

ROCK OUT! LESSONS IN STREAM ECOSYSTEM ENGINEERING THROUGH THE ROCK PACK EXPERIMENT

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The Rock Pack experiment combines STEM topics of engineering, ecology, geomorphology, and mathematics in stream ecosystems through the world of the net-spinning caddisfly. Interactive and hands-on activities can be used indoors or outdoors in a 7th-12th grade lesson plan to get students excited about insects and rocks in streams and to learn interdisciplinary science skills and real-world science research applications.

PROJECT BACKGROUND



Through a Division of Environmental Biology Ecosystem Studies grant funded by the National Science Foundation titled '**Sediment stabilization by animals in stream ecosystems: consequences for erosion, ecosystem processes, and biodiversity**,' scientists and educators from Montana State University and Stroud Water Research Center are interested in how the net-spinning Caddisfly (Hydropsychidae family) play a role in stream erosion regimes.

WHY DOES IT MATTER?

- ✓ Predicting erosion is important in landscapes experiencing stress!
- ✓ Hydropsychid caddisfly larvae that build silk webs can bind together gravels on the riverbed and stabilize the bed during floods.
- ✓ Organisms play a vital role in our healthy ecosystems, and biodiversity loss and shifts in ecological community composition are critical problems facing our streams.

STEM CAREER HIGHLIGHT: Dr. Lindsey Albertson (above right) is an assistant professor in the Department of Ecology at Montana State University and one of the lead PIs for this project along with Associate Research Scientist Dr. Melinda Daniels (above left), a fluvial geomorphologist at Stroud Water Research Center.

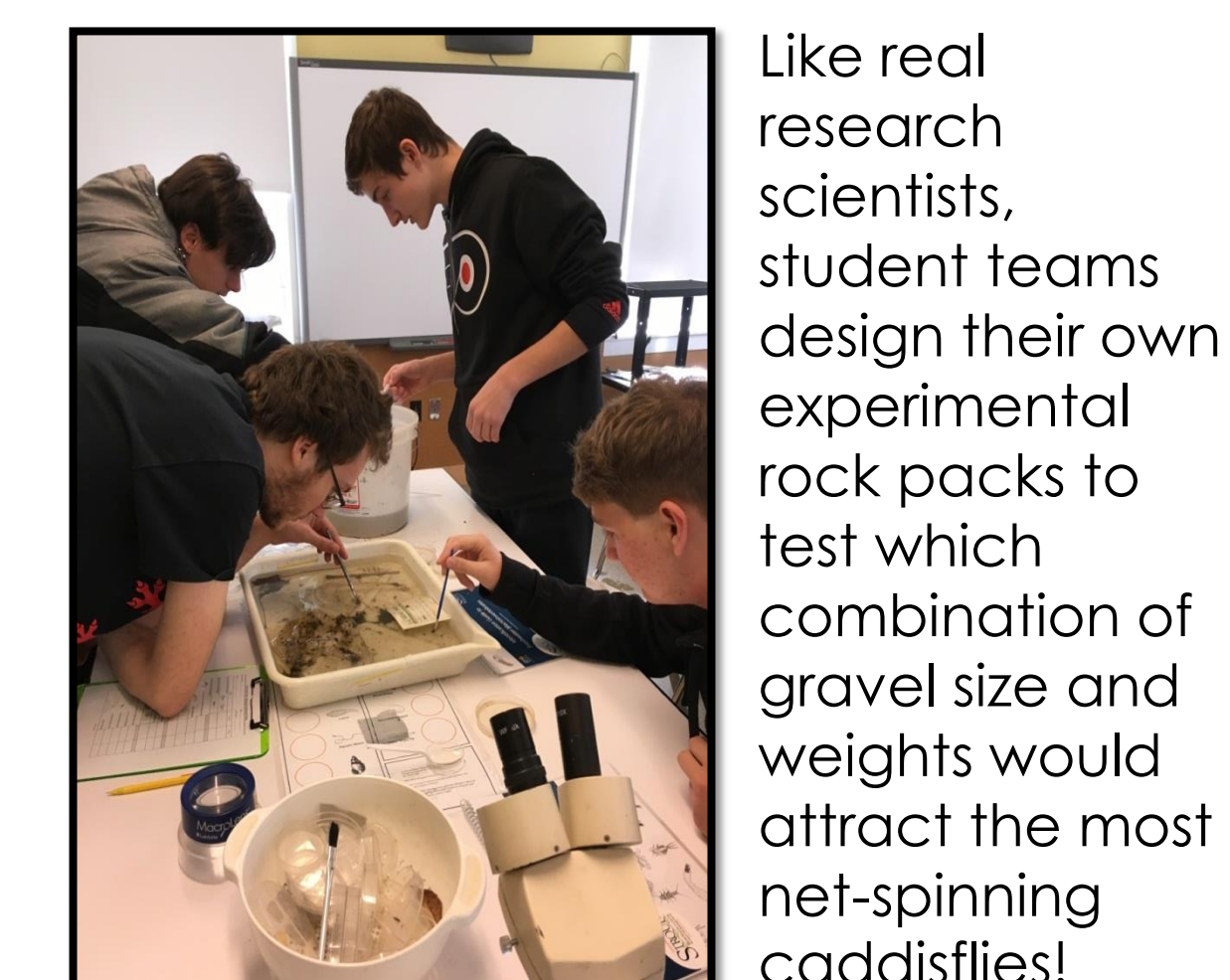
TEACHER TRAINING DAYS (MONTANA)

In 2017 and 2018, Two 1-day Teacher workshops were held at Montana State University! Attendees learned hands-on from Dr. Albertson, Ms. Muenz, and other biologists about hydropsychid caddisflies, rock pack methods, and core content on ecosystem engineers and geomorphology, to then take back to their students!



ROCK PACK UNIT EXAMPLE: UNIONVILLE H.S. (PENNSYLVANIA)

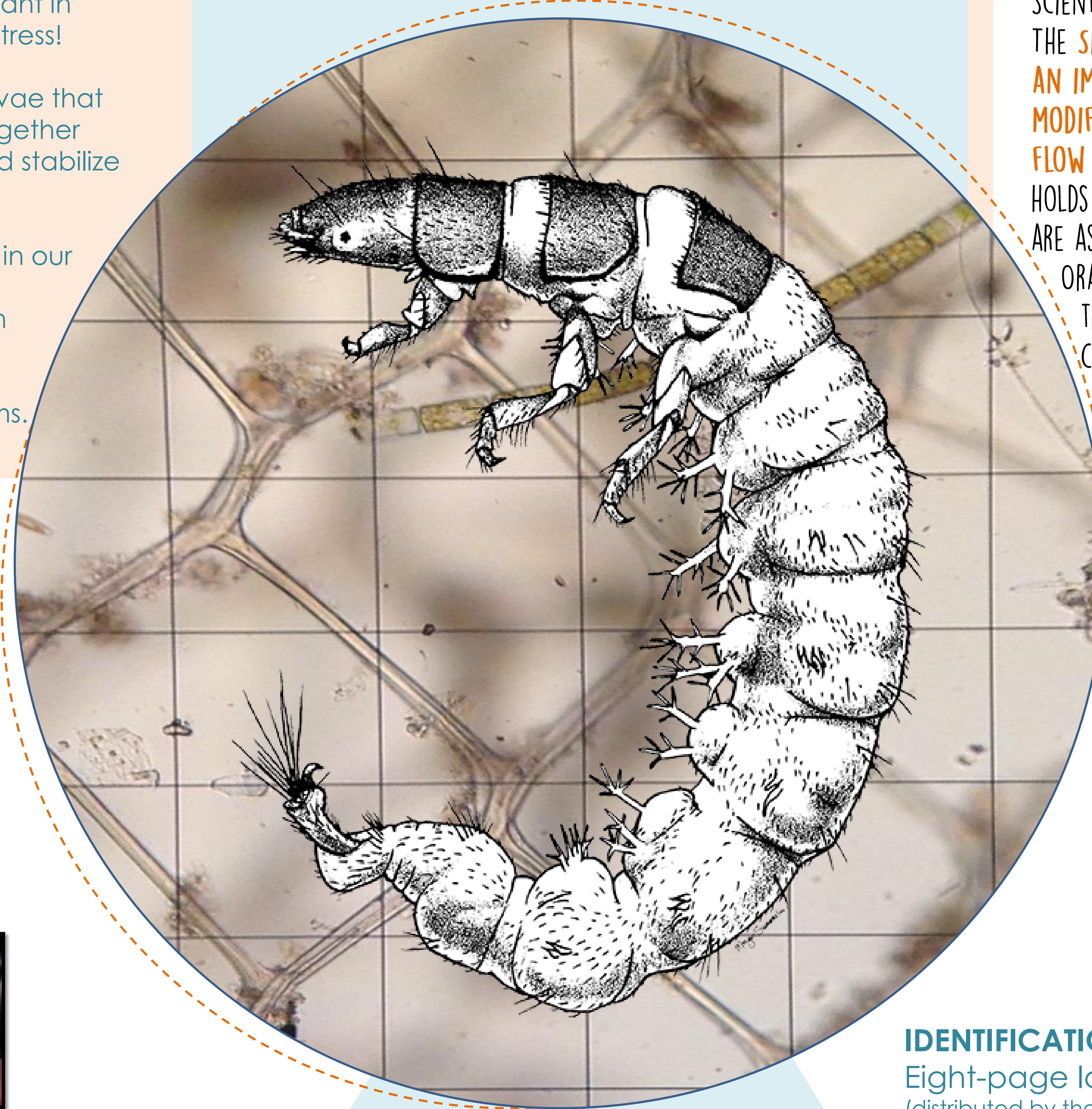
For two years now, environmental science and global ecology students from Unionville High School have been testing their predictions of what make the perfect hydropsychid pack! Through a seven-day fall unit, which includes one day at the Stroud Center retrieving and processing packs to then analyze data, students also learn from Dr. Albertson's videos, and perform stream water chemistries.



Like real research scientists, student teams design their own experimental rock packs to test which combination of gravel size and weights would attract the most net-spinning caddisflies!



'ROCK PACKS' ARE SIMPLY REPLICATING AVAILABLE HABITAT THAT YOU FIND WITHIN A STREAM RIFFLE AREA. FILLING ONION BAGS FULL OF GRAVELS (SIZES 10-60MM) WITH WEIGHTS BETWEEN 1000-3000 GRAMS, PROVIDES JUST THE RIGHT HABITAT FOR MAKING A CADDISFLY RETREAT! PACKS ARE LEFT IN THE STREAM FOR 3-4 WEEKS, SORTING AND ID OCCUR EITHER BACK IN THE CLASSROOM OR STREAMSIDE!



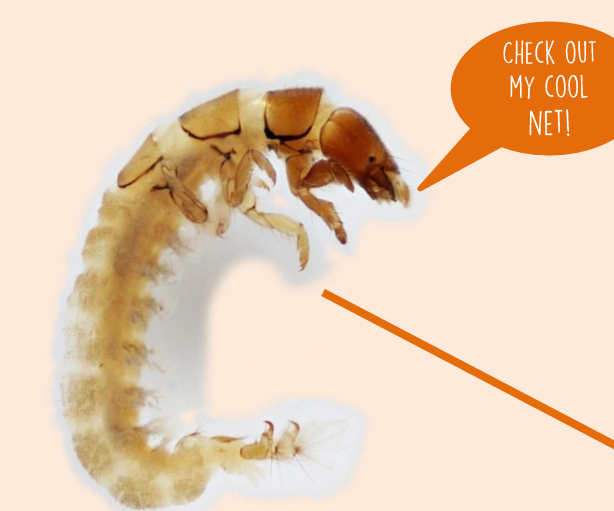
CADDISFLIES, ENGINEERING AN ECOSYSTEM



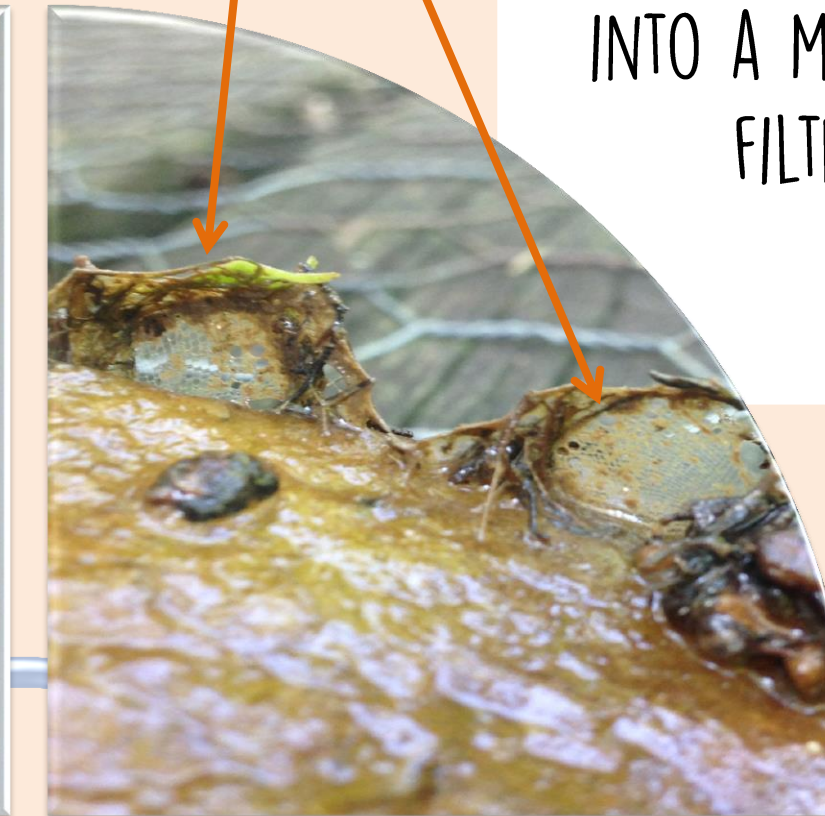
IMAGINE LIVING IN A WORLD WHERE FOOD WAS FLOATING ALL AROUND YOU, BUT YOU HAD NO WAY TO GRAB IT? TO CATCH ALL OF THIS YUMMY NUTRITION, THE NET-SPINNING CADDISFLIES HAVE DEVELOPED A CLEVER WAY TO TRAP AND EAT THAT FOOD.



CADDISFLIES OF THE FAMILY **HYDROPSYCHIDAE** ARE A GROUP OF GLOBALLY DISTRIBUTED AQUATIC INSECTS THAT PRODUCE SILK THREADS (NOT QUITE AS STRONG AS SPIDERS) THAT THEY WEAVE INTO A MESH NET TO CATCH AND FILTER FOOD PARTICLES THAT FLOAT DOWNSTREAM.



SCIENTISTS HAVE FOUND THE **SILK THREADS** ALSO PLAY AN IMPORTANT ROLE IN **MODIFYING EROSION AND WATER FLOW** IN THE STREAM. THE SILK HOLDS TOGETHER GRAVELS THAT ARE AS BIG AS THE SIZE OF AN ORANGE! BY HOLDING THOSE ROCKS TOGETHER, THEY CAN REDUCE EROSION DURING FLOODS.



USING PAINSTAKING **DETAIL AND PRECISION**, EACH THREAD IS PLACED INTO JUST THE RIGHT SPOT TO CREATE MESH WEBBING THAT WILL FILL UP WITH FOOD. WHEN THEY AREN'T HARVESTING FOOD FROM THEIR SILK NET, THEY HUNKER DOWN IN THEIR **RETREAT**, WHICH MAY ALSO PROVIDE FOOD OR SHELTER FOR OTHER MACROINVERTEBRATES.

FUN FACT: NET-SPINNING CADDISFLIES CAN VARY THE STRENGTH OF THE SILK, THE NUMBER OF SILK THREADS IN THEIR NET, AND SIZE OF THE SILK STRUCTURE!

GET STARTED WITH ROCK PACK!

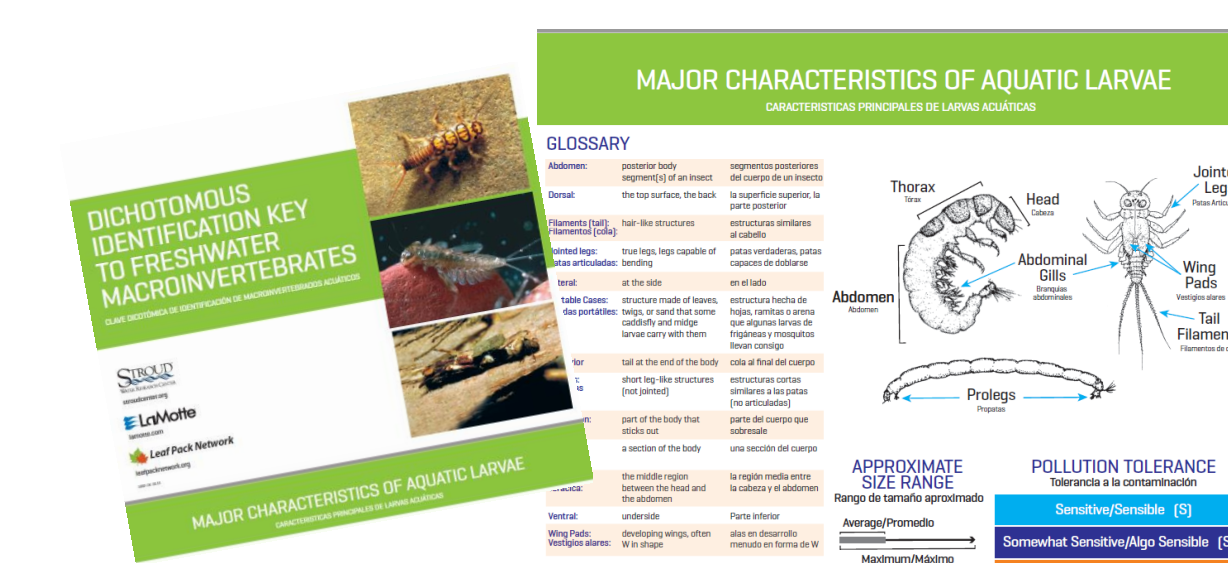
TO MAKE PACKS! (see manual for details)

- Onion bags (3-4/riffle)
- Calipers
- Hanging scale
- Sieves of different sizes or Wentworth grid
- Gravel sizes 10mm-60mm
- Data sheets
- Other supplies as needed

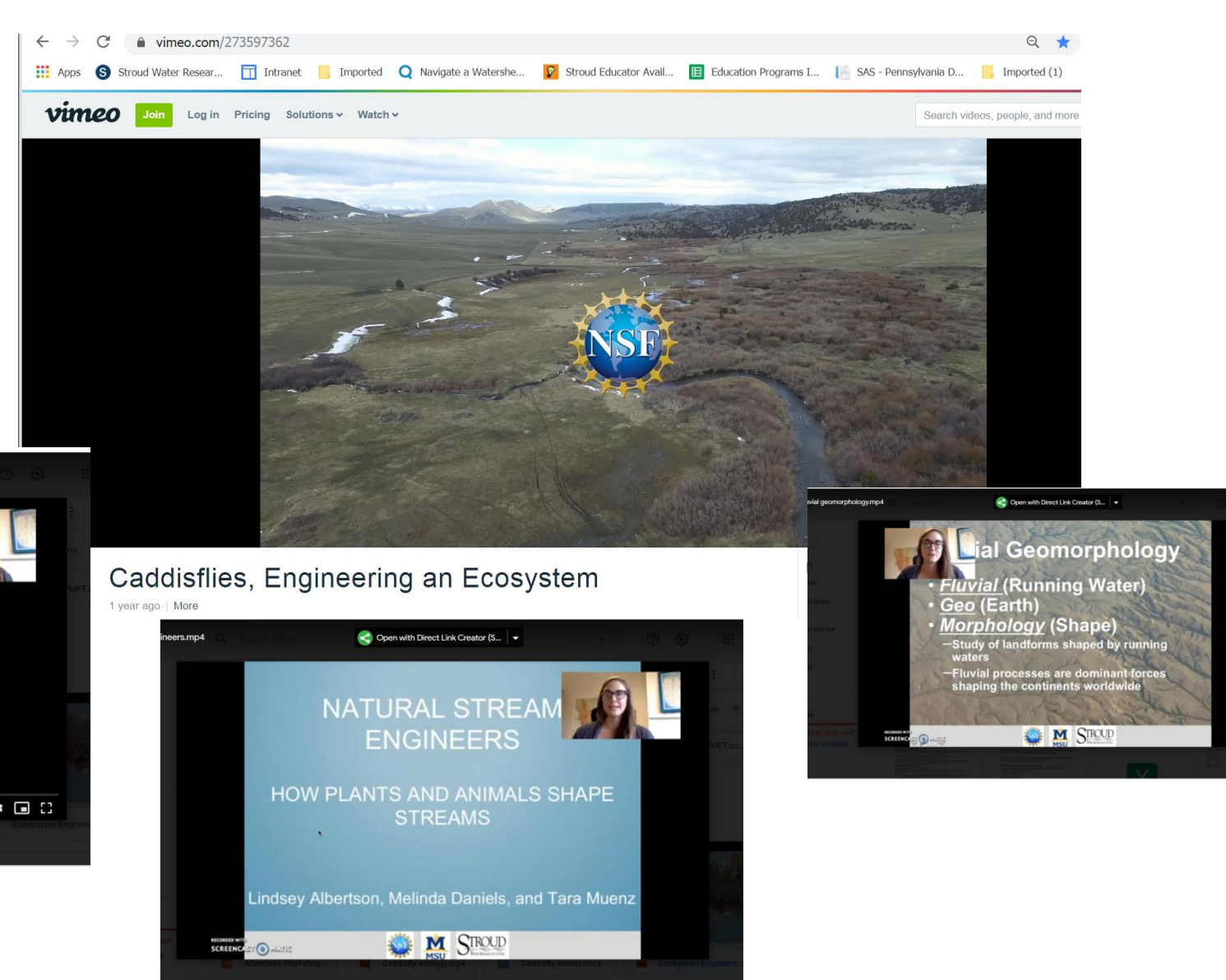


IDENTIFICATION KEY!

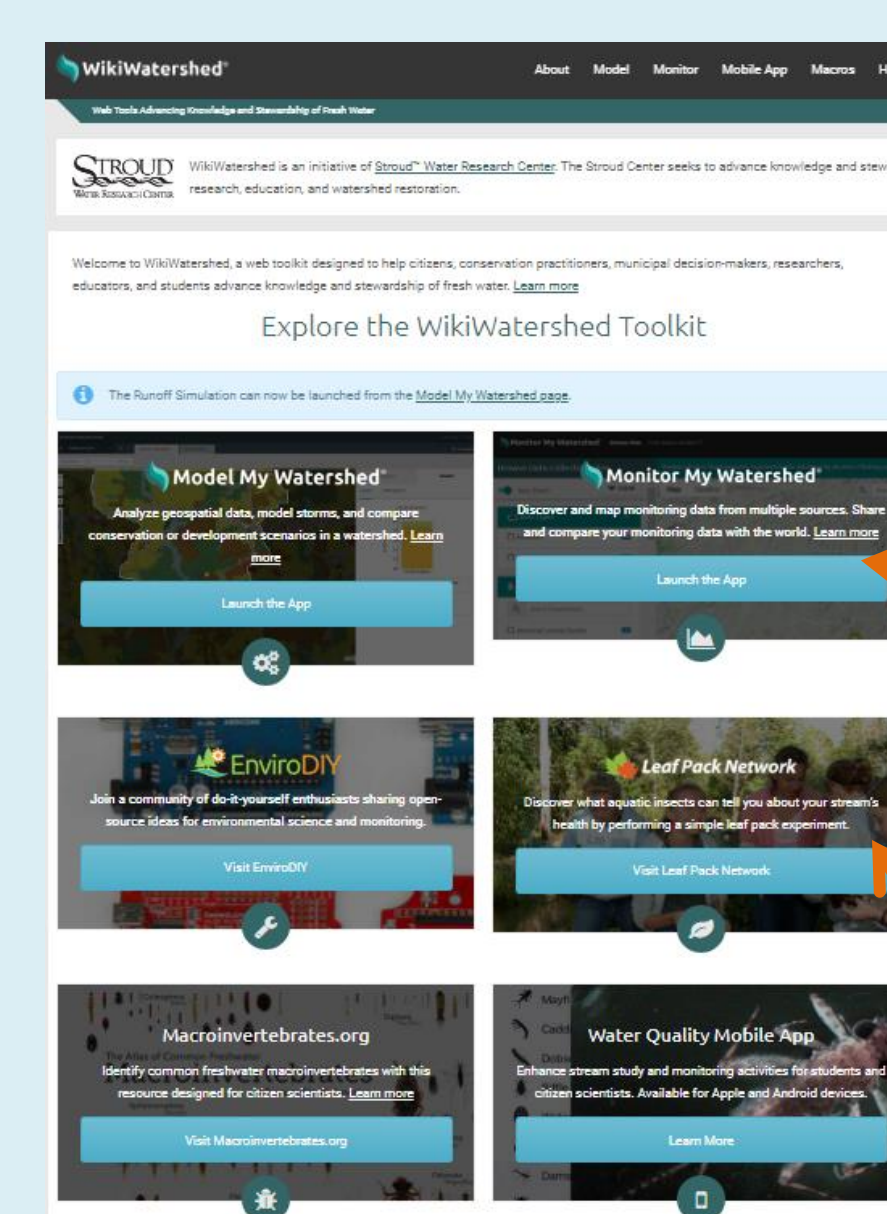
Eight-page laminated dichotomous key (distributed by the LaMotte Company).



VIDEOS! Learn about ecosystem engineers, geomorphology, rock pack methods and more from MSU and the Stroud Center!



WikiWatershed® is a web toolkit to support citizens, conservation practitioners, municipal decision-makers, researchers, educators, and students to collaboratively advance knowledge and stewardship of fresh water.



Rock Pack data can be entered into **Monitor My Watershed**.

Data sheets, instructions, and lesson plans can be accessed on the **Leaf Pack Network** website.



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