs</li> </ul> </li> <li>factors in production               <ul style="list-style-type: none"> <li>feeding methods used with ponds (e.g., hand, mechanical, natural)                   <ul style="list-style-type: none"> <li>types of feed (e.g., floating, sinking, neutral buoyancy pellets)</li> <li>frequency of feed</li> <li>amount of feed</li> </ul> </li> <li>oxygen management (aeration devices).</li> </ul> </li> </ul> | <p>important?</p> <ul style="list-style-type: none"> <li>Why might a pond require oxygen supplementation?</li> </ul>                |   |                            |
| AIU-13   | Explain cage culture. | <p>Explanation should include</p> <ul style="list-style-type: none"> <li>factors in site selection (e.g., depth of water, water quality, prevailing winds, natural currents)</li> </ul>   | <ul style="list-style-type: none"> <li>What types of problems are associated with putting a cage in a pond vs. an ocean?</li> </ul> | English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5 | AS.01.02.<br><br>AS.02.01. |

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|          |      | <ul style="list-style-type: none"> <li>species suitability</li> <li>source and materials <ul style="list-style-type: none"> <li>rearing aquaculture species inside confined enclosures (to include cages, net pens, baskets, etc.) in freshwater and marine environments</li> <li>types of cages (i.e., fixed, floating, submersible, and submerged)</li> <li>cage requirements (vary by species and location)</li> </ul> </li> <li>engineering/construction (to incorporate cage design requirements)</li> <li>cage maintenance <ul style="list-style-type: none"> <li>clean fish cages in accordance with BMPs (routine scrubbing)</li> <li>use anti-fouling materials</li> <li>arrange and secure fish cages in the pond</li> </ul> </li> <li>preventive controls/biosecurity <ul style="list-style-type: none"> <li>BMPs for cages</li> </ul> </li> <li>advantages of cage culture</li> <li>disadvantages of cage culture</li> <li>stocking densities based on species and cage size</li> <li>factors in production</li> <li>species selection for cage culture <ul style="list-style-type: none"> <li>salmon</li> <li>catfish</li> <li>tilapia</li> <li>trout</li> <li>striped bass</li> <li>red drum</li> <li>bluegill</li> <li>carp</li> </ul> </li> <li>feeding methods for cages (feeding ring).</li> </ul> | <ul style="list-style-type: none"> <li>What are the consequences of poor site selection?</li> <li>Why is security an issue?</li> <li>Why is maintenance important?</li> <li>What are some causes of crop loss?</li> <li>What are some preventative measures for reducing crop loss in cages?</li> <li>What are some of the environmental impacts caused by cage culture in different environments?</li> <li>How important is the feeding ring in cage culture?</li> <li>What are the causes, consequences, and solutions of fish cage fouling?</li> <li>What are the benefits of proper cage maintenance?</li> <li>How can you reduce stress on a species when cleaning the cage?</li> <li>How does fouling reduce water flow?</li> <li>How is water quality affected when fish are</li> </ul> | Science: ES.8, ES.12, ES.10, BIO.8 |                   |

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|          |  |  | overfed?   |   |                                   |
| AIU-14   | Explain flow-through systems (raceways). | <p>Explanation should include</p> <ul style="list-style-type: none"> <li>• site selection <ul style="list-style-type: none"> <li>○ water sources/availability (management)</li> <li>○ climate</li> <li>○ topography</li> </ul> </li> <li>• species suitability</li> <li>• essential materials</li> <li>• engineering/construction <ul style="list-style-type: none"> <li>○ address given formulas and a case situation</li> <li>○ determine the size for a flow-through system including shape, capacity, depth, and construction</li> <li>○ design requirements</li> </ul> </li> <li>• maintenance</li> <li>• preventive controls/biosecurity <ul style="list-style-type: none"> <li>○ BMPs for flow-through systems</li> </ul> </li> <li>• advantages of flow-through systems</li> <li>• disadvantages of flow-through systems</li> <li>• species selection <ul style="list-style-type: none"> <li>○ trout</li> <li>○ salmon</li> <li>○ catfish</li> <li>○ striped bass</li> <li>○ tilapia</li> </ul> </li> <li>• stocking densities based on species and size of flow-through system</li> <li>• factors of production.</li> </ul> | <ul style="list-style-type: none"> <li>• What could happen if a flow-through facility were constructed in a flood zone?</li> <li>• What are the consequences of poor site selection?</li> <li>• Why use a flow-through system over another system?</li> <li>• Why is maintenance important?</li> <li>• What are some causes of crop loss?</li> <li>• What are some preventative measures for reducing crop loss in flow-through systems?</li> <li>• What are some water quality issues associated with a flow-through system?</li> </ul> | <p>English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5</p> <p>Math: 6.7, 6.13, 7.2, 7.3, 7.4, 7.11, 7.12, 8.6, 8.9, 8.10, 8.14, 8.17, A.1, G.9, G.13, G.14</p> <p>Science: ES.8, ES.12, BIO.8</p> | <p>AS.01.02.</p> <p>AS.02.01.</p> |
| AIU-15   | Explain recirculating                    | <p>Explanation should include</p>  | <ul style="list-style-type: none"> <li>• What are the advantages and disadvantages of using</li> </ul>   | <p>English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5,</p>   | <p>AS.01.02.</p>                  |

| Task No. | Task               | Task Definition   | Process/Skill Questions  | SOL Correlations  | AFNR Correlations                         |
|----------|--------------------|---|--|---|---|
|          | systems.           | <ul style="list-style-type: none"> <li>design of recirculating systems (e.g., silo, circular tanks)</li> <li>site selection <ul style="list-style-type: none"> <li>water sources/availability</li> <li>access to energy</li> <li>effluent</li> </ul> </li> <li>species suitability</li> <li>essential components</li> <li>aeration</li> <li>removal of particulate matter</li> <li>biological filtration</li> <li>engineering/construction <ul style="list-style-type: none"> <li>address given formulas and a case situation</li> <li>determine the size for a flow-through system including shape, capacity, depth, and construction</li> </ul> </li> <li>maintenance</li> <li>preventive controls/biosecurity (BMPs)</li> <li>advantages of recirculating systems</li> <li>disadvantages of recirculating systems</li> <li>stocking densities based on species and size of recirculating system</li> <li>factors of production.</li> </ul> | <p>a recirculating system vs. using a pond or raceway system?</p> <ul style="list-style-type: none"> <li>Why is maintenance important?</li> <li>What are some causes of crop loss in recirculating systems?</li> <li>What are some preventative measures for reducing crop loss in recirculating systems?</li> </ul> | <p>12.5</p> <p>Math: 6.7, 6.13. 7.2, 7.3, 7.4, 7.11, 7.12, 8.6, 8.9, 8.10, 8.14, 8.17, A.1, G.9, G.13, G.14</p> <p>Science: BIO.8</p> | AS.02.01.                                 |
| AIU-16   | Define aquaponics. | <p>Definition should include aquaponics is a food production system that couples aquaculture (raising aquatic animals such as fish, crayfish, snails, or prawns in tanks) with hydroponics (cultivating plants in water) whereby the nutrient-rich aquaculture water is fed to hydroponically-grown plants, where nitrifying bacteria convert ammonia into nitrates, and detailing the types of aquaponics systems, such as</p> <ul style="list-style-type: none"> <li>Nutrient film technique (NFT)</li> <li>Deep Water Culture (DWC)</li> </ul>   | <ul style="list-style-type: none"> <li>What are the benefits of aquaponics?</li> <li>What makes aquaponics a sustainable approach?</li> <li>Why is maintenance important in an aquaponics system?</li> <li>What are the benefits of raising ornamental crops?</li> <li>What plants could be</li> </ul>               | <p>English: 6.4, 6.6, 7.4, 7.6, 8.4, 8.6, 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5</p> <p>Science: BIO.4, ES.12, BIO.8</p>        | <p>PS.02.01.01.a</p> <p>PS.01.02.01.a</p> |

| Task No. | Task   | Task Definition  | Process/Skill Questions   | SOL Correlations   | AFNR Correlations                      |
|----------|--|--|---|--|--|
|          |  | <ul style="list-style-type: none"> <li>Media Bed</li> <li>Decoupled.</li> </ul> <p>Definition should include</p> <ul style="list-style-type: none"> <li>site selection <ul style="list-style-type: none"> <li>water sources/availability (management)</li> <li>climate</li> <li>topography</li> <li>location/facility (e.g., greenhouses, warehouses)</li> <li>environmental factors</li> </ul> </li> <li>essential equipment (e.g., lighting, water quality test kits, irrigation systems)</li> <li>maintenance</li> <li>preventive controls/biosecurity <ul style="list-style-type: none"> <li>BMPs for aquaponics</li> </ul> </li> <li>advantages of aquaponics</li> <li>disadvantages of aquaponics</li> <li>species selection <ul style="list-style-type: none"> <li>tilapia</li> <li>ornamental (e.g., koi)</li> </ul> </li> <li>stocking densities</li> <li>factors of production.</li> </ul> | successfully grown in a freshwater, brackish water, and/or saltwater aquaponics system?   |  |  |
| AIU-17   | Select an aquaculture system for a given crop. | <p>Selection should include knowledge of</p> <ul style="list-style-type: none"> <li>regulation and policy <ul style="list-style-type: none"> <li>permitting</li> </ul> </li> <li>availability of an area</li> </ul>  | <ul style="list-style-type: none"> <li>How might a cost-benefit analysis help in the selection of an aquaculture system?</li> </ul> | <p>English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5</p> <p>History and Social</p> | <p>AS.01.02.</p> <p>AS.01.02.01.c.</p> |

| Task No.                                     | Task                            | Task Definition  | Process/Skill Questions  | SOL Correlations   | AFNR Correlations               |
|--|---------------------------------|--|--|--|---------------------------------|
|  |                                 | <ul style="list-style-type: none"> <li>○ water rights</li> <li>○ land ownership</li> <li>● suitability of an area               <ul style="list-style-type: none"> <li>○ water availability, quality, and temperature</li> <li>○ environmental factors (e.g., water source and effluent)</li> <li>○ light</li> <li>○ cost effectiveness</li> <li>○ available labor</li> <li>○ available market.</li> </ul> </li> </ul> |  | Sciences: Govt 9, 14, 15<br><br>Science: BIO.8                     | AS.02.01.<br><br>AS.02.02.01.b. |
| <b>Maintaining the Aquaculture Operation</b> |                                 |  |  |  |                                 |
| AIU-18                                       | Describe aquaculture equipment. | Description should include equipment related to <ul style="list-style-type: none"> <li>● water sources</li> <li>● aeration</li> <li>● harvest</li> <li>● water quality management</li> <li>● feeding</li> <li>● filtration</li> <li>● transportation</li> <li>● effluent disposal</li> <li>● crop disposal (e.g., composting)</li> <li>● emergency systems and contingency plans.</li> </ul>                           |  | English: 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 10.1, 11.1, 12.1       | ESS.04.01.02.c                  |
| AIU-19                                       | Record operation data.          | Recording should include <ul style="list-style-type: none"> <li>● maintenance of structures and equipment</li> <li>● importance of water quality management</li> </ul>   | <ul style="list-style-type: none"> <li>● Why is it important to keep records?</li> <li>● What are the components of a complete and an</li> </ul> | English: 6.7, 6.8, 7.7, 7.8, 8.7, 8.8, 9.6, 9.7, 10.6, 10.7, 11.6, | BS.02.01.01.b                   |

| Task No. | Task  | Task Definition  | Process/Skill Questions   | SOL Correlations                              | AFNR Correlations |
|----------|---|--|---|---|-------------------|
|          |   | <ul style="list-style-type: none"> <li>○ prevention of oxygen depletion</li> <li>○ turbidity</li> <li>○ aquatic plant control methods</li> <li>○ temperature</li> <li>○ chemicals, compounds, and elements detrimental to water quality</li> <li>○ methods for managing the pH cycle</li> <li>○ general guidelines for water chemistry management</li> <li>○ importance of nitrogen compounds in water quality management</li> <li>• feed (e.g., type, amount, storage)</li> <li>• stocking activity</li> <li>• fish weight gain and loss</li> <li>• production data</li> <li>• financial information.</li> </ul>      | incomplete record?  | 11.7, 12.6, 12.7<br><br>Science: CH.1, BIO.8  |                   |
| AIU-20   | Describe technologies used in aquaculture operations. | <p>Description should include</p> <ul style="list-style-type: none"> <li>• integrated monitoring and operations systems</li> <li>• sensors <ul style="list-style-type: none"> <li>○ water quality</li> <li>○ air temperature, humidity</li> <li>○ disease management</li> </ul> </li> <li>• emergency notification systems</li> <li>• camera systems</li> <li>• automated feeding systems</li> <li>• drones (UAVs)</li> <li>• biosecurity equipment</li> <li>• sorting and grading equipment</li> <li>• emerging technologies <ul style="list-style-type: none"> <li>○ AI decision making tools</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• What cybersecurity threats might affect an aquaculture operation?</li> <li>• What is nanobubble technology?</li> </ul> | English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5 | CS.01.02.02.b.    |

| Task No.                       | Task   | Task Definition  | Process/Skill Questions   | SOL Correlations  | AFNR Correlations |
|--------------------------------|--|--|---|---|-------------------|
|                                |  | <ul style="list-style-type: none"> <li>○ robotics</li> <li>• cybersecurity considerations.</li> </ul>  |   |   |                   |
| AIU-21                         | Measure water quality in an aquaculture operation. | Measurement should include <ul style="list-style-type: none"> <li>• oxygen</li> <li>• temperature</li> <li>• total ammonium nitrogen (TAN)</li> <li>• nitrites</li> <li>• chlorides</li> <li>• nitrates</li> <li>• phosphorous</li> <li>• alkalinity</li> <li>• hardness</li> <li>• pH</li> <li>• CO2</li> <li>• chlorine and chloramines.</li> </ul>  | <ul style="list-style-type: none"> <li>• In what types of systems would CO2 be a concern?</li> <li>• What is TAN?</li> <li>• What positive and negative effects can algae have on fish development?</li> </ul>  | English: 6.4, 7.4, 8.4, 9.3, 10.3, 11.3, 12.3<br><br>Science: CH.4, CH.1, BIO.8 | AS.02.02.01.b.    |
| <b>Feeding Aquatic Species</b> |  |  |   |   |                   |
| AIU-22                         | Feed various species in an aquaculture system.     | Feeding should include <ul style="list-style-type: none"> <li>• feed selection (e.g., nutritional requirements across the life stages and among species, feed size)</li> <li>• methods for preparing feed and feeding finfish in ponds, cages, tanks, and raceways</li> <li>• relationship between feeding and dissolved oxygen (DO)</li> <li>• importance of choosing appropriate aquaculture feeds from reputable sources</li> <li>• importance of choosing quality and quantity of rations</li> <li>• importance of planning the feeding schedule</li> <li>• calculation of the cost of feed</li> <li>• calculation of the amount of feed needed for a given species</li> </ul> | <ul style="list-style-type: none"> <li>• What factors influence feed selection?</li> <li>• What are advantages and disadvantages of live feed vs. commercial feed?</li> <li>• How are feeds similar and different from each other?</li> <li>• What happens if one species is given food intended for another?</li> <li>• What are the parameters for proper feed storage and why are they important?</li> <li>• Why is it important that</li> </ul> | Math: 6.1, 6.5, 6.12, 6.13. 7.2, 7.3, 7.11, 7.12, 8.14, 8.17, A.1               | AS.03.01.01.a.    |



| Task No.  | Task                                     | Task Definition  | Process/Skill Questions   | SOL Correlations  | AFNR Correlations |
|---|--|--|---|---|-------------------|
|   |  | <ul style="list-style-type: none"> <li>calculation of the feed conversion ratio (FCR)</li> <li>importance of ensuring proper feed storage</li> <li>impacts on effluent.</li> </ul>   | <p>fish rapidly consume all of the feed?</p> <ul style="list-style-type: none"> <li>What methods are used to distribute feed to fish?</li> </ul>  |   |                   |
| <b>Maintaining a Healthy Stock in an Aquaculture System</b> |  |  |   |   |                   |
| AIU-23  | Identify common health problems of fish. | <p>Identification should include types of fish disease and common stressors of fish that contribute to infectious and non-infectious diseases. They are</p> <ul style="list-style-type: none"> <li>stressors <ul style="list-style-type: none"> <li>chemical (e.g., poor water, pollution, diet, and metabolic waste)</li> <li>biological (e.g., density, microorganisms, macroorganisms)</li> <li>physical (e.g., temperature, light, sounds , and gases)</li> <li>procedural (e.g., handling, shipping, and treatments)</li> </ul> </li> <li>infectious diseases <ul style="list-style-type: none"> <li>bacterial <ul style="list-style-type: none"> <li>clinical signs <ul style="list-style-type: none"> <li>behavioral (e.g., lack of appetite, lethargy)</li> <li>physical (e.g., lesions, discoloration, hemorrhaging)</li> </ul> </li> <li>contributing factors</li> <li>prevention</li> </ul> </li> <li>viral <ul style="list-style-type: none"> <li>clinical signs (e.g., behavioral, physical)</li> <li>contributing factors</li> </ul> </li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>What are some behavioral signs of a fish in distress?</li> <li>If a fish has lesions, what is the likely culprit?</li> <li>What are some examples of unusual fish behavior that may indicate disease?</li> <li>What are three management practices that prevent stress?</li> </ul> | <p>English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5</p> <p>Science: BIO.8, BIO.4</p> | AS.02.02.01.a     |

| Task No. | Task   | Task Definition  | Process/Skill Questions  | SOL Correlations                              | AFNR Correlations |
|----------|--|--|--|---|-------------------|
|          |  | <ul style="list-style-type: none"> <li>▪ prevention</li> <li>○ parasitic               <ul style="list-style-type: none"> <li>▪ clinical signs (e.g., behavioral, physical)</li> <li>▪ contributing factors</li> <li>▪ prevention</li> </ul> </li> <li>○ fungal               <ul style="list-style-type: none"> <li>▪ clinical signs (e.g., behavioral, physical)</li> <li>▪ contributing factors</li> <li>▪ prevention</li> </ul> </li> <li>• non-infectious diseases               <ul style="list-style-type: none"> <li>▪ clinical signs (e.g., behavioral, physical)</li> <li>▪ contributing factors (e.g., water quality issues)</li> <li>▪ prevention</li> </ul> </li> </ul>   |  |   |                   |
| AIU-24   | Identify methods for prevention and treatment of fish health problems. | <p>Identification should include</p> <ul style="list-style-type: none"> <li>• BMPs for preventing disease</li> <li>• stress reduction measures               <ul style="list-style-type: none"> <li>○ regulating water quality (e.g., temperature, pH, oxygen)</li> <li>○ managing stocking densities</li> <li>○ avoiding poor nutrition</li> <li>○ avoiding excessive handling</li> </ul> </li> <li>• general guidelines for treatment of fish diseases               <ul style="list-style-type: none"> <li>○ methods                   <ul style="list-style-type: none"> <li>▪ dips/baths</li> <li>▪ flushes</li> <li>▪ injections</li> <li>▪ vaccines</li> <li>▪ indefinite</li> </ul> </li> </ul> </li> <li>• biosecurity</li> </ul> | <ul style="list-style-type: none"> <li>• What are some indicators that fish are under stress?</li> <li>• What is biosecurity?</li> <li>• How is biosecurity used to prevent disease introduction?</li> <li>• How can biosecurity be improved?</li> <li>• How can stress cause fish disease?</li> </ul> | English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5 | AS.01.02.01.b.    |

| Task No.  | Task                        | Task Definition  | Process/Skill Questions  | SOL Correlations  | AFNR Correlations |
|---|-----------------------------|--|--|---|-------------------|
|   |                             | <ul style="list-style-type: none"> <li>○ minimize pathogen introduction (access control)</li> <li>○ ensure proper treatment of water</li> <li>• environmental conditions</li> </ul> <p>and treatment in accordance with veterinary consultation.</p>   |  |   |                   |
| <b>Harvesting Fin Fish, Crustaceans, and Mollusks</b> |                             |  |  |   |                   |
| AIU-25  | Harvest crop.               | <p>Harvest should include</p> <ul style="list-style-type: none"> <li>• methods of harvesting <ul style="list-style-type: none"> <li>○ seining (ponds)</li> <li>○ draining (ponds)</li> <li>○ crowding and collecting (tanks)</li> <li>○ trapping (natural ponds and streams)</li> <li>○ hooking</li> <li>○ cage (oysters, clams, mussels)</li> </ul> </li> <li>• time of harvest</li> <li>• cooling method (and validation of the process)</li> <li>• type of equipment used</li> <li>• written instructions for harvest</li> <li>• sanitation (equipment and personnel)</li> <li>• storing aquatic crops</li> </ul> <p>in accordance with BMPs.</p> | <ul style="list-style-type: none"> <li>• What is meant by the validation of a cooling method?</li> <li>• Why is proper cooling critical for quality?</li> <li>• Why is sanitation important to maintain quality?</li> <li>• What should be cleaned and sanitized?</li> <li>• How should equipment be cleaned and sanitized?</li> </ul> | English: 6.7, 6.8, 7.7, 7.8, 8.7, 8.8, 9.6, 9.7, 10.6, 10.7, 11.6, 11.7, 12.6, 12.7 |                   |
| AIU-26  | Create a post-harvest plan. | <p>Creation of a post-harvest plan should include</p> <ul style="list-style-type: none"> <li>• using equipment</li> <li>• fish handling</li> <li>• proper storage practices (e.g., first-in, first-out [FIFO], allergen control, temperature)</li> <li>• sanitation (equipment and personnel)</li> </ul>   | <ul style="list-style-type: none"> <li>• What is Hazard Analysis and Critical Control Points (HACCP)?</li> <li>• What does FIFO mean?</li> <li>• What can be done to ensure refrigeration of the aquatic crop in the event of a power outage? Why is this</li> </ul>   | English: 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 10.1, 11.1, 12.1                        | CS.01.01.01.a     |

| Task No.                              | Task                      | Task Definition   | Process/Skill Questions  | SOL Correlations   | AFNR Correlations |
|---------------------------------------|---------------------------|---|--|--|-------------------|
|                                       |                           | in accordance with BMPs.  | critical?  |  |                   |
| <b>Marketing Aquaculture Products</b> |                           |   |  |  |                   |
| AIU-27                                | Develop a marketing plan. | <p>Developing the marketing plan should include</p> <ul style="list-style-type: none"> <li>importance of developing a marketing plan (market research and analysis)</li> <li>determination of market goals</li> <li>identification of possible market outlets for the product <ul style="list-style-type: none"> <li>processing markets</li> <li>recreational markets</li> <li>retail markets</li> <li>restaurant markets</li> </ul> </li> <li>factors in selecting an appropriate market and implementing marketing strategies (i.e., wholesale vs. direct-to-consumer vs. retail) <ul style="list-style-type: none"> <li>profitability</li> <li>need for equipment</li> <li>accessibility</li> <li>species of aquatic crop</li> <li>quantity</li> <li>size and maturity</li> <li>quality</li> </ul> </li> <li>cost of marketing <ul style="list-style-type: none"> <li>transportation</li> <li>grading</li> <li>harvesting</li> <li>packaging</li> <li>storing</li> <li>advertising</li> </ul> </li> <li>development of plans to reach the marketing goals</li> </ul> | <ul style="list-style-type: none"> <li>Why is it important to have a marketing plan?</li> <li>How does seasonality affect an aquaculture product's marketing plan?</li> <li>Why is sanitary transport important?</li> <li>What are some scientific skills required to maintain quality of fish and fish products?</li> </ul> | English: 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 10.1, 11.1, 12.1 | ABS.05.03.02.c.   |

| Task No.   | Task                                     | Task Definition   | Process/Skill Questions  | SOL Correlations  | AFNR Correlations |
|------------|--|---|--|---|-------------------|
|            |  | <ul style="list-style-type: none"> <li>process of marketing promotion</li> <li>quality control procedures (e.g., sanitary transport of product)</li> <li>activities associated with marketing               <ul style="list-style-type: none"> <li>product tracing</li> <li>grading</li> <li>transporting</li> <li>processing</li> <li>packaging</li> <li>storing</li> <li>wholesaling</li> <li>retailing</li> </ul> </li> <li>evaluation of the marketing plans.</li> </ul>  |  |   |                   |
| AIU-28 (O) | Prepare aquaculture products for market. | <p>Preparation of finfish, crustaceans, and mollusks for market should include</p> <ul style="list-style-type: none"> <li>processing the product               <ul style="list-style-type: none"> <li>receiving and weighing the live product at the processing plant</li> <li>holding product alive until processed</li> <li>stunning</li> <li>de-heading</li> <li>eviscerating</li> <li>skinning</li> <li>chilling</li> <li>product form</li> <li>sizing</li> <li>grading</li> <li>freezing or ice packing</li> <li>packaging</li> <li>warehousing</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>How does processing maintain quality control?</li> <li>What causes off-flavor in catfish?</li> <li>What are the key elements of marketing an aquaculture product?</li> <li>What are five activities that are part of marketing?</li> <li>What are two product characteristics that affect buying decisions?</li> <li>What are six quality control functions?</li> <li>What is a food allergen plan, and how is it implemented?</li> </ul> | <p>English: 6.6, 7.6, 8.6, 9.5, 10.5, 11.5, 12.5</p> <p>History and Social Sciences: Govt 9, 14, 15</p> | ABS.05.03.03.c.   |

| Task No. | Task | Task Definition  | Process/Skill Questions | SOL Correlations | AFNR Correlations |
|----------|------|--|-------------------------|------------------|-------------------|
|          |      | <ul style="list-style-type: none"> <li>○ icing</li> <li>○ shipping the finished product</li> <li>• quality control procedures</li> <li>• preparing carriers for hauling</li> <li>• sanitary transport of foods (STF)</li> <li>• loading finfish, crustaceans, and mollusks</li> <li>• ensuring proper temperatures for shipment of product</li> <li>• HACCP</li> </ul> <p>in accordance with the aquaculture product marketing plan, international, federal, and state guidelines.</p> |                         |                  |                   |