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|  *Watershed Assessment of 3 Tributaries in the Petaluma River Watershed*  |
| **Teachers: Todd Adams, Sten Mander, Katie Tobin** | **Duration: Year-long** |
| **Subject/Course: Physical Science** | **School: Casa Grande High School** | **Grade Level: 9th** |
| **Collaborating Organizations: Friends of the Petaluma River** |
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| **Standards Met**(NGSS, CCSS, or otherwise) Please include full text of standards.  | HS-ESS 2-2: Analyze geoscience data to make the claim that one change to Earth’s surface can create feedbacks that cause changes to other Earth systems. HS-ESS 2-5: Plan and conduct an investigation of the properties of water and its effects of Earth’s materials and surface properties. HS-ESS 3-3: Create a computational simulation to illustrate the relationship among the management of natural resources, the sustainability of human populations, and biodiversity.  |
| **Project Summary**(include student role, issue, problem or challenge, action taken, and purpose/beneficiary) | This will mostly be a continuation of the watershed research conducted by our AP Environmental class for the past 3 years, but we are going to implement these lessons into our 9th grade Physical Science classes. The watershed curriculum will have two main parts. First, we will conduct an assessment of the overall health of 3 streams in the Petaluma River watershed. This will be accomplished by collecting water quality data (turbidity, specific conductivity, nutrients, and temperature) during and between rainstorms, collecting and analyzing benthic macroinvertebrates (BMIs), and using Google Earth to measure riparian widths. The second part of this lesson students will use stream tables to measure the effects of vegetative cover on erosion and how stream processes affect the distribution of sediment types in the stream channel. We will then compare our results from the stream table models to what we find in our 3 local streams.  |
| **Essential Question**Question students will explore throughout the course of the unit. | How do land use practices affect water quality and biodiversity in 3 local streams? |
| **Key Learning Objectives and Assessments**Concrete objectives for student skill building and comprehension and how these will be measured. | Learning Objective | Assessment |
| The amount and quality of vegetative cover within a watershed and within a riparian corridor influences the amount of sediment and nutrients entering streams as well as aquatic biodiversity. | Report produced and presented which compares riparian width to the amount of sediment and nutrients entering streams and aquatic biodiversity. |
| Vegetation has the ability to reduce the amount of sediment that enters streams.  | Lab report produced from stream table lab comparing vegetative cover to turbidity in the runoff.  |
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| **Orientation** | In-Class Visit | X | Field Trip to River Heritage Center |  | Other |  | If other, describe in timeline how you will meet entry activity requirements |
| **Making Products Public**Include how student work will be shared with community members and/or organizations, who students will engage with during/at end of project, and which product(s) will be presented at the Watershed Classroom Student Showcase. | A report and presentation will be created and shared with the Friends to summarize our findings and students will present their findings at the 4th Annual Watershed Symposium.  |
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| PROJECT TIMELINE |
| Please list all activities which are part of the unit in the order they will be implemented. Timeline must include pre and post-assessments, other in-class assessments, an entry activity, at least three outdoor fieldwork activities, a plan for participation in the student showcase, and any other supporting activities and classwork. |
| **Activity** | **Type of Activity**(Field Work, In-Class, Presentation, Assessment) | **Description**  | **Resources Needed** | **Exact or** **Approximate Dates** |
| *Name the activity* | ***Field Work:*** *Any hands-on outdoor lesson or field trips****In-Class:*** *Any in-class activity or project* ***Presentation:*** *Any activity during which students share their work with each other or an outside audience****Assessment:*** *Any written or oral exams given to assess student understanding and knowledge*  | *A thorough outline of the activity.*  | *All reading materials, activity materials and equipment, transportation, third party help, or other resources needed to make the activity possible.*  | *Please be as specific as possible so that we best know when to reach out with resources and tools to aid in implementation. Exact dates will be emitted from publicly shared version to protect student privacy.* |
| Orientation  | In-Class and Assessment | Give Pre-assessment and introduce the project to the students. | Copies of pre-assessment | Early September |
| Collecting and Analyzing Water Quality Data | In-Class | We will collect water quality samples (at least 3) per storm event. Students will measure turbidity, nutrients, specific conductivity, and pH in the classroom. Temperature will be measured in the field.  | Water quality test kits.  | October-January |
| Stream Table Lab: Erosion | In-Class | In the spring we will set up 3 stream tables. One completely vegetated, one with only the riparian corridor vegetated, and one with no vegetation. Students will spray with water and compare the turbidity in the runoff for each.  | 3 stream tablesSoilWheat grass seeds | March |
| Stream Table Lab: Sediment and stream power | In-class and field trip | Students will use stream tables to observe fluvial processes such as down-cutting, bank erosion, braiding and deposition. Students will document how stream velocity determines sediment size and distribution in streams. Students will participate in a field trip to Adobe creek to perform a transect across a meandering channel to compare sediment distribution in real life to the stream table model.  | 6 stream tablesSand, silt, clay, gravel. | March |
| Benthic Macroinvertebrate (BMI) Analysis | Field Trip and In-Class | Taking 13 ninth grade classes out to collect BMIs will not be feasible, so we will take 3 small groups of students out to collect BMIs after school or on the weekend. BMIs will be sorted and identified in the classroom. Students will use these samples to analyze the following for the 3 creeks in our study area: species richness, diversity, and weighted average tolerance.  | Jars and vialsRubbing AlcoholBMI Identification GuidesTweezersStereomicroscopes | April |
| Riparian Width Analysis | In-Class | Students will use Google Earth to quantify the average riparian width for each of the 3 streams.  | Desktop Computers | April |
| Report Writing | In Class | Student teams will prepare a report which includes the following: 1. Maps of the 3 sub-watersheds.
2. Methods and results from the stream table erosion lab.
3. Graphs that compare the water quality conditions (turbidity, nutrients, temperature, and specific conductivity) in each tributary during storm events.
4. Graphs that compare riparian width to water quality and biodiversity.
 | Desktop computers with Google Docs and Sheets. | April-May |
| Assessment | In Class  | Give FOPR Post Assessment | Post Assessment | May |

Please add more rows if needed. (Right click in last box, “Insert Row Below”)

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| **Other Notes:** |