*Water Dawgs* Summer Training Program Outline

Vision

The *Water Dawgs* summer training program provides innovative freshwater science education and professional development for local high school students from groups typically underrepresented in STEM. During the paid summer training program, 10-20 local students will be rigorously trained in freshwater science and Adopt-A-Stream water quality monitoring protocols through engaging, hands-on lessons. Following the summer training program, students will have the opportunity to participate in a paid internship with a citizen science water quality monitoring group or research lab at UGA.

Overarching goals

1. Students will be able to describe the effects of urbanization on water quality.
2. Students will be able to explain the importance of water quality monitoring in maintaining stream ecosystem health.
3. Students will become proficient in Adopt-A-Stream water quality monitoring protocols.
4. Students will receive career professional development, particularly for careers in STEM.

Schedule

* There are a total of twenty learning modules and each learning module is 3.5 hours in length. This format allows for the program to be conducted as a two-week program with full instructional days (i.e., two learning modules per day) or as a four-week program with instructional half days (i.e., one learning module per day).
  + Note that the lesson plans and PowerPoints contain timing information based off of a two-week format (9:00-12:30 for the morning learning module; 1:00-4:30 for afternoon learning module). If you decide to conduct the program in a 4-week format, you will need to adjust the PowerPoints accordingly.
* If the program is conducted in a two-week format with full days, lunch should be provided for the students.
* There are scheduled breaks within each learning module.

Learning Module Information

* There are full lesson plans for 17 of the 20 learning modules (LM#3- LM#19). There are suggested activities for the Program Introduction (LM#1 and LM#2) and the Program Conclusion (LM#20), as the program introduction and conclusion should be scheduled to cater to the specific needs of the students, university partners, internship directors, etc.
* Each learning module is based off of a “5E” instructional model. The program outline (Table 1) contains summaries of each module’s Explore and Elaborate activities.
* All learning modules include a lesson plan/instructor guide, a PowerPoint, and all student handouts.
* Each learning module can be implemented individually, independent of the other learning modules, with the exception of the following learning modules, which build off of one another:
  + Chemical Monitoring Part A (LM#5) and Part B (LM#6)
  + Stream Bioassessments Part A (LM#16), Part B (LM#17), and Part C (LM#18)
  + Bacterial Monitoring begins in LM#12, but since Petrifilm plates take two days to incubate, colonies must be counted two days later (scheduled in LM#16).
* All learning modules contain water quality monitoring protocols based off of the Georgia Adopt-A-Stream program. If you are conducting the *Water Dawgs* training program in another state, you may choose to supplement the Georgia protocols with your state’s citizen science water quality monitoring protocols.
* The following learning modules contain information/activities specific to the Athens, Georgia, area. If you are conducting this program in another city or state, you may choose to supplement these activities with local stream information/activities.
  + LM#3
  + LM#4
  + LM#5
* The following learning modules require computer access for students:
  + LM#9
  + LM#12
  + LM#15
  + LM#16
  + LM#18
  + LM#19

***Please see the Water Dawgs Summer Training Program - Instructor Guide***

***for more information and additional tips regarding the learning modules!***

Table 1: Outline of *Water Dawgs* Training Program Learning Modules. Each learning module contains information including: topic, overarching goals addressed, lesson objectives, linked AP Environmental Science and NGSS standards, and primary activities.

| **Learning Module**  **#1** | **Topic:** Program Introduction, Part A  **Suggested activities:**   * Welcome and introductions * Review program expectations/code of conduct * Tour of facilities * Icebreaker activities * Pre-training program survey/questionnaire |
| --- | --- |
| **Learning Module**  **#2** | **Topic:** Program Introduction, Part B  **Suggested activities:**   * Distribute program materials * Review program information * Team building activities * Question and answer session |
| **Learning Module #3** | **Topic:** Urban Watersheds  **Overarching goals addressed**: 1  **Lesson objectives:**   * SWBAT define: watershed, percolation, ground water, runoff, water quality monitoring. * SWBAT describe characteristics of an urban watershed.   SWBAT analyze maps to explain how land use changes could affect stream ecosystem health.  **Linked AP Environmental Science standards:**   * ERT-4-F-Describe the characteristics of a watershed   **Linked NGSS standards:**   * NA   **Primary activities:**   * EXPLORE: “Color Me a Watershed” from Project WET * ELABORATE: Campus Watersheds Overview |
| **Learning Module #4** | **Topic:** Stream Habitat Assessments  **Overarching goals addressed:** 2, 3  **Lesson objectives:**   * SWBAT define: riffle, run, pool, thalweg, point bars, substrate, channel sinuosity, bank-cutting, riparian vegetation zone, buffer. * SWBAT describe advantages and disadvantages of using stream habitat assessments as method of assessing stream ecosystem health. * SWBAT conduct stream habitat assessment of a campus stream.   **Linked AP Environmental Science standards:**   * N/A   **Linked NGSS Standards:**   * N/A   **Primary activities:**   * EXPLORE: Stream Habitat Assessment Activity * ELABORATE: Habitat Assessment of Campus Streams |
| **Learning Module #5** | **Topic:** Chemical Monitoring, Part A  **Overarching goals addressed**: 1,2  **Lesson objectives:**   * SWBAT define: temperature, pH, dissolved oxygen, conductivity, water clarity. * SWBAT describe the effects of urbanization on stream temperature, pH, dissolved oxygen, conductivity, and clarity. * SWBAT describe relationship between temperature and dissolved oxygen. * SWBAT explain the importance of different types of chemical monitoring in maintaining stream ecosystem health. * SWBAT analyze chemical monitoring parameters in a campus stream over time.   **Linked AP Environmental Science standards:**   * STB-3-G-Describe the effects of thermal pollution on aquatic ecosystems * EIN-2-M-Describe the effects of urbanization on the environment.   **Linked NGSS standards:**   * NA   **Primary activities:**   * EXPLORE: How do chemical properties of water relate to stream health? * ELABORATE: Monitoring the chemical properties of our campus stream over time |
| **Learning Module #6** | **Topic:** Chemical Monitoring, Part B  **Overarching goals addressed**: 1,2,3  **Lesson objectives:**   * SWBAT define: eutrophication, nitrate, orthophosphate. * SWBAT explain effects of eutrophication on aquatic ecosystems. * SWBAT explain how nutrients enter ecosystems. * SWBAT conduct nutrient monitoring in a campus stream using Adopt-A-Stream protocols.   **Linked NGSS standards:**   * NA   **Linked AP Environmental Science standards:**   * STB-3-B-Describe the impacts of human activities on aquatic ecosystems   **Primary activities:**   * EXPLORE: Adopt-A-Stream protocols for chemical monitoring * ELABORATE: Chemical monitoring in our campus stream |
| **Learning Module #7** | **Topic:** Point Source and Nonpoint Source Pollution  **Overarching goals addressed**: 1,2  **Lesson Objectives:**   * SWBAT define: nutrients, point source pollution, and nonpoint source pollution. * SWBAT describe how excess nutrients enter stream ecosystems. * SWBAT differentiate between point and nonpoint sources of pollution.   **Linked NGSS standards:**   * NA   **Linked AP Environmental Science standards:**   * STB-3-A-Identify differences between point and nonpoint sources of pollution   **Primary activities:**   * EXPLORE: Stream Table Investigation * ELABORATE: The Pucker Effect Activity (Project WET) |
| **Learning Module #8** | **Topic:** Nutrient Monitoring  **Overarching goals addressed**: 1, 3  **Lesson objectives:**   * SWBAT define: eutrophication, nitrate, orthophosphate. * SWBAT explain effects of eutrophication on aquatic ecosystems. * SWBAT explain how nutrients enter ecosystems. * SWBAT conduct nutrient monitoring in a campus stream using Adopt-A-Stream protocols.   **Linked NGSS standards:**   * N/A   **Linked AP Environmental Science standards:**   * STB-3-F-Explain the environmental effects of excessive use of fertilizers and detergents on aquatic ecosystems   **Primary activities:**   * EXPLORE Protocols for Nutrient Monitoring (Hach Colorimeter) * ELABORATE: Nutrient Monitoring of Campus Stream |
| **Learning Module #9** | **Topic:** Data Accuracy  **Overarching goals addressed**: 2,4  **Lesson objectives:**   * SWBAT define Clean Water Act, TMDL, data accuracy. * SWBAT create a scatter plot. * SWBAT compare and contrast measurements from two procedures. * SWBAT describe qualifications necessary to pursue a career as an analytical lab technician. * SWBAT explain why collecting accurate water quality information is important to upholding standards of the Clean Water Act.   **Linked NGSS standards:**   * NA   **Linked AP Environmental Science standards:**   * NA   **Primary activities:**   * EXPLORE: Comparing procedures * ELABORATE: Field trip to Analytical Lab |
| **Learning Module #10** | **Topic:** Professional Development  **Overarching goals addressed**: 4  **Lesson objectives:**   * SWBAT reflect on own skill set and ambitions. * SWBAT describe careers related to freshwater ecology/STEM. * SWBAT explain how own career ambitions/interests may be able to relate to freshwater ecology/STEM.   **Linked NGSS standards:**   * NA   **Linked AP Environmental Science standards:**   * NA   **Primary activities:**   * EXPLORE: Career Panel * ELABORATE: Career Clusters Interest Survey |
| **Learning Module #11** | **Topic:** Drinking Water and Human Health  **Overarching goals addressed**: 1,2  **Lesson objectives:**   * SWBAT analyze primary source documents to identify the cause and effects of the Flint Water Crisis. * SWBAT describe the causes, symptoms, method of transmission, and water treatment for water borne illnesses. * SWBAT explain how drinking water is related to human health. * SWBAT create an action plan to address potential problems in local water quality.   **Linked NGSS standards:**   * NA   **Linked AP Environmental Science standards:**   * EIN-3-C-Identify sources of human health issues that are linked to pollution * EIN-3-D-Explain human pathogens and their cycling through the environment   **Primary activities:**   * EXPLORE: Investigating the Flint Water Crisis * ELABORATE: Disease-causing Microbes in Drinking Water |
| **Learning Module #12** | **Topic:** Bacterial Monitoring  **Overarching goals addressed**: 1,2,3  **Lesson objectives:**   * SWBAT define: coliform, fecal coliform*, E. coli.* * SWBAT describe how bacteria and *E. coli* enters stream ecosystems. * SWBAT conduct Adopt-A-Stream bacterial monitoring protocols.   **Linked NGSS standards:**   * NA   **Linked AP Environmental Science standards:**   * NA   **Primary activities:**   * EXPLORE: *E. coli* in the Chattahoochee * ELABORATE: Bacterial Monitoring Protocols |
| **Learning Module #13** | **Topic:** Stream Food Webs  **Overarching goals addressed**: 1,2  **Lesson objectives:**   * SWBAT define: algae, detritus, macroinvertebrates, macroconsumers. * SWBAT construct a stream food web. * SWBAT describe how energy flows through stream food web. * SWBAT explain how forest ecosystems are intricately connected with stream food webs. * SWBAT analyze how stream food webs would be affected by a change in one of its constituents.   **Linked NGSS standards:**   * NA   **Linked AP Environmental Science standards:**   * ENG-1-B-Explain how energy flows and matter cycles through trophic levels * ENG-1-D-Describe food chains and food webs, and their constituent members by trophic level.   **Primary activities:**   * EXPLORE: Stream Food Web Activity * ELABORATE: RiverWebs Documentary Viewing and Discussion |
| **Learning Module #14** | **Topic:** Basal Resources  **Overarching goals addressed**: 1,2,3  **Lesson objectives:**   * SWBAT define stream basal resources. * SWBAT describe protocols for quantifying basal resources in streams. * SWBAT explain importance of basal resources to stream ecosystem processing.   **Linked NGSS standards:**   * NA   **Linked AP Environmental Science standards:**   * NA   **Primary activities:**   * EXPLORE: Basal Resources in our Campus Stream * ELABORATE: Basal Resources and Water Health |
| **Learning Module #15** | **Topic:** Biodiversity  **Overarching goals addressed:** 1, 2  **Lesson objectives:**   * SWBAT define species richness and abundance. * SWBAT calculate species richness and abundance. * SWBAT describe the importance of biodiversity in freshwater ecosystems.   SWBAT explain threats to biodiversity in freshwater ecosystems.  **Linked NGSS standards:**   * HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.     **Linked AP Environmental Science standards:**   * ERT-2-A Explain levels of biodiversity and their importance to ecosystems. * EIN-4-C-Explain how human activities affect biodiversity and strategies to combat the problem.   **Primary activities:**   * EXPLORE: Bean Biodiversity * ELABORATE: Estimating Stream Biodiversity |
| **Learning Module #16** | **Topic:** Stream Bioassessments, Part A  **Overarching goals addressed**: 1,2,3  **Lesson objectives:**   * SWBAT define bioassessment. * SWBAT describe the use of bioassessments to assess stream ecosystem health. * SWBAT conduct macroinvertebrate bioassessment for hypothetical stream. * SWBAT calculate results of bacterial monitoring using Adopt-A-Stream methods.   **Linked NGSS standards:**   * HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.   **Linked AP Environmental Science standards:**   * NA   **Primary Activities:**   * EXPLORE: All about Macroinvertebrates * ELABORATE: Practice Macroinvertebrate Bioassessment |
| **Learning Module #17** | **Topic:** Stream Bioassessments, Part B  **Overarching goals addressed**: 3  **Lesson objectives:**   * SWBAT explain why standardization of macroinvertebrate collection protocols is important for bioassessment data quality. * SWBAT conduct macroinvertebrate collection and bioassessment in a campus stream using Adopt-a-Stream protocols.   **Linked NGSS standards:**   * NA   **Linked AP Environmental Science standards:**   * NA   **Primary activities:**   * EXPLORE: Macroinvertebrate Collection Methods * ELABORATE: Campus Stream Macroinvertebrate Collection and ID |
| **Learning Module #18** | **Topic:** Stream Bioassessments, Part C  **Overarching goals addressed**: 1,3  **Lesson objectives:**   * SWBAT conduct macroinvertebrate bioassessment of a non-urban stream using Adopt-a-Stream protocols. * SWBAT compare and contrast bioassessments in urban vs. non-urban streams.   SWBAT identify a stream macroinvertebrate to the family level.  **Linked NGSS standards:**   * NA   **Linked AP Environmental Science standards:**   * NA   **Primary activities:**   * EXPLORE: Non-urban Stream Bioassessment * ELABORATE: Macroinvertebrate Family-Level IDs |
| **Learning Module #19** | **Topic:** Water Pollution Prevention  **Overarching goals addressed**: 1  **Lesson objectives:**   * SWBAT describe methods for mitigating problems related to urban runoff and polluted streams. * SWBAT create a stream pollution prevention plan to minimize problems related to urban runoff and improve stream water quality.   **Linked NGSS standards:**   * HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.   **Linked AP Environmental Science standards:**   * STB-1-B-Describe methods for mitigating problems related to urban runoff   **Primary activities:**   * EXPLORE: Water Blues, Green Solutions * ELABORATE: Stream Pollution Prevention Plan |
| **Learning Module #20** | **Topic:** Program Conclusion  **Suggested activities:**   * Information session on the post-training internship * Post-training program survey/questionnaire * Class conversation about expectations vs. outcomes of the training program * Training program celebration/pizza party * Watch a student selected Freshwaters Illustrated video |