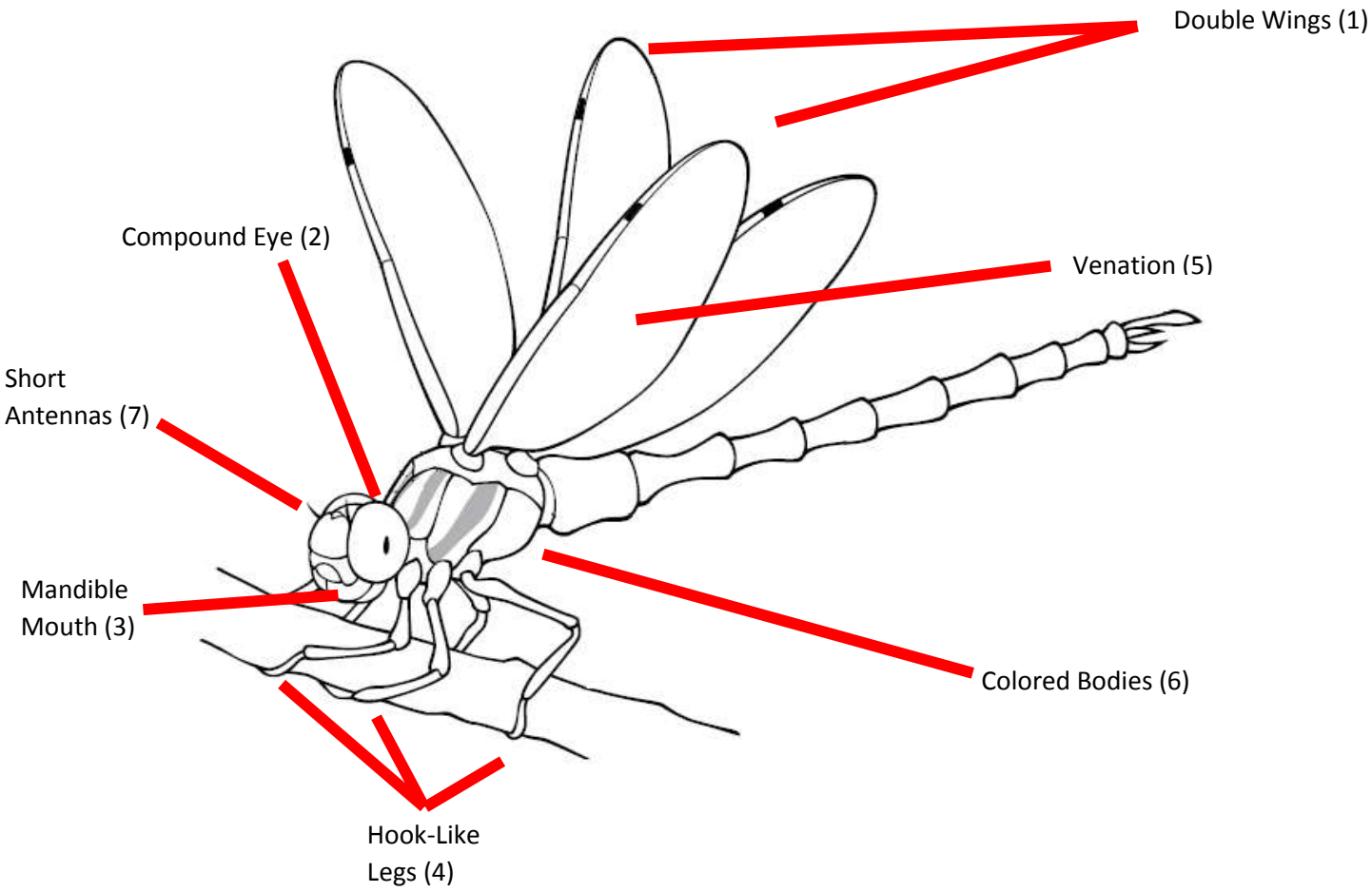
Supplement A: Dragonfly Adaptations

1. Double Wings
    a. With two sets of wings, the dragonfly does not have to beat its wings as rapidly as other insects, enabling it to conserve energy.
    b. The two sets of wings beat out of synchronization, helping the dragonfly maneuver and accelerate.
    c. They can fly straight up and down, hover like a helicopter and even mate mid-air
2. Compound Eye
    a. Dragonfly eyes are made up of 30,000 separate lenses and make up most of their head. Therefore the dragonflies can see almost every direction at once, enabling them to catch 90-95% of their prey, and communicate with other dragonflies.
3. Antennas
    a. For some insects, antennas are very long and used to find food or communicate with other insects. Dragonflies however have short antennas because they have such good eye site and long antennas would reduce their speed in flight.
4. Hook-like legs
    a. The six legs of a dragonfly can be used to reach out a grasp prey. Some dragonflies even have small hairs on their legs making a stronger grip.
    b. The legs create a cage around their prey, preventing escape
5. Mandible Mouth
    a. A dragonfly has serrated teeth that can mash prey very quickly and efficiently
    b. When a dragonfly catches something, hinged jaws can open as wide as their entire head, and close down with enough force to tear apart their prey.
    c. As nymphs, these powerful jaws help dragonflies eat mosquito larvae, tadpoles, and even small fish
6. Gills (in nymph stage)
    a. Dragonflies lay their eggs in freshwater, and spend most of their life as a nymph. In order to survive in the water, nymph dragonflies have a set of gills on either side of their abdomen
7. Venation
    a. Lines on the wings of a dragon fly separate the wings into many different triangle spaces which helps keep dragonflies aerial and balanced.
8. Body Color
    a. Dragonflies come in many colors. Some male dragonflies have a brighter color in order to attract a mate. Other dragonflies will change color, becoming darker to trap heat when it is cool out, or lighter when it is hot out.

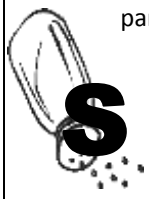
Supplement B: Dragonfly Puzzle/Journal Page

Dragonfly Adaptation Diagram

Answer key to the dragonfly puzzle with numbers from the students' journal page in parenthesis



Supplement C: Components of a Healthy Dragonfly Habitat

Measurement	Healthy Levels for Dragonflies	Human Impacts
Water Temperature 	65-95˚F Dragonflies are ectotherms—meaning they have to regulate temperature using outside sources like the sun or shade (unlike warm-blooded animals like humans). More stable, warm temperatures between 65-95 degrees are best for healthy populations.	Water temperature naturally fluctuates with changes in season. Human development can also impact temperature because stormwater runoff from surfaces like roads and parking lots enters streams and rivers at a higher temperature to create a warming effect.
Salinity A measure of how much salt is in the water, measured in parts per thousand (PPT). 	Close to 0 ppt Dragonflies lay their eggs in freshwater and spend the nymph (larval) beginning stage of their life in water so they depend on low or no salinity to survive and reproduce.	Indian Creek is a fresh body of water but at its mouth, it mixes with the brackish (partly salty) Severn River. Salinity can fluctuate with changes in season, tide, rainfall, and runoff. Humans can impact salinity by salting roads, which gets carried into the water as runoff.
Turbidity A measure of how cloudy or murky the water is (measured in Turbidity Units, or NTUs). Turbid water is high in suspended sediment. 	≤ 12 NTUs If the water is too turbid (not clear) sunlight is unable to reach phytoplankton (plants), an important food source for young (nymph) dragonflies in the water.	Turbid water is high in suspended sediment like soil eroded from land, and increases after a storm or rain event carries stormwater runoff into the water. Turbidity can also increase with excess bacteria or algae in the water.
Dissolved Oxygen A measure of the available oxygen in the water, measured in parts per million (PPM). 	4-8 ppm Young dragonflies have gills in order to breathe during their nymphal stage underwater. Without enough available dissolved oxygen, the nymphs will not be able to reach maturity and become adult dragonflies.	Just like on land, aquatic plants like underwater grasses photosynthesize and produce oxygen in the water. Dissolved oxygen can decrease when plants are blocked from the sun because of high turbidity or algae blooms (from excess nutrients in the water) and cannot photosynthesize. Temperature also affects dissolved oxygen because cold water holds more oxygen, so dissolved oxygen fluctuates depending on the season.

Supplement D: Water Quality Monitoring Procedures

Dissolved Oxygen Tablets (dissolved oxygen):

Fill the small glass vial with water from Indian Creek. Place two dissolved oxygen tablets into the vial and firmly twist on the cap. Turn the vial end over end for about five minutes or until the tablets dissolve completely. Refer to the dissolved oxygen key to match the color of the water to the dissolved oxygen content in Parts Per Million (PPM).

Water thermometer (Water temperature):

Allow the water thermometer to fill with water so it sinks into the creek and only the top floats at surface level. Hold the line so you don't lose the thermometer. Allow 3 to 5 minutes to get an accurate temperature reading. Read the temperature in degrees Fahrenheit.

Hydrometer (Salinity):

Remove white cap and press the power button. Wait until the screen says 0.00, then place the tip in the water and gently move back and forth until the meter reading stabilizes. This may take a moment. Record the number. The reading is in Parts Per Thousand (PPT).

Turbidity tube (Turbidity):

Collect a sample of water in the provided bucket, being careful not to scrape up excess sediment from the bottom. Hold the turbidity tube upright in the empty bucket under the awning and fill it using the large funnel. Stand so you can stare straight down into the tube. Have someone else slowly release water (by gently pushing down on the tube) at the bottom of the tube. Continue releasing water until the black and white disc (called a Secchi disk) at the bottom of the tube **just** becomes visible (looking straight down, not from the side); and stop releasing water. Measure the water level using the markings on the side of the tube and refer to the turbidity key to determine turbidity.

Supplement E: Survey 123 and Online Water Quality Reporting Procedure

Your water quality data will be recorded and graphed on the Arlington Echo website (arlingtonecho.org) so we can track the health of our nearby waters. Thank you for your help in this project!

Please follow the water quality testing instructions (Supplement D) as closely as possible to ensure consistency of data and follow the below procedures to record the data online:

1. Turn on the iPad by holding down the button on the top right corner of the iPad.
2. Sign into the iPad using the 4 digit code: **3822**
3. Select the green icon for the app **"Survey 123"**
4. On the "My Surveys" screen select the water drop icon for the survey called **"Water Quality Monitoring"**
5. Select the blue symbol that says **"Collect"** and the survey should begin loading
6. Fill in the school name, date, and time and select **"marsh"** for observation station
7. Choose the temperature, dissolved oxygen, and salinity range that your data best falls into.
8. Choose the turbidity you found in **NTUs** *note: this is <u>not</u> visible depth in centimeters, but can be found in the "Turbidity Units" column on the Turbidity Scale. The NTUs correlate to the visible depth in centimeters column on the left of the Turbidity Scale.
9. Check over your responses to ensure accuracy and then click the **green arrow** in the bottom right corner to submit your data.
10. After selecting the green arrow, select "**Send Now".**
11. Once you return to the Survey home screen, keep it up so you can easily access it with your next groups. Please put the iPad to sleep during long breaks for debriefs, snacks, or meals.

At the end of the day <u>please</u> return the iPad to an Arlington Echo 4th grade staff member. During lessons, let a staff member know if the iPad loses charge, stops working, or is damaged. In the morning of the second day of overnight field trips, ask a staff member to retrieve the iPad for you.

Thank you again for your help on this project!

Supplement F: Design-A-Dragon Journal Page

Design-a-Dragon

Use the space below to draw a dragonfly with adaptations to survive a habitat that has been altered. Be as creative in your design!

What adaptations did you add, and why?

_____

_____

_____