

Aquatic Insect Guide



Flathead Lake Biological Station



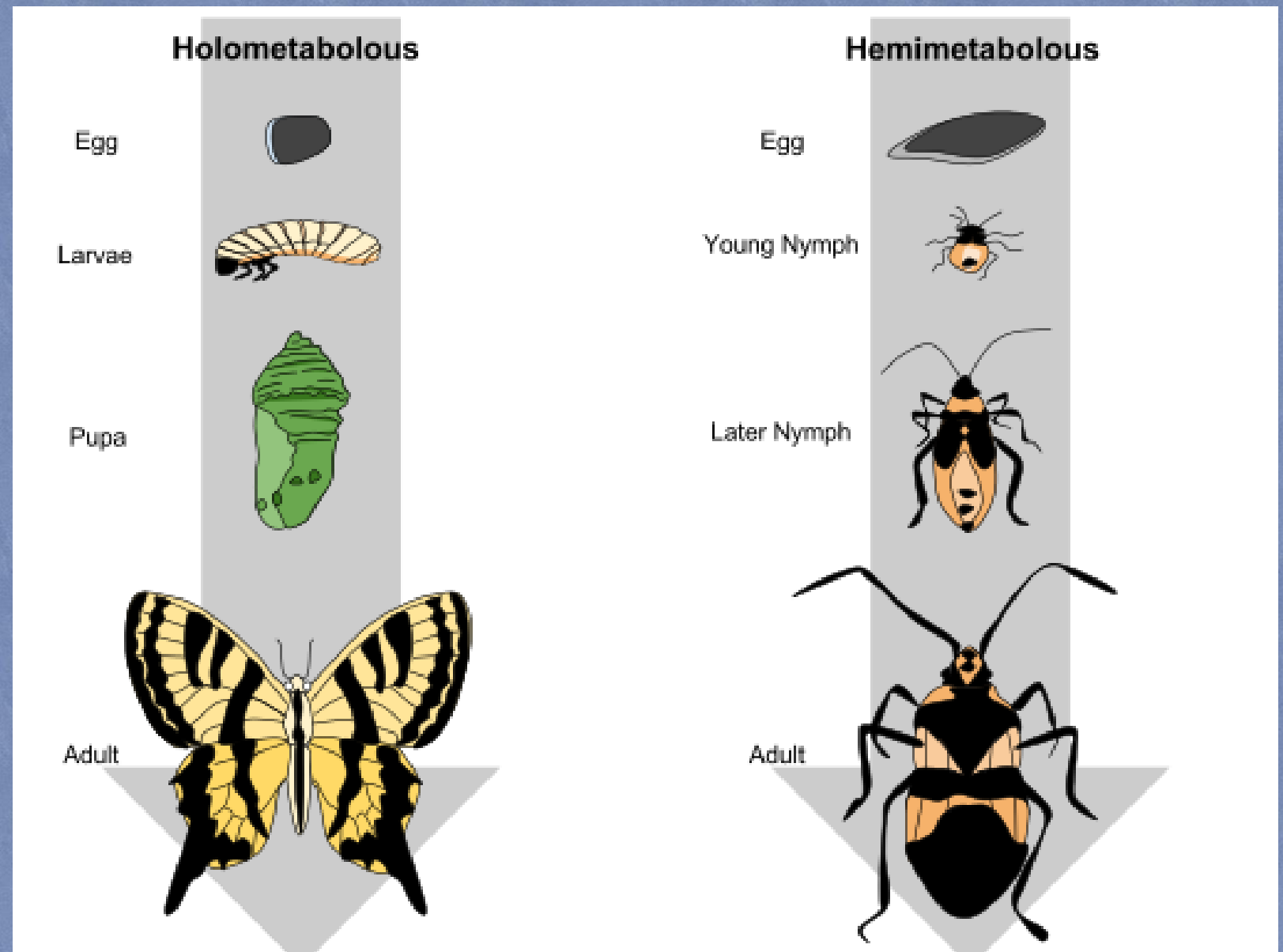
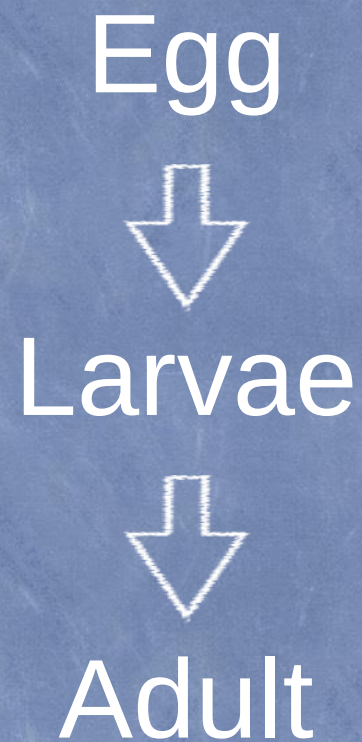
What do
all of
these
insects
have in
common?





Common Insect Traits

They go through metamorphosis



Complete
metamorphosis
(4 distinct phases)

Incomplete
metamorphosis
(larval nymphs look
similar to the adult)



Common Insect Traits



Cold blooded



Open circulatory system



Exoskeleton



3 body regions
- Head
- Thorax
- Abdomen



Pair of antennae on their head

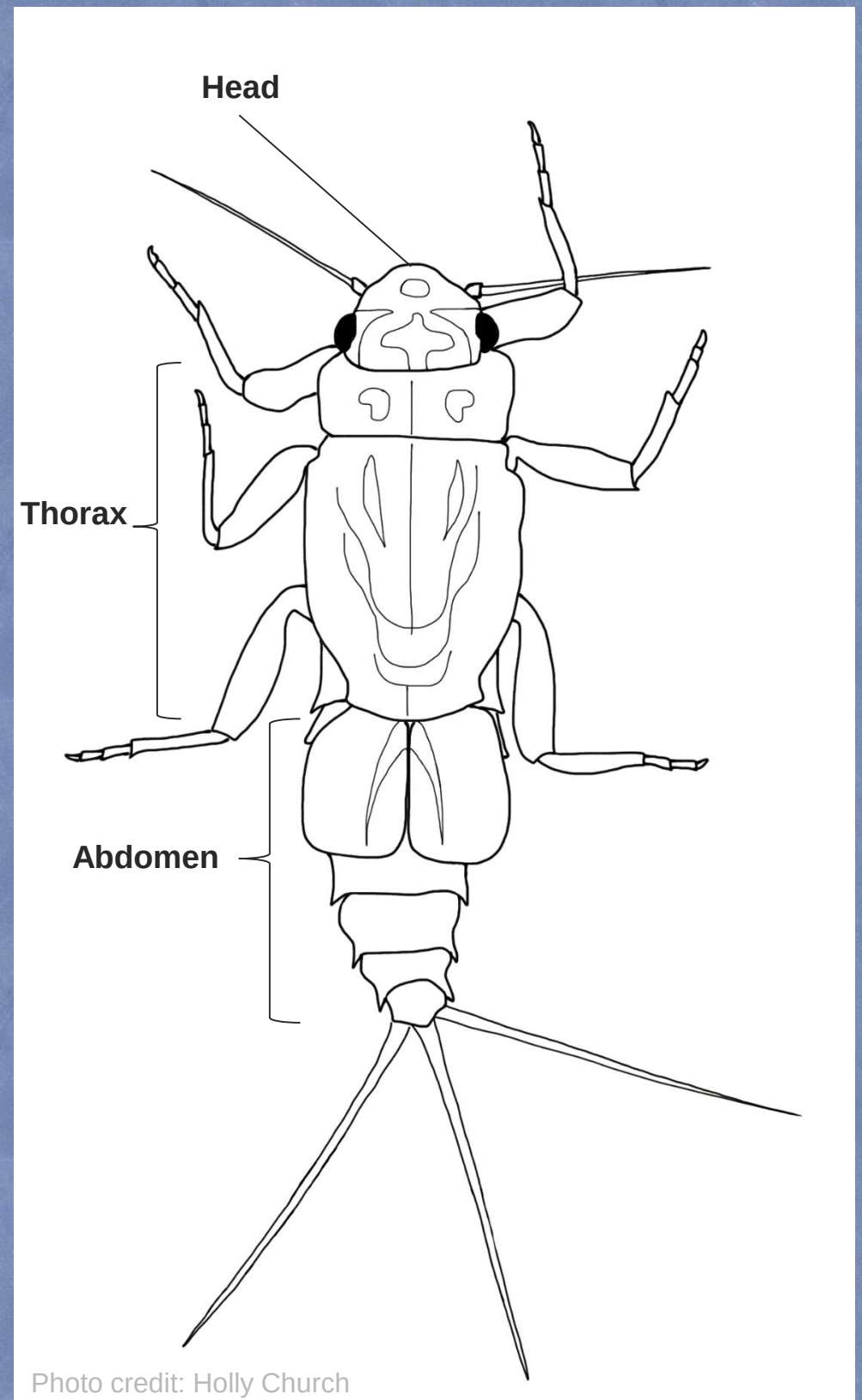


Photo credit: Holly Church



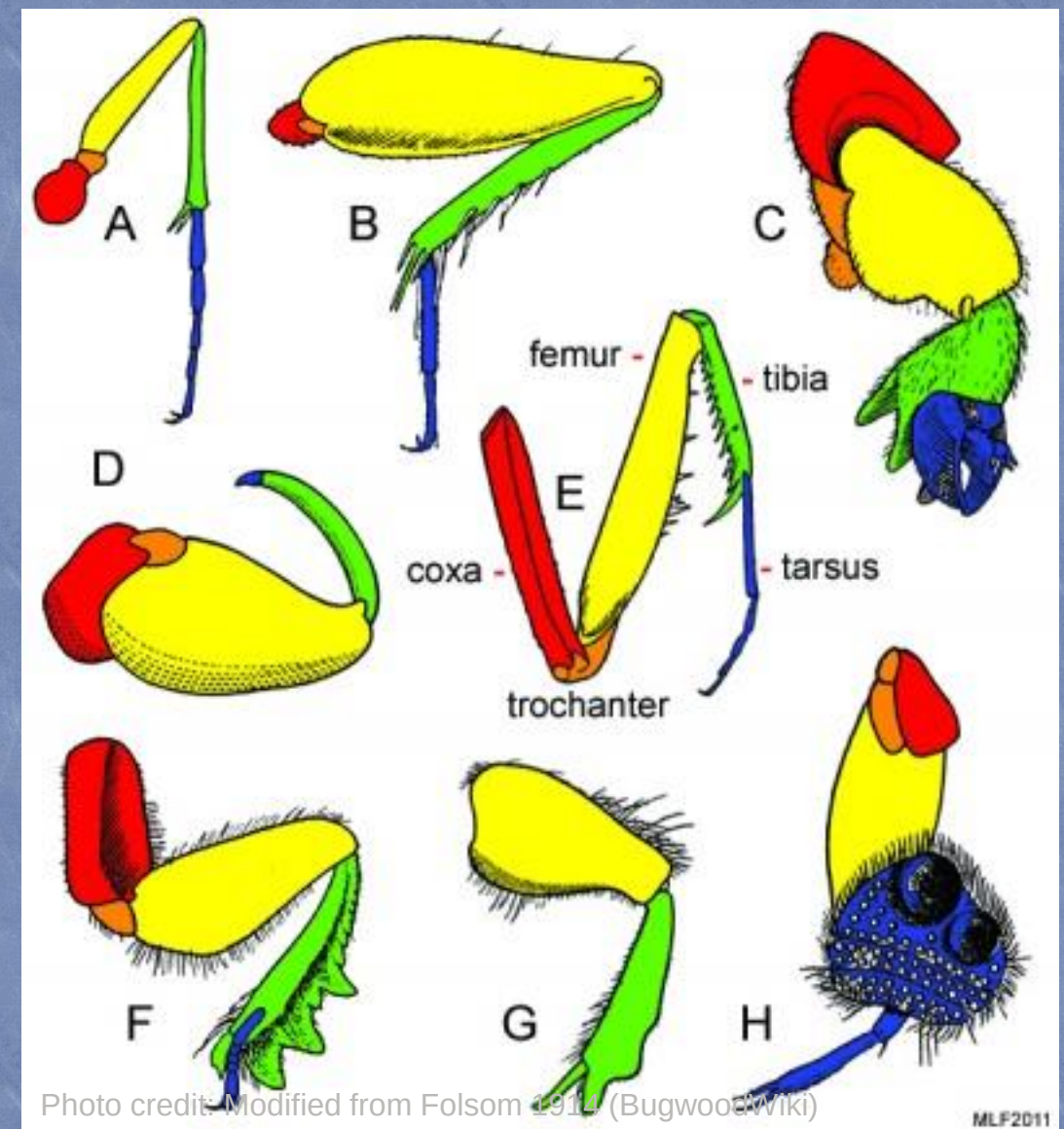
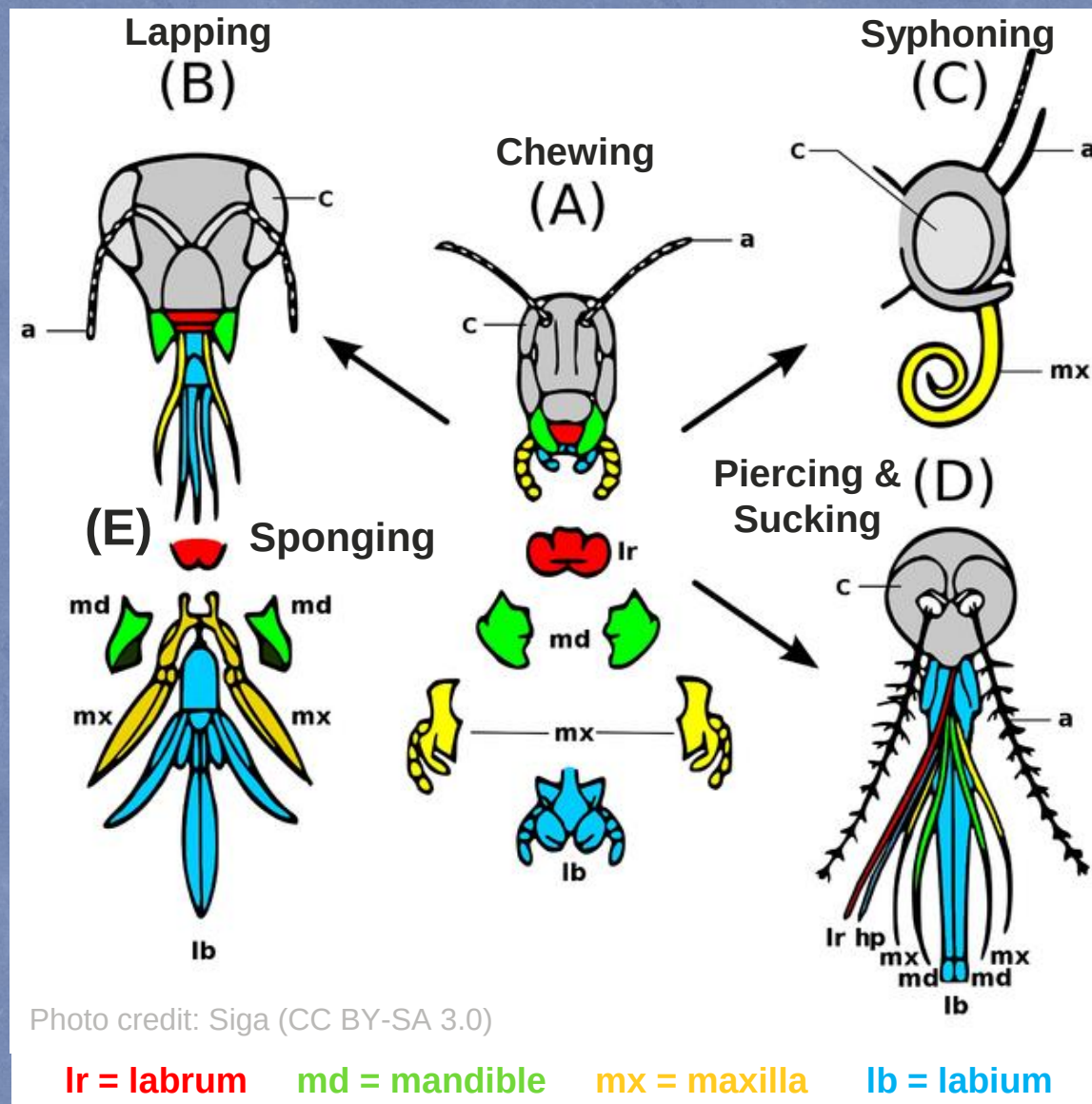
Common Insect Traits



Specialized mouthparts



3 pairs of legs





Aquatic Insect Adaptations

Insects need special adaptations or physical traits to live in the different aquatic habitats!

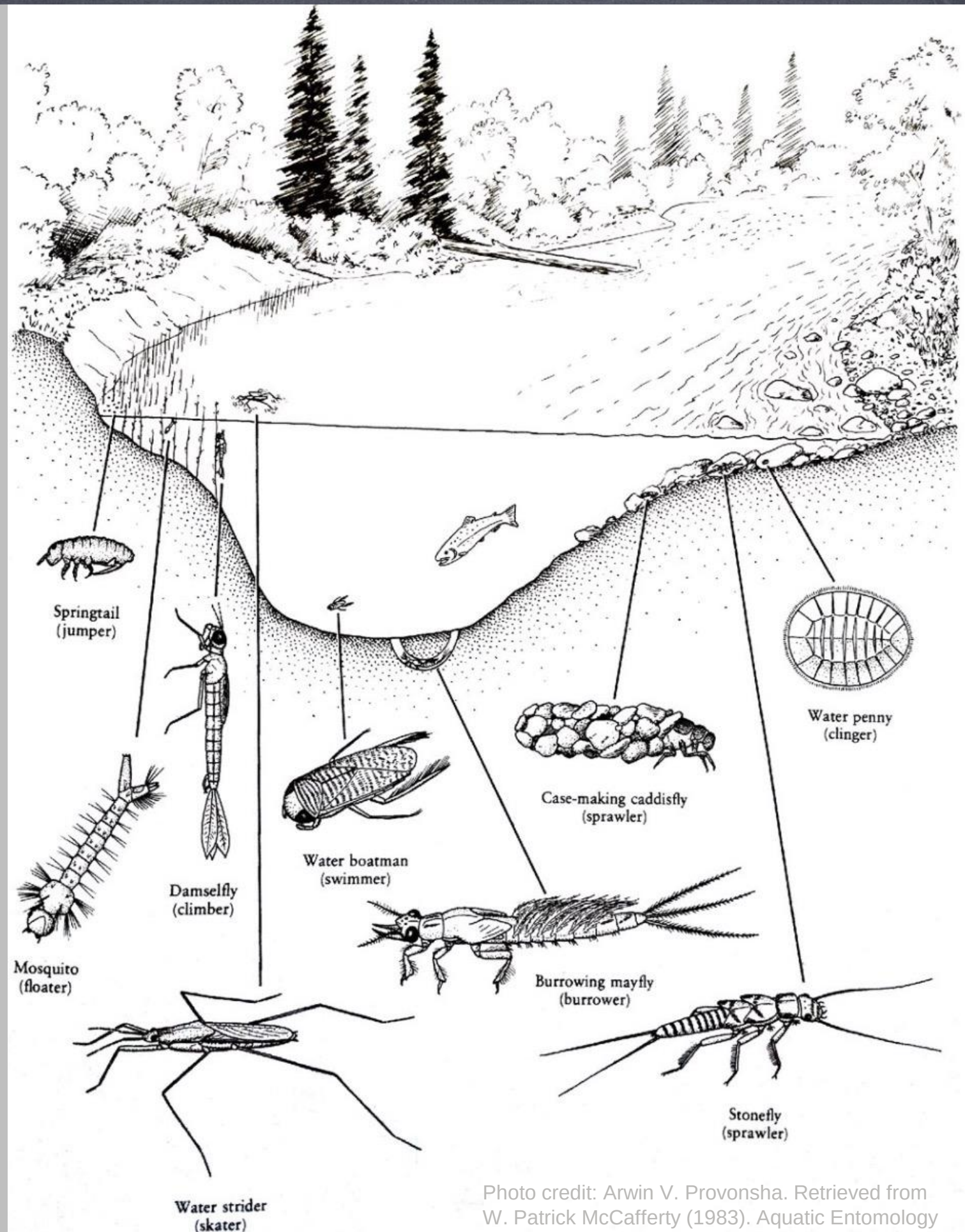


Photo credit: Arwin V. Provonsha. Retrieved from W. Patrick McCafferty (1983). Aquatic Entomology



Aquatic Insect Adaptations

Benthic

(bottom dwellers):

- Clingers
- Sprawlers
- Climbers
- Burrowers

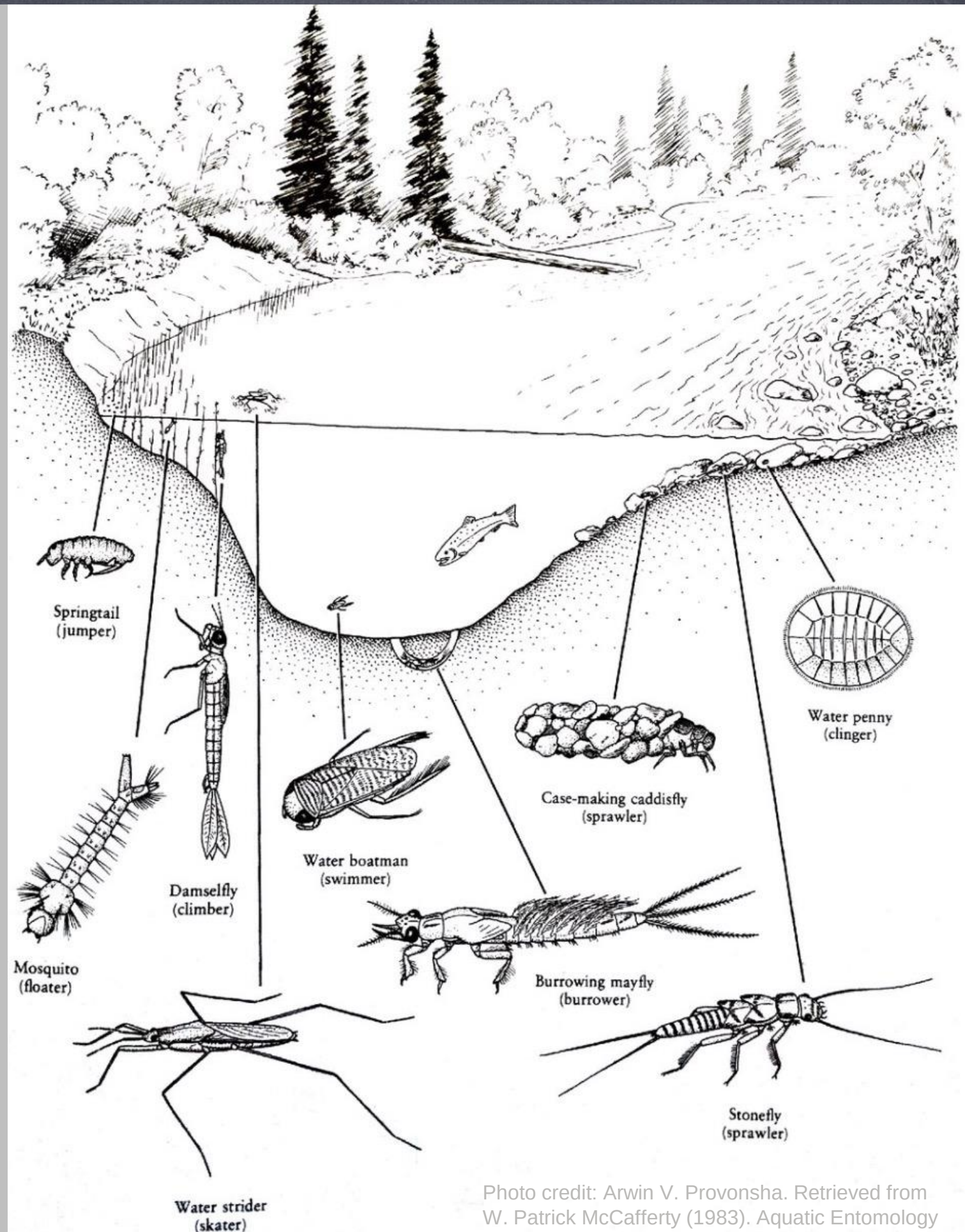


Photo credit: Arwin V. Provonsha. Retrieved from W. Patrick McCafferty (1983). Aquatic Entomology



Aquatic Insect Adaptations

Benthic

(bottom dwellers):

- Clingers
- Sprawlers
- Climbers
- Burrowers

Plankton

(drift w/currents):

- Floaters
- Drifters

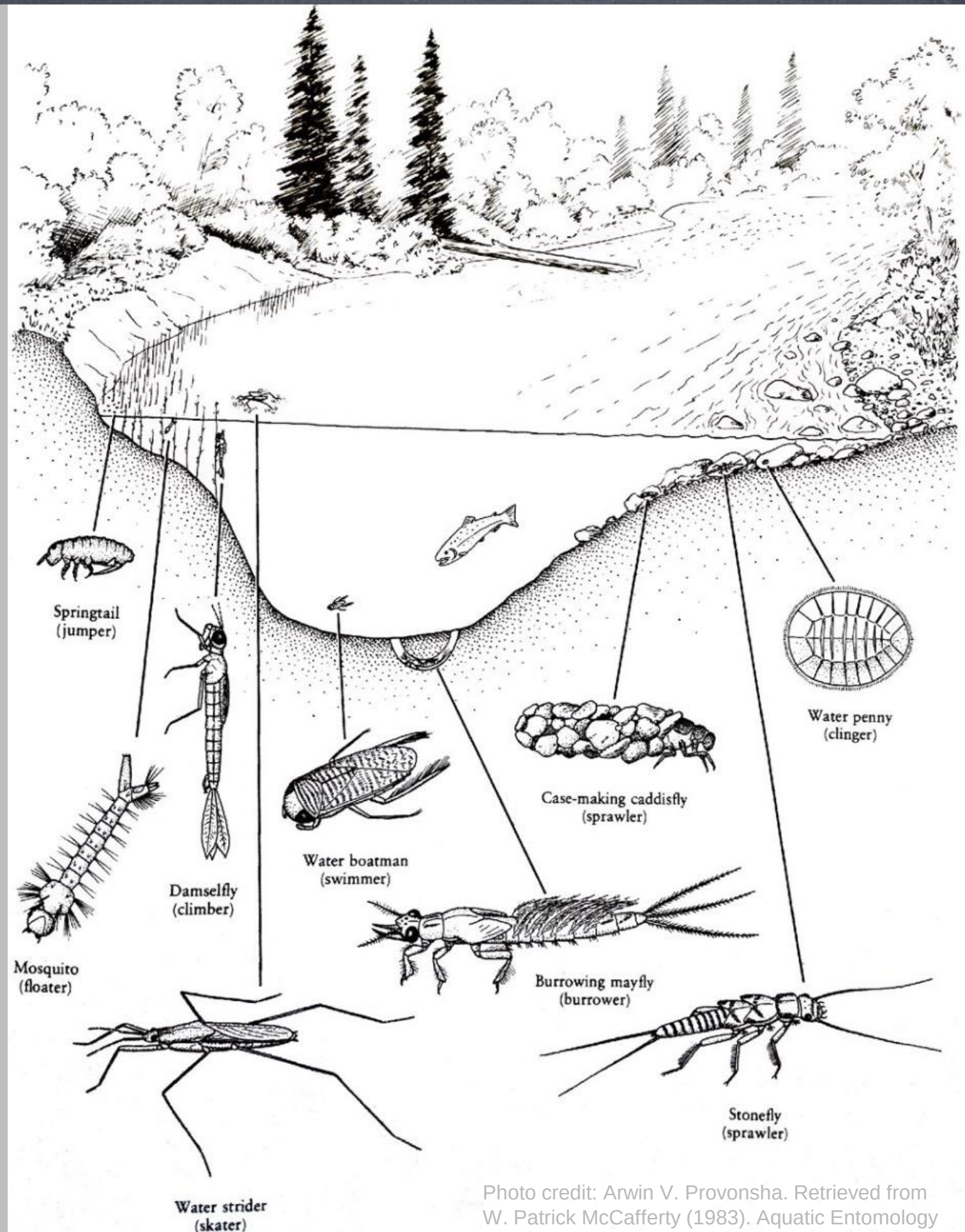


Photo credit: Arwin V. Provonsha. Retrieved from W. Patrick McCafferty (1983). Aquatic Entomology



Aquatic Insect Adaptations

Benthic

(bottom dwellers):

- Clingers
- Sprawlers
- Climbers
- Burrowers

Plankton

(drift w/currents):

- Floaters
- Drifters

Nekton

(Swim against currents):

- Swimmers

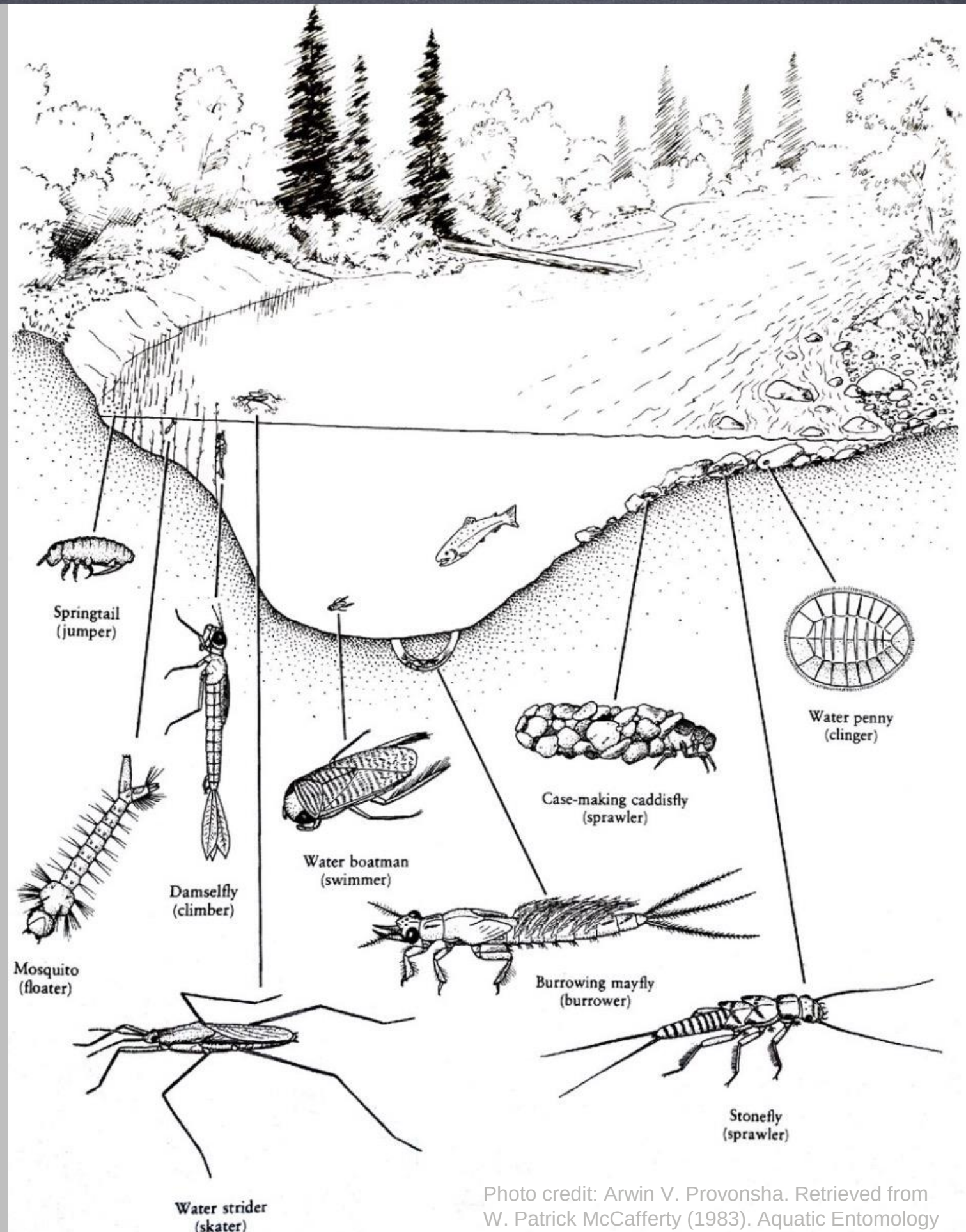


Photo credit: Arwin V. Provonsha. Retrieved from W. Patrick McCafferty (1983). Aquatic Entomology



Aquatic Insect Adaptations

Benthic

(bottom dwellers):

- Clingers
- Sprawlers
- Climbers
- Burrowers

Plankton

(drift w/currents):

- Floaters
- Drifters

Nekton

(Swim against currents):

- Swimmers

Neuston

(Surface dwellers):

- Skaters
- Jumpers

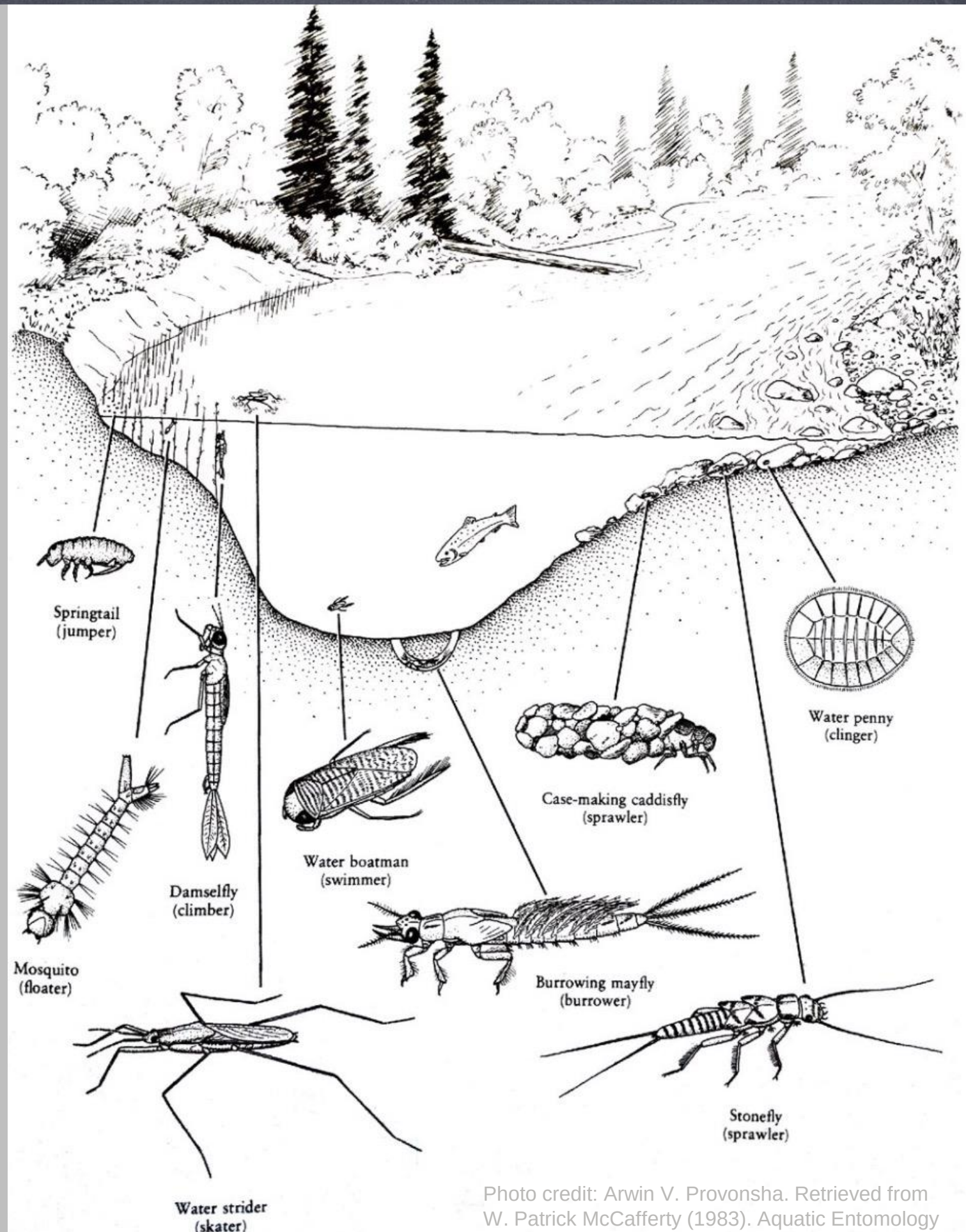


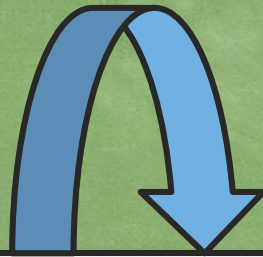
Photo credit: Arwin V. Provonsha. Retrieved from W. Patrick McCafferty (1983). Aquatic Entomology



Build the Aquatic Insect Guide

#1. FOLLOW THE DIRECTIONS TO BUILD YOUR BOOKLET

STEP A: Fold the provided $\frac{1}{2}$ sheet of paper in half lengthwise (hot dog fold)



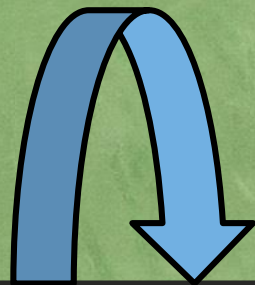
Before

After



Build the Aquatic Insect Guide

STEP B: Fold the paper again in half lengthwise
(hot dog fold)



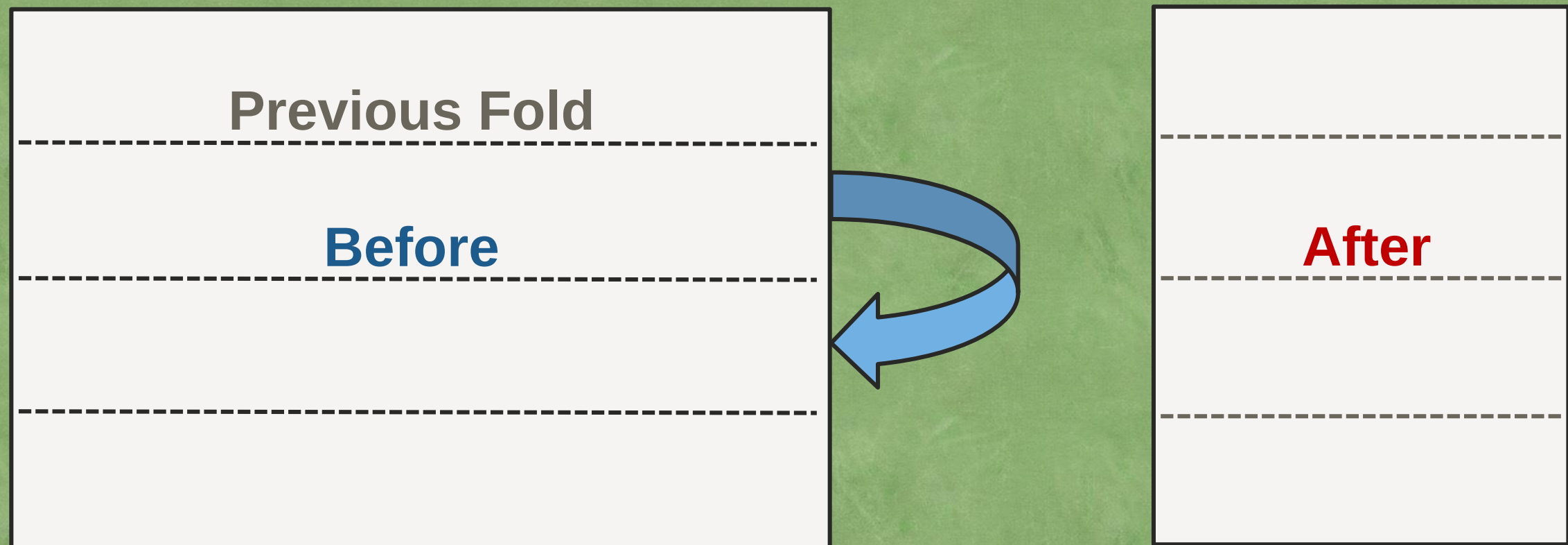
Before

After



Build the Aquatic Insect Guide

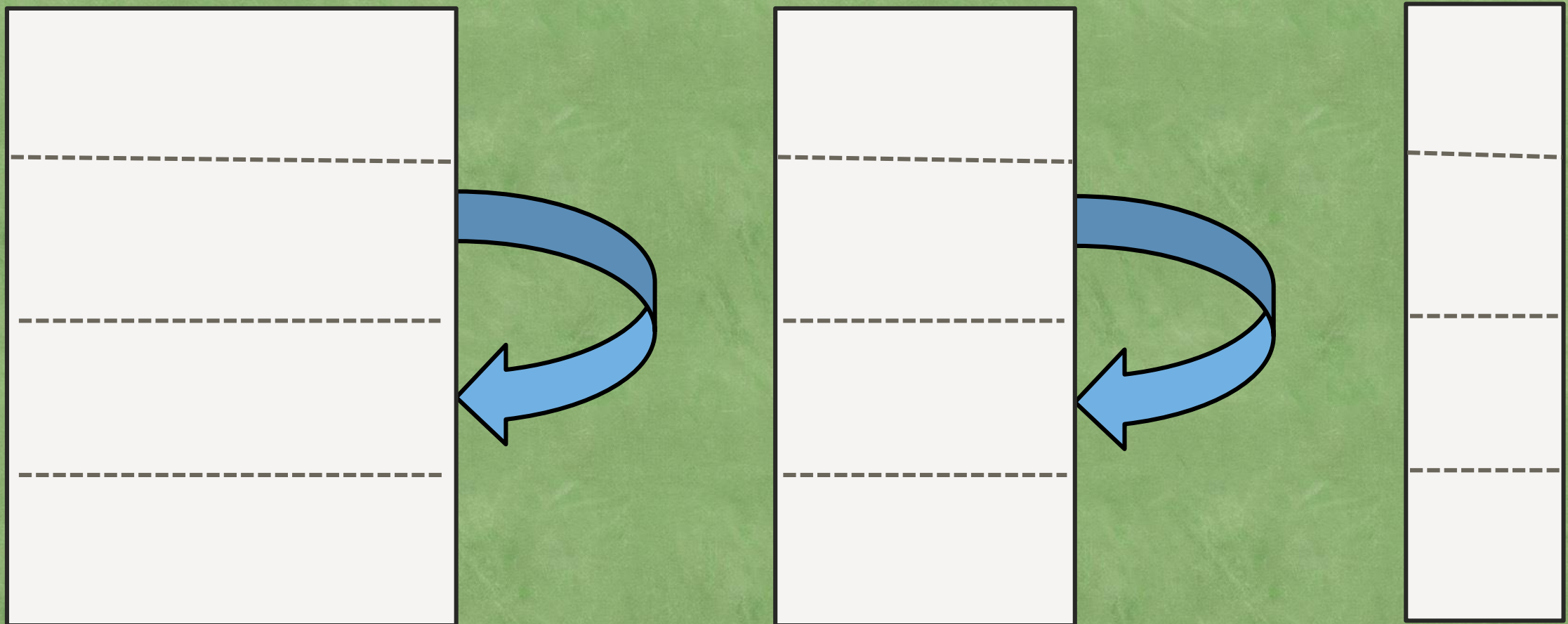
STEP C: Open the $\frac{1}{2}$ sheet of paper back up and fold in half widthwise (hamburger fold)





Build the Aquatic Insect Guide

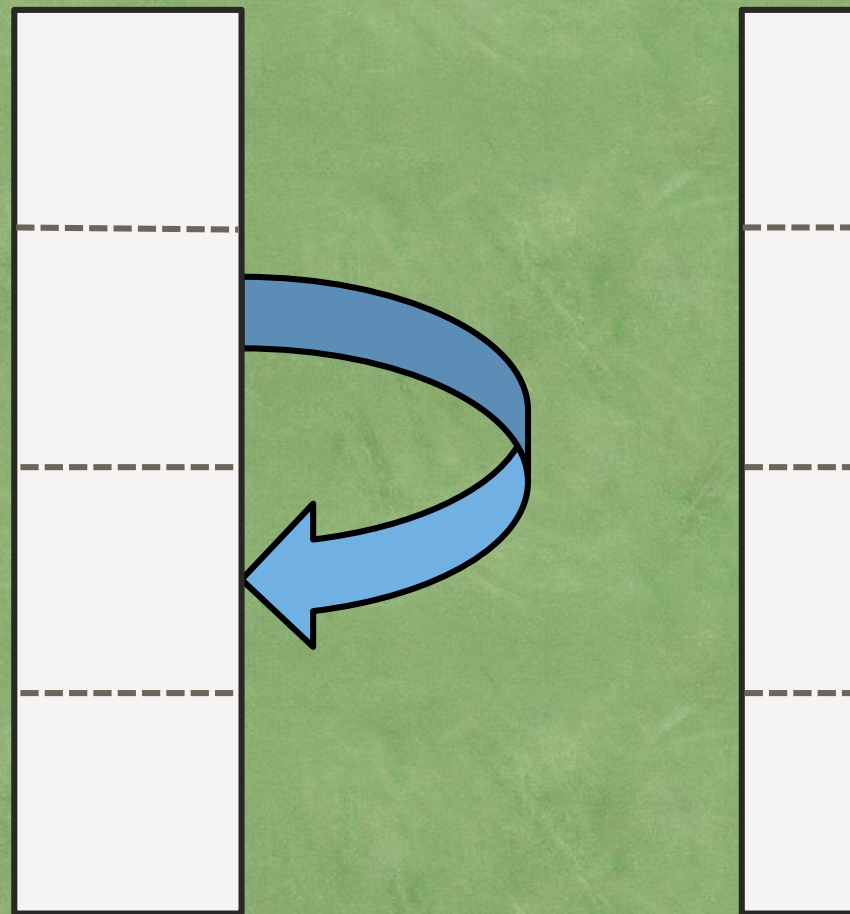
STEP D: Fold this over again EQUALLY IN THIRDS





Build the Aquatic Insect Guide

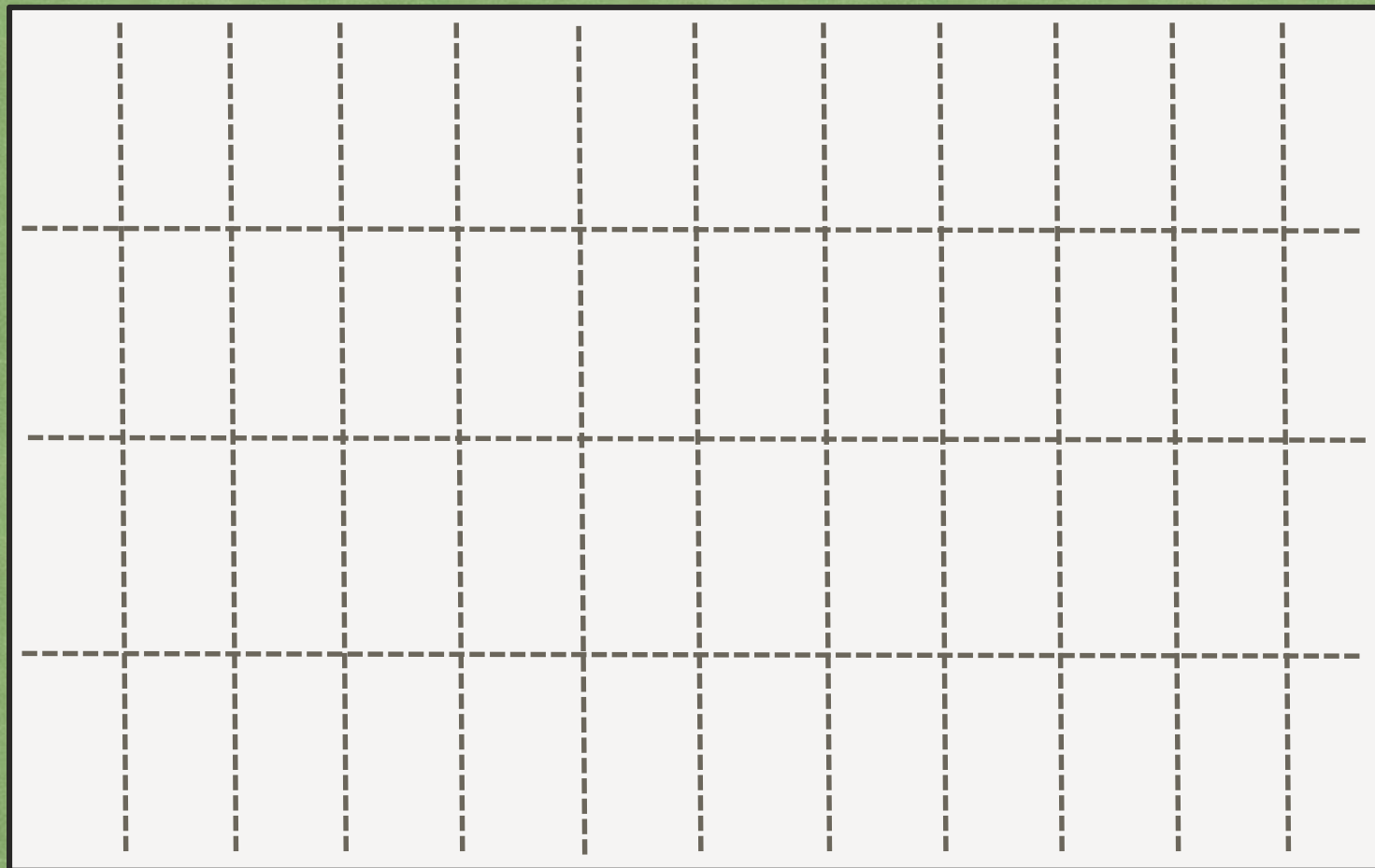
STEP E: Fold one last time in half.





Build the Aquatic Insect Guide

STEP F: Open up the half sheet of paper so that you can use it as a cutting template. RECREASE all of the vertical and horizontal folds.





Build the Aquatic Insect Guide

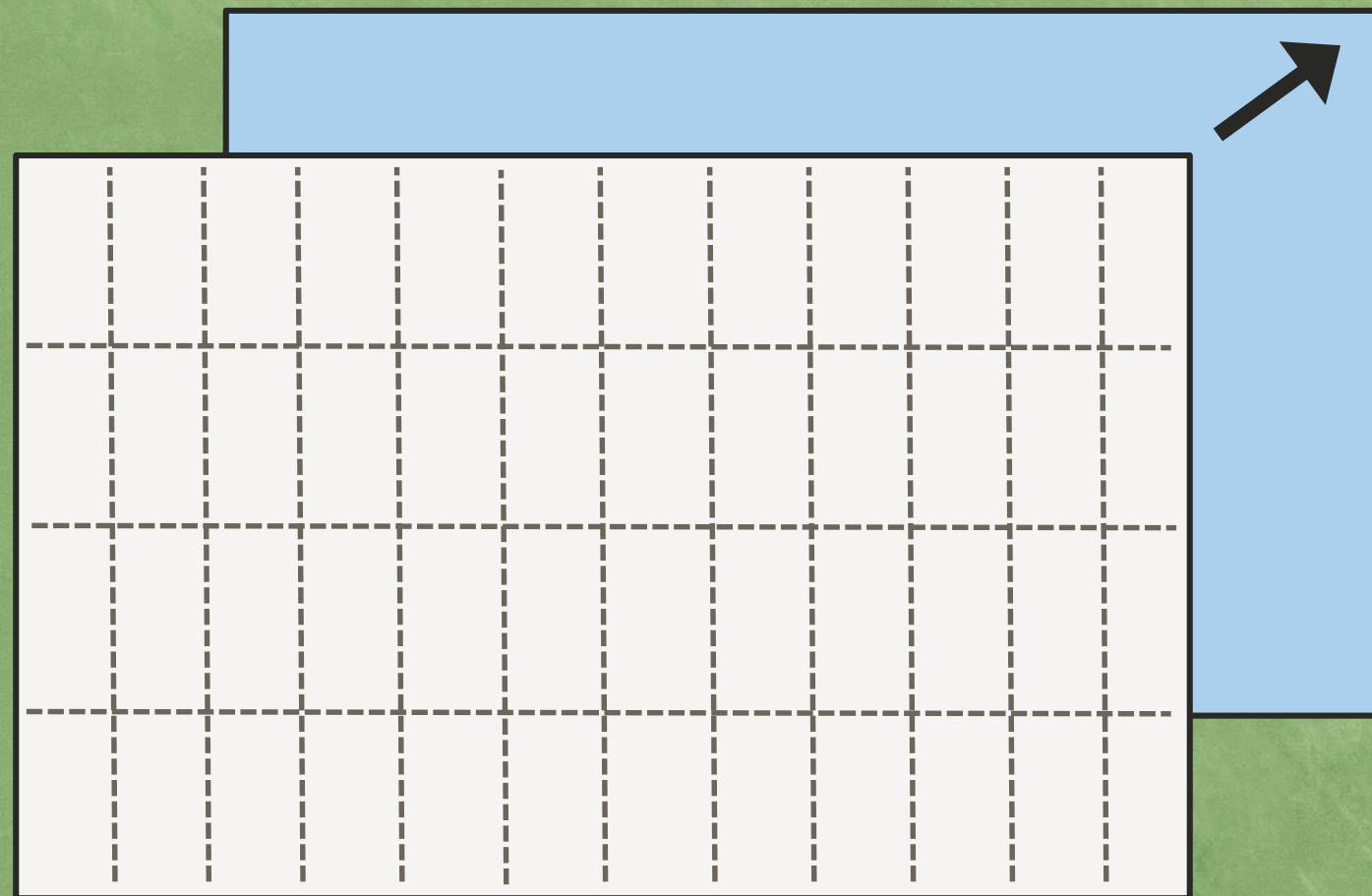
STEP G: Gather 12 NEW half sheets of paper (colors of your choice). Arrange the 12 sheets into a pattern of your choice. Set the bottom (12th) page aside.





Build the Aquatic Insect Guide

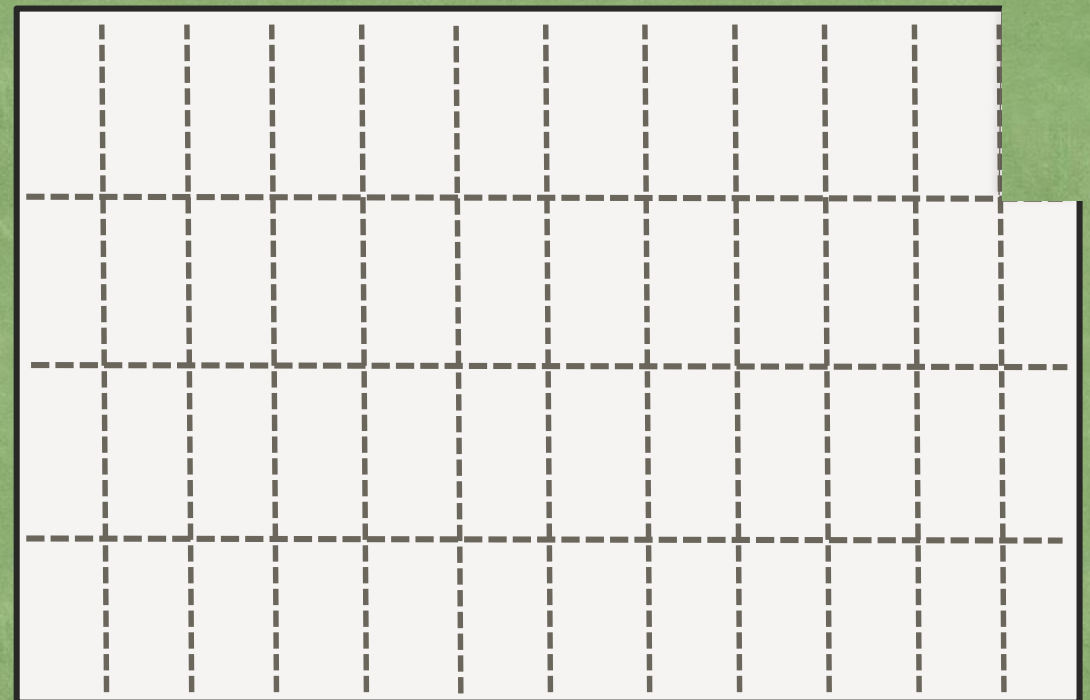
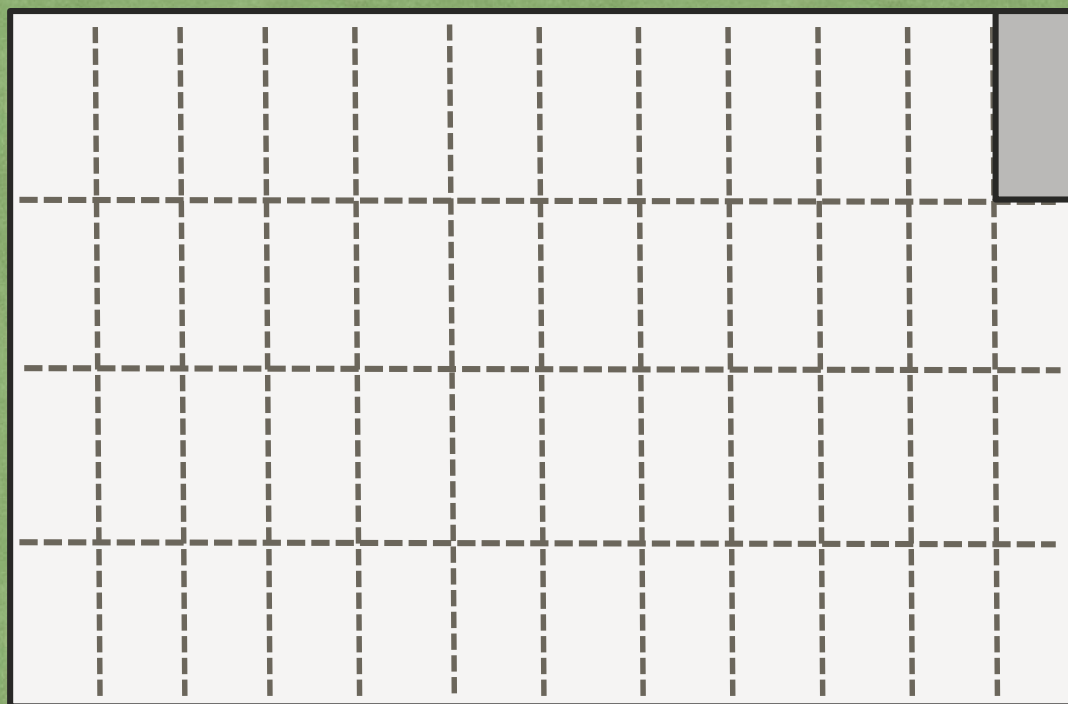
STEP H: Place the template OVER THE TOP of the 11th page of your booklet. Carefully line up the template with the TOP RIGHT corner of the 11th page.





Build the Aquatic Insect Guide

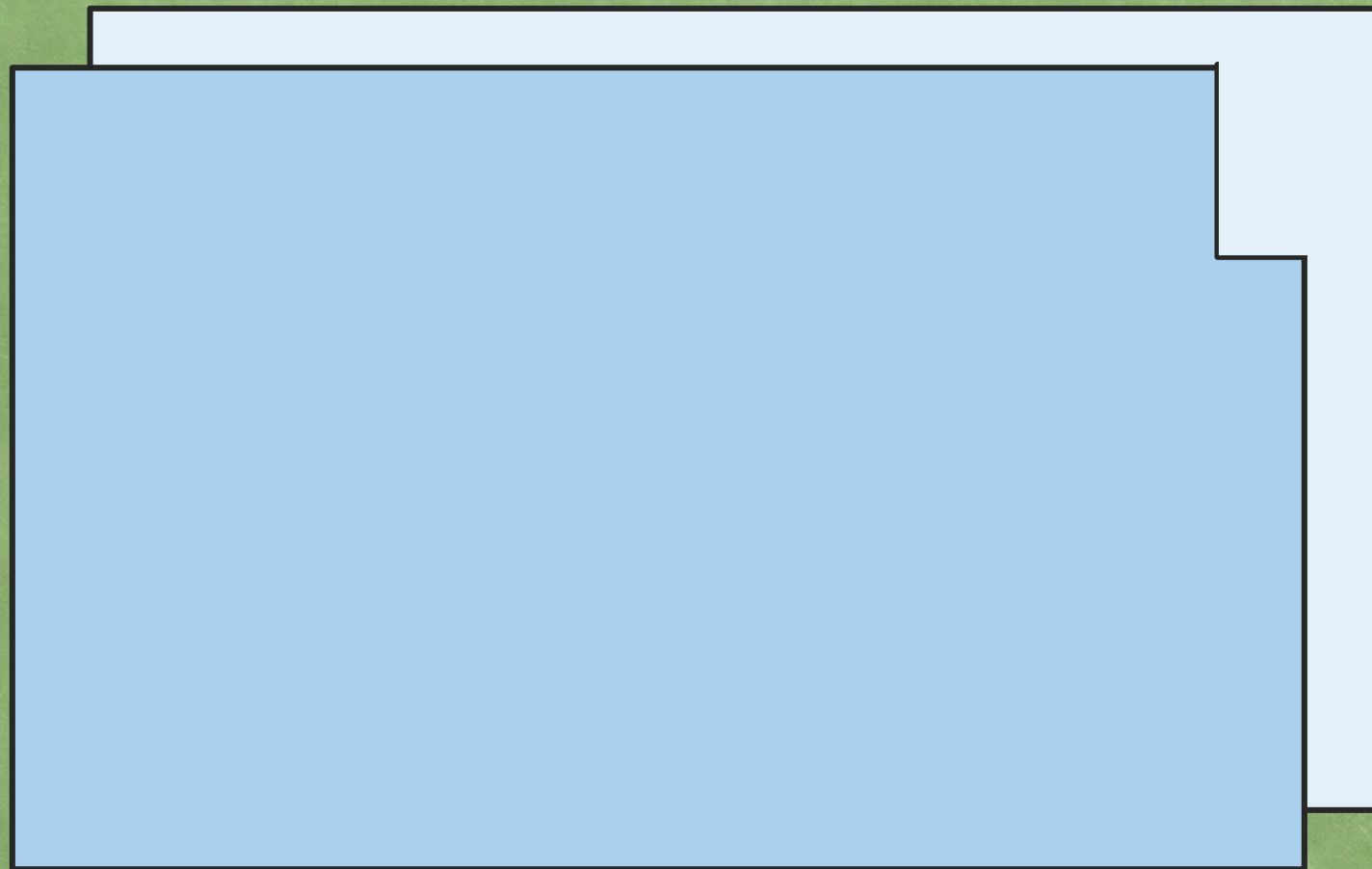
STEP I: Place the template OVER THE TOP of the 11th page of your booklet. Carefully line up the template with the TOP RIGHT corner of the 11th page.





Build the Aquatic Insect Guide

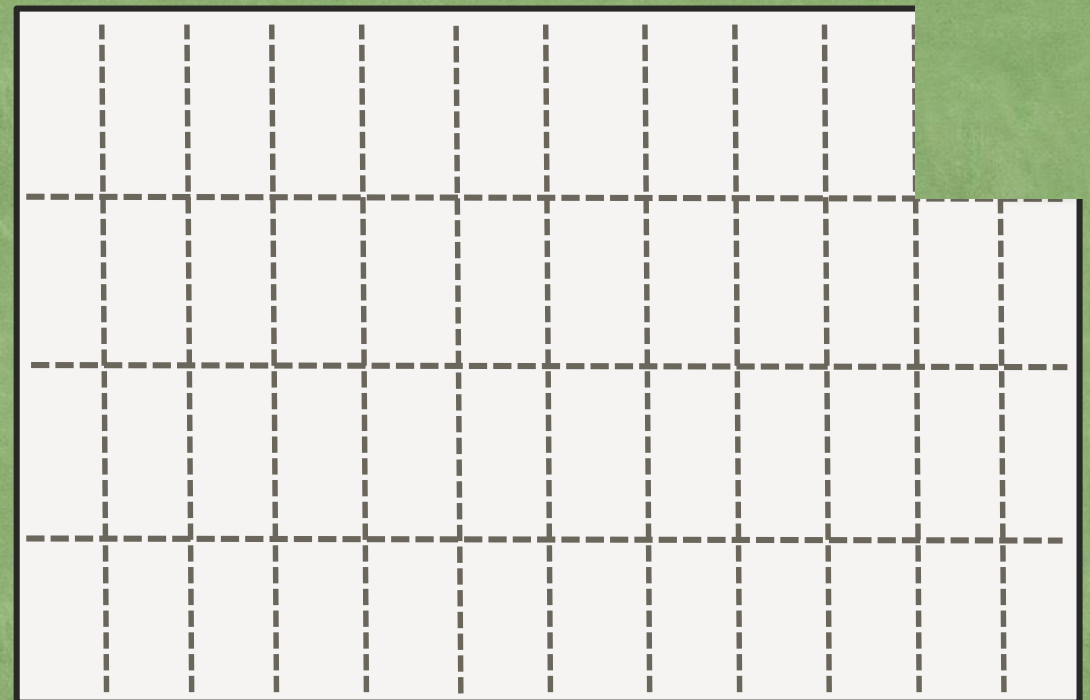
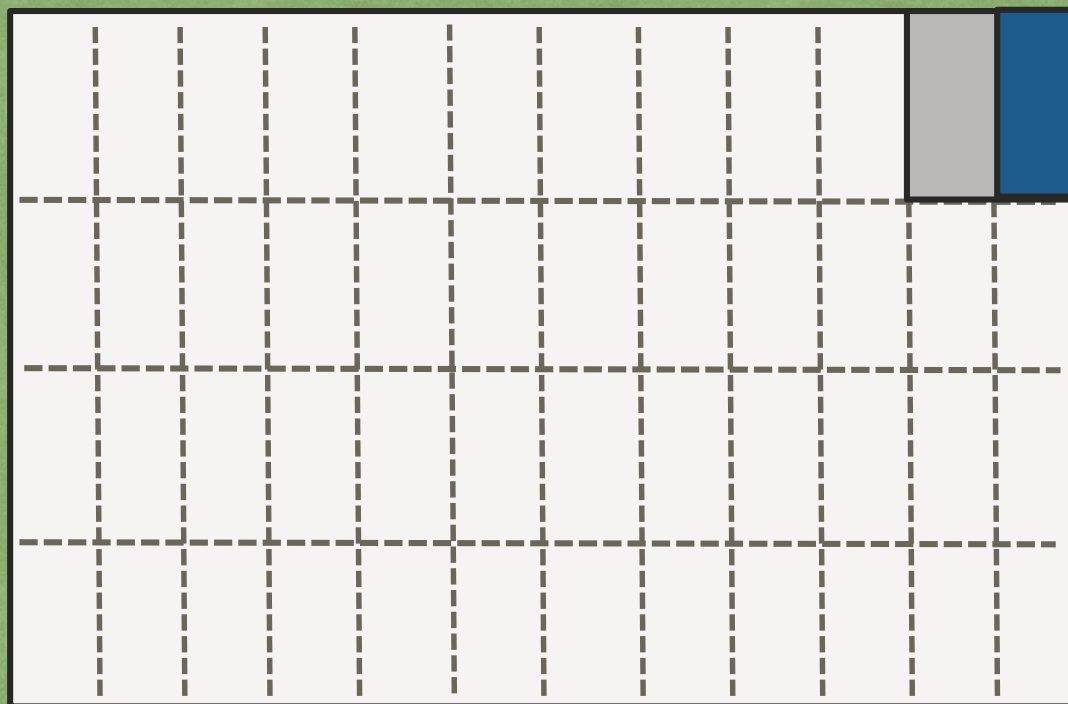
STEP J: Place the newly cut 11th page over the 12th page and set it aside.





Build the Aquatic Insect Guide

STEP K: Line up the template with the top right corner of the 10th page. Carefully cut the FAR TWO RIGHT boxes out of both sheets. Again be sure to cut as close to the creased folds as possible.





Build the Aquatic Insect Guide

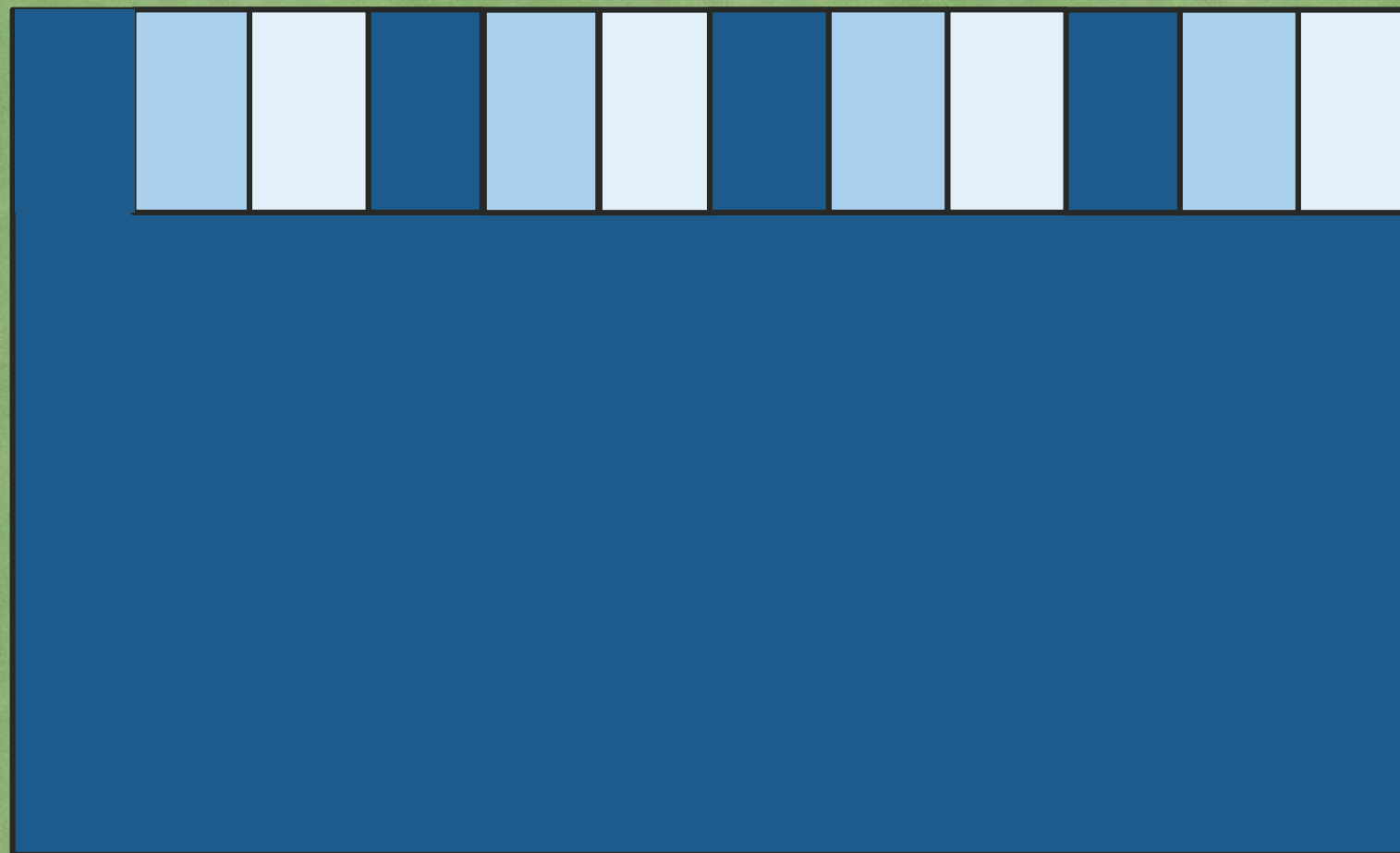
STEP L: Place the newly cut 10th page over the 11th page and set aside.





Build the Aquatic Insect Guide

STEP M: Repeat step K above for pages 9-2, cutting out an extra box towards the left each time until you have a booklet like the example below.





Basic Insect Anatomy

- Ephemeroptera
- Odonata
- Plecoptera
- Hemiptera
- Megaloptera
- Neuroptera
- Coleoptera
- Trichoptera
- Lepidoptera
- Diptera

Basic Insect Anatomy	Ephemeroptera	Odonata	Plecoptera	Hemiptera	Megaloptera	Neuroptera	Coleoptera	Trichoptera	Lepidoptera	Diptera
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Build the Aquatic Insect Guide

#3. Use your creativity to decorate the cover page so that the front of your booklet contains a title, name, and period.

Basic Insect Anatomy	Ephemeroptera	Odonata	Plecoptera	Hemiptera	Megaloptera	Neuroptera	Coleoptera	Trichoptera	Lepidoptera	Diptera
Aquatic Insect Guide By: Insert Your Name Here Period #?										



For each Order, record the “nickname”
and the types of organisms.



*Germanium
Photography*

Photo credit: Janith Pramuditha (CC BY-SA 4.0)



Ephemeroptera: "Short-lived wings" Mayflies



Photo credit: David Huth (CC BY 2.0)



Photo credit: Michael Palmer (CC BY-SA 4.0)



Odonata:

"Toothed ones"

dragonflies + damselflies

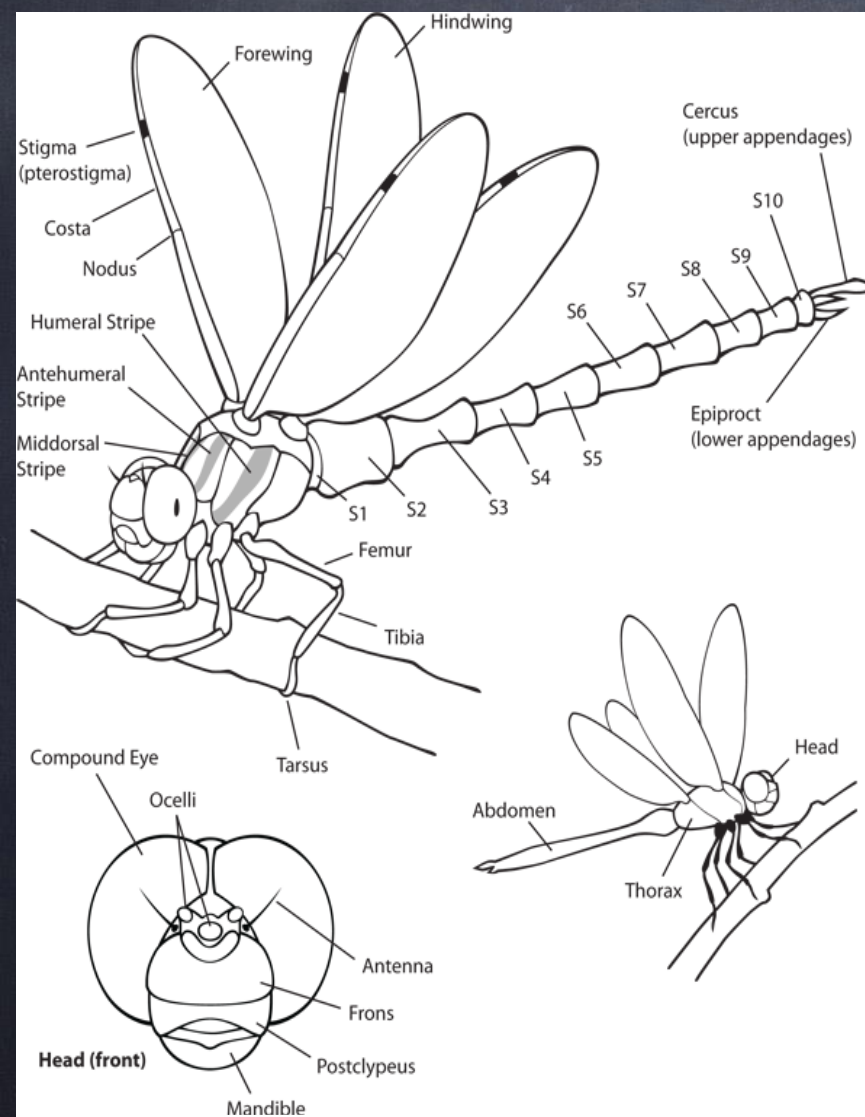


Photo credit: Sabine Deviche
<http://devichedesigns.com/work/odonate-anatomy>

Dragonfly



Photo credit: R. A. Norenmacher (CC BY-SA 3.0)

Damselfly



Photo credit: <https://www.pickpik.com/>

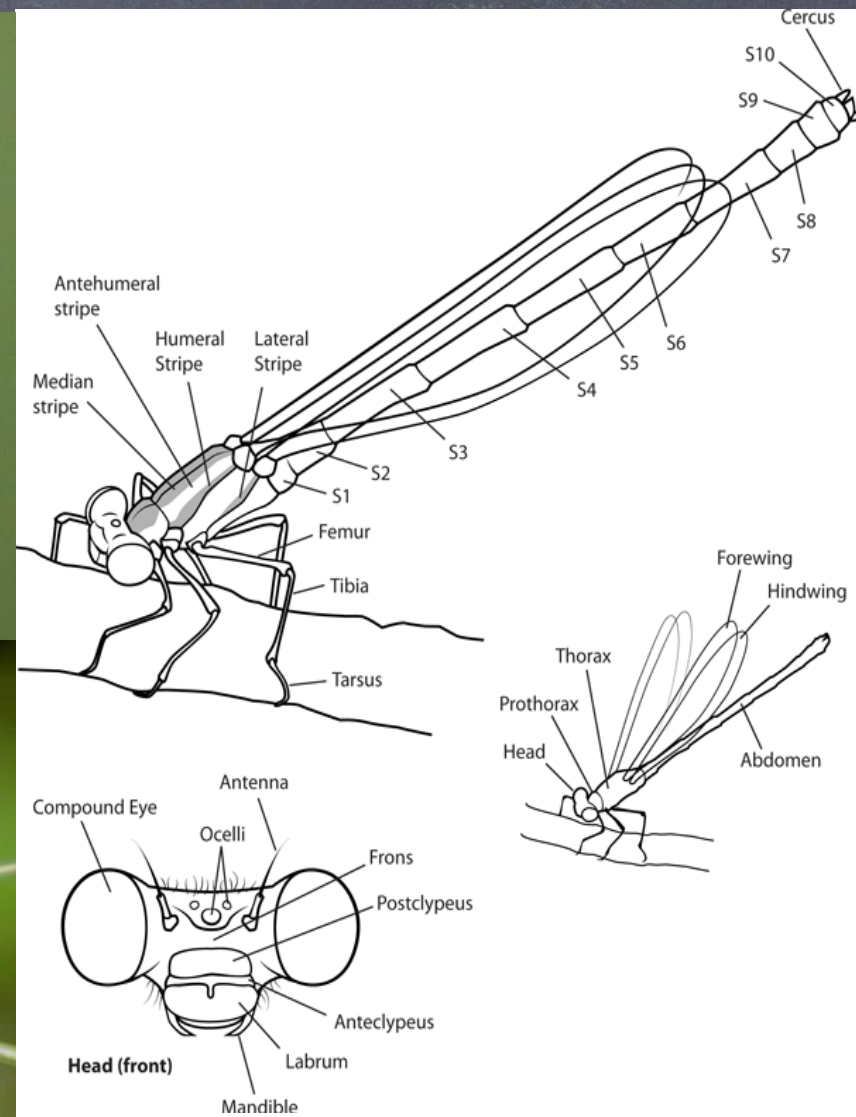


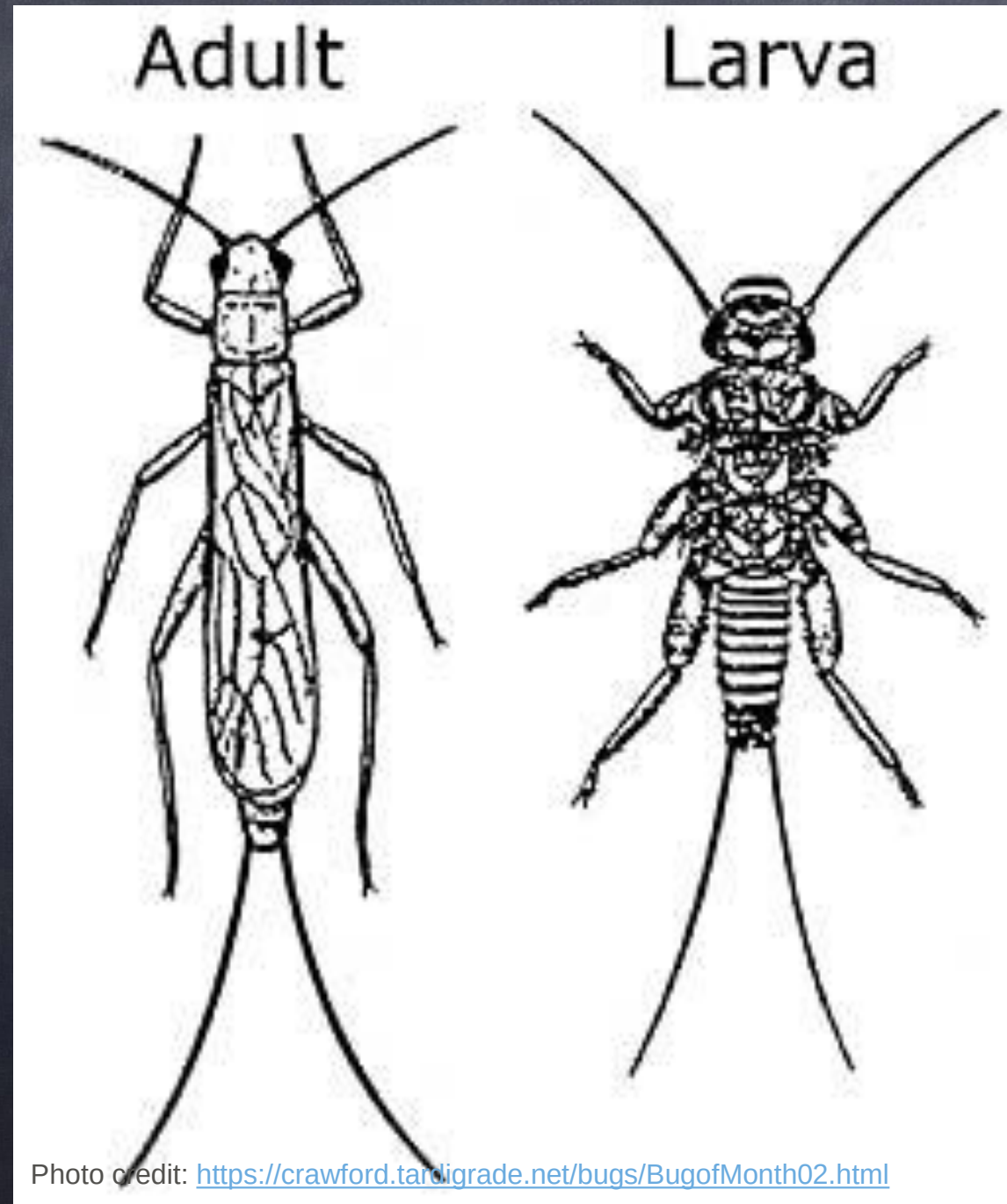
Photo credit: Sabine Deviche
<http://devichedesigns.com/work/odonate-anatomy>



Plecoptera:

"Braided wings"

Stoneflies





Hemiptera: "True bugs"

Water boatmen, water scorpions, back swimmers, water striders

Water
boatmen



Photo credit: AnemoneProjectors (CC BY-SA 2.0)

Water
scorpion



Photo credit: Ben Sale (CC BY 2.0)

Back
swimmer



Photo credit: gailhampshire (CC BY 2.0)

Water
strider



Photo credit: Fyn Kynd (CC BY 2.0)



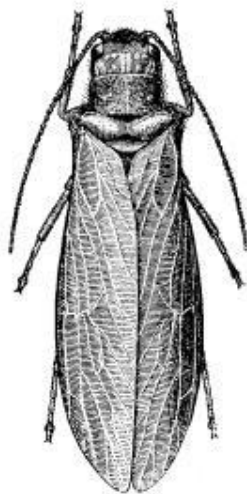
Megaloptera: "large wings"

Alderflies, dobsonflies, & fishflies

Megaloptera (meg-ga-LOP-ter-ra)

megalo = large

dobsonflies, fishflies, alderflies



dobsonflies →
≥2.5 cm (1 in)

← alderfly
<2.5 cm

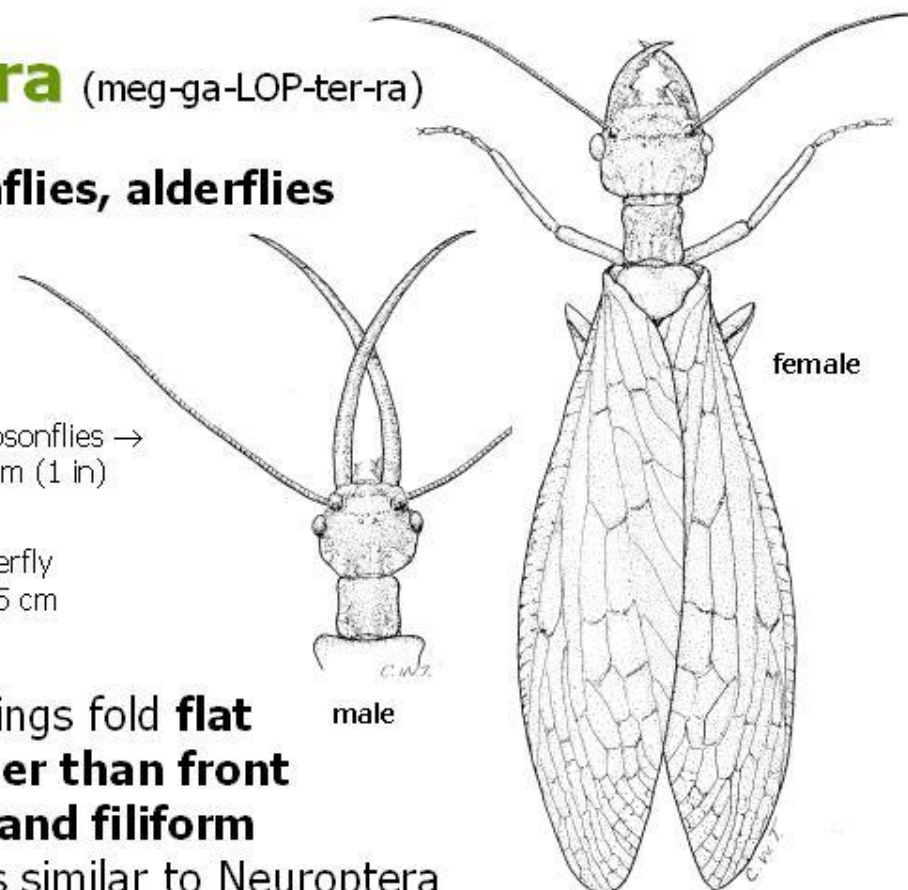
- Wings fold **flat**

- Hind wings **larger than front**

- Antennae **long and filiform**

- other characters similar to Neuroptera

Photo credit: Erik Donald France



female

male

Alderfly



Photo credit: Patrick Coin (CC BY-SA 2.5)

Dobsonfly



Photo credit: Andy Reago & Chrissy McClarren (CC BY 2.0)



Neuroptera: "Net wings"

Lacewings, mantidflies, antlions

Green lacewing



Photo credit: Alvesgaspar (CC BY-SA 3.0)

Green mantidfly



Photo credit: cotinis (CC BY-NC-SA 2.0)

Adult antlion



Photo credit: Rudi Steenkamp (CC BY-SA 4.0)

Antlion pit



Photo credit: Jacy Lucier (CC BY-SA 4.0)

Antlion larvae

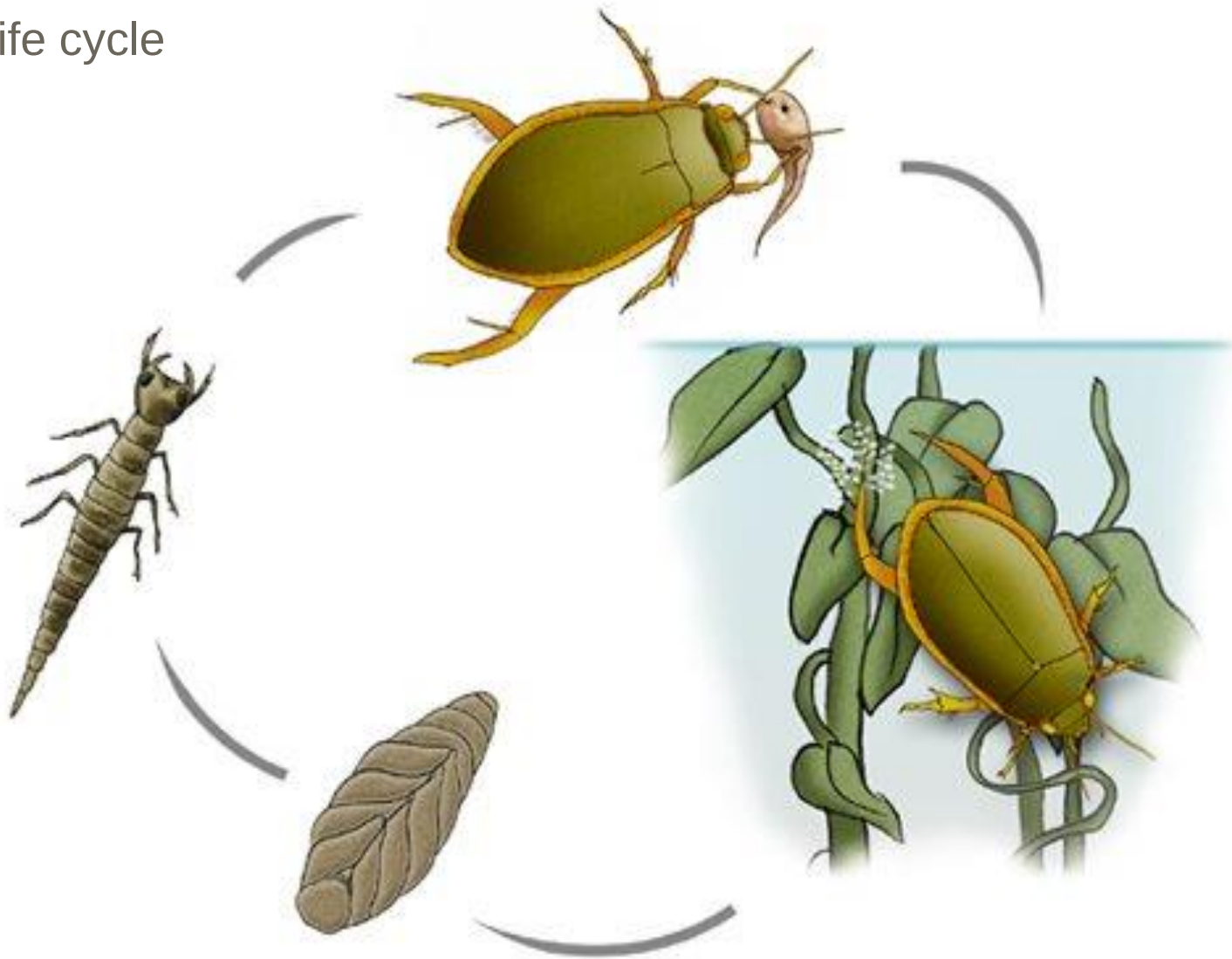


Photo credit: Joseph Berger (CC BY 3.0 US)



Coleoptera: "Sheath wings" Beetles

Life cycle



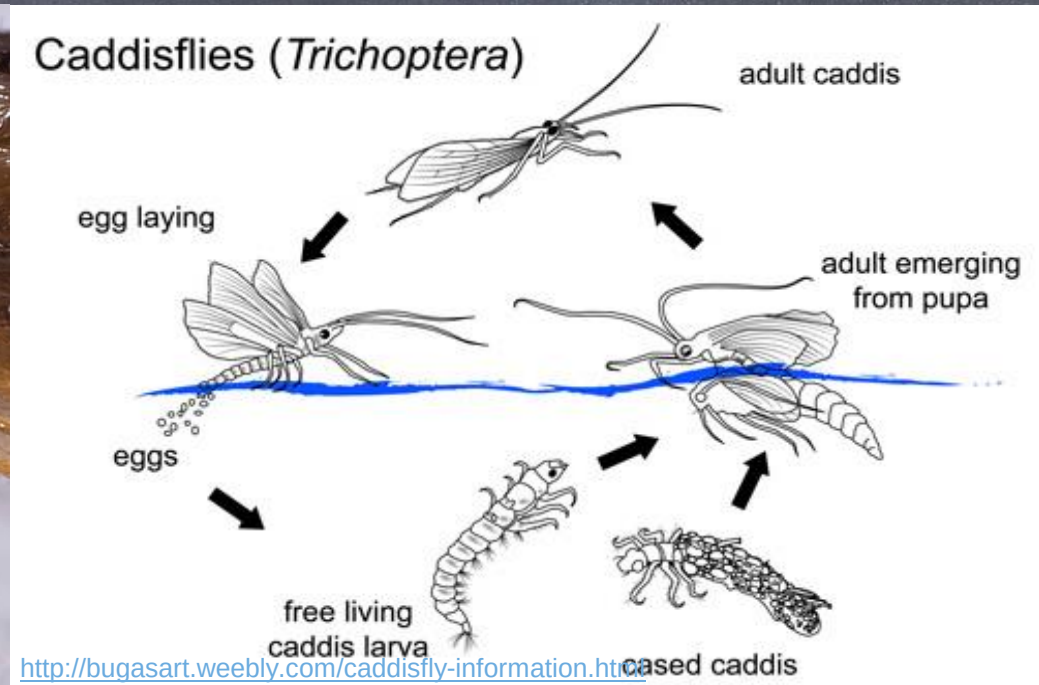
Water
scavenger
beetle



Photo credit: Justin Cret (CC BY-ND-NC-1.0)



Trichoptera: "Hairy wings" Caddisflies





Lepidoptera:

"Scaled wings"

Moths and butterflies



Photo credit: Alan Schmierer (CC0 1.0)



Photo credit: Charles J. Sharp (CC BY-SA 4.0)



Photo credit: Charles J. Sharp (CC BY-SA 4.0)



Photo credit: USFWS (CC BY 2.0)



Diptera:

"Two wings"

True flies



Photo credit: <https://www.whatsthatbug.com/category/flies/long-legged-flies/>



Photo credit: Frank Fox (CC BY-SA 3.0)



Photo credit: kallerna (CC BY-SA 3.0)



Complete the Basic Insect Anatomy Page

Cut out, arrange, and glue the diagrams and text boxes provided on “Lesson Materials” worksheet.





Fill the Aquatic Insect Guide

Use reliable (.org/.gov/.edu) websites and/or other sources to research all 10 insect Orders.

Each page (pages 3-12) must include the following:

- A list of ≥ 3 animals that share the same order (list common names).
- At least 5 adaptations or distinguishing physical traits for the insect order. These are the physical traits that allow you to distinguish the different groups of insects from each other.
- A description of the preferred habitats.
- Seasons or when during the year the insects will appear in the different stages of development.
- One diagram of the anatomy of one insect in the order.
- A diagram of the stages of development/life cycle for insects in the order.
- At least 2 photographs of animals in the insect order.



Tips for Success

- Your booklet must be creative, colorful, and typed and/or neatly handwritten.
- Keep track of your sources for your reference lists.
- Use copyright free photographs and diagrams or make your own.
- Use the provided rubric.



Project Rubric

	REQUIREMENTS	SCORE
CONTENT (50 pts)	Includes: ☐ A list of 3 or more animals that share the same order. ☐ A list of 5 or more adaptations for each order of insects. ☐ A description of the habitats insects in each order can be found in. ☐ A description of the seasons during the year in which the insects in each order will appear in the different stages of development.	
GRAPHICS (30 pts)	Contains: ☐ One diagram of the anatomy of one insect in each order. ☐ Two or more pictures of the animals in EACH insect order. ☐ One diagram of the stages of development/life cycle for each insect order.	
DESIGN (10 pts)	☐ Creative, colorful design	
FORMAT (5 pts)	☐ Typed or <u>NEATLY</u> handwritten	
REFERENCE LIST (5 pts)	☐ Includes a complete list of sources for each photograph and/or diagram used in the booklet. ☐ Includes a complete list of sources for the content used in the booklet. ☐ Both reference lists are alphabetized.	



Create Two Reference Lists

Create two alphabetical reference lists: one for the photographs and diagrams and one for the content you collect.

Include a description of the resource and the website you retrieved the materials from. Attach both lists to the back page of the booklet.

For example:

Photo/Diagram List of References

Anatomy diagram of a stone fly: list website

Life cycle diagram of a stone fly: list website



Wrap Up with a Partner

- Review each order in your booklet
- Select ONE unique trait that will help you to remember the insects in that order
- Record your responses on your worksheet



References

Slide 1:

Mayfly: (CC BY-SA 3.0) https://commons.wikimedia.org/wiki/File:Gro%C3%9Fe_Eintagsfliege,_mayfly,_Ephemera_danica_2011-05-03_IMG_1125_EDIT2_SQUARE_CUT_1600x1600.jpg

Slide 2:

Bee: John Severns (public domain) https://commons.wikimedia.org/wiki/File:European_honey_bee_extracts_nectar.jpg

Lady bug: Jon Sullivan (public domain) <https://commons.wikimedia.org/wiki/File:Ladybird.jpg>

Damselfly: (Royalty-free photo) <https://www.pickpik.com/dragonfly-blue-nature-blue-dragonfly-close-macro-58737>

Moth: Jason Neuswanger <http://www.troutnut.com>

Green fly: Umberto Salvagnin (CC BY 2.0) https://commons.wikimedia.org/wiki/File:Green_Fly.jpg

Beetle: Ben Clarke (CC BY 3.0) [https://commons.wikimedia.org/wiki/File:Black_Beetle_\(62617899\).jpeg](https://commons.wikimedia.org/wiki/File:Black_Beetle_(62617899).jpeg)

Antlion adult: RudiSteenkamp (CC BY-SA 4.0) [https://commons.wikimedia.org/wiki/File:Antlion_\(order_Neuroptera\).jpg](https://commons.wikimedia.org/wiki/File:Antlion_(order_Neuroptera).jpg)

Slide 3:

Metamorphosis diagram: Username1927 (CC BY-SA 4.0)

https://commons.wikimedia.org/wiki/File:Holometabolous_vs._Hemimetabolous.svg

Slide 4:

Mayfly diagram: Holly Church

Slide 5:

Insect Mouth parts: Siga (CC BY-SA 3.0) https://commons.wikimedia.org/wiki/File:Evolution_insect_mouthparts_coloured_derivate.png

Insect legs: Based on work by Folsom 1914 retrieved from https://wiki.bugwood.org/Insect_Biology

Slides 6-10:

Aquatic habitat illustration created by Arwin V. Provonsha. Retrieved from

W. Patrick McCafferty (1983). Aquatic Entomology: The Fishermen's and Ecologists' Guide to Insects and Their Relatives. Jones and Barlett Publishers, Massachusetts.



References

Slides 11-25: Booklet Diagrams by Holly Church

Slide 26: Stonefly: Dave Huth (CC BY 2.0 [https://commons.wikimedia.org/wiki/File:Stonefly_nymph_\(5795327322\).png](https://commons.wikimedia.org/wiki/File:Stonefly_nymph_(5795327322).png))

Slide 27: Dragon Fly: Janith Pramuditha (CC BY-SA 4.0) https://commons.wikimedia.org/wiki/File:Dragon_Fly_Sri_Lanka.jpg

Slide 28:

Mayfly nymph: Dave Huth (CC BY 2.0) [https://commons.wikimedia.org/wiki/File:Mayfly_nymph_\(rhithrogena_sp.\)_\(5789175336\).png](https://commons.wikimedia.org/wiki/File:Mayfly_nymph_(rhithrogena_sp.)_(5789175336).png)

Mayfly adult: Michael Palmer (CC BY-SA 4.0) https://commons.wikimedia.org/wiki/File:Yellow_mayfly_on_leaf.jpg

Slide 29:

Dragonfly: R. A. Nonenmacher (CC BY-SA 3.0) https://commons.wikimedia.org/wiki/File:Dragonfly_ran-384.jpg

Damselfly: (Royalty-free photo) <https://www.pickpik.com/dragonfly-blue-nature-blue-dragonfly-close-macro-58737>

Damselfly and dragonfly diagrams: Sabine Deviche <http://devichedesigns.com/home>

Slide 30:

Stonefly diagram: Louise Kulzer <https://crawford.tardigrade.net/bugs/BugofMonth02.html>

Golden Stone stonefly adult: Jason Neuswanger <http://www.troutnut.com/hatch/965/Stonefly-Perlidae-Golden-Stones>

Golden Stone Stonefly nymph: Jason Neuswanger <http://www.troutnut.com/specimen/699>

Slide 31:

Water boatmen: AnemoneProjectors (CC BY-SA 2.0)

[https://commons.wikimedia.org/wiki/File:Lesser_Water_Boatman_\(Corixa_punctata\)_19349498661.jpg](https://commons.wikimedia.org/wiki/File:Lesser_Water_Boatman_(Corixa_punctata)_19349498661.jpg)

Water scorpion: Ben Sale (CC BY 2.0) https://commons.wikimedia.org/wiki/File:Water_Scorpion_-_Flickr_-_Bennyboymothman.jpg

Back swimmer: gailhampshire (CC BY 2.0)

https://commons.wikimedia.org/wiki/File:Backswimmer.Notonecta_maculata_Notonectidae_-_Flickr_-_gailhampshire.jpg

Water strider: Fyn Kynd (CC BY 2.0) <https://www.flickr.com/photos/79452129@N02/11108981086>

Slide 32:

Megaloptera diagram: Erik Donald France: <http://eriklerouge.blogspot.com/2006/06/attack-of-fishflies-theyre-back.html>

Alderfly: Patrick Coin (CC BY-SA 2.5) https://commons.wikimedia.org/wiki/File:Sialis_spPCCA20050708-9036A.jpg

Dobsonfly: Andy Reago & Chrissy McClarren (CC BY 2.0) [https://commons.wikimedia.org/wiki/File:Dobsonfly_\(43608844874\).jpg](https://commons.wikimedia.org/wiki/File:Dobsonfly_(43608844874).jpg)



References

Slide 33:

Green lacewing: Alvesgaspar (CC BY-SA 3.0) https://commons.wikimedia.org/wiki/File:Crisopid_July_2013-9.jpg

Green Mantidfly: cotinis (CC BY-NC-SA 2.0) <https://www.flickr.com/photos/pcoin/4986382105>

Antlion adult: RudiSteenkamp (CC BY-SA 4.0) [https://commons.wikimedia.org/wiki/File:Antlion_\(order_Neuroptera\).jpg](https://commons.wikimedia.org/wiki/File:Antlion_(order_Neuroptera).jpg)

Antlion pit: Jacy Lucier (CC BY-SA 4.0) https://commons.wikimedia.org/wiki/File:Common_Antlion_Myrmeleon_immaculatus_trap-hole.jpg

Antlion larvae: Joseph Berger (CC BY 3.0 US) [https://commons.wikimedia.org/wiki/File:Myrmeleontidae_\(antlion\)_5370350.jpg](https://commons.wikimedia.org/wiki/File:Myrmeleontidae_(antlion)_5370350.jpg)

Slide 34:

Diving beetle life cycle diagram: <https://australianmuseum.net.au/learn/teachers/learning/diving-beetle-life-cycle/>

Water Scavenger Beetle: Iustin Cret (CC BY-ND-NC 1.0) <https://bugguide.net/node/view/941708>

Slide 35:

Caddisfly lifecycle: <http://bugasart.weebly.com/caddisfly-information.html>

Apatania caddisfly: Jason Neuswanger <http://www.troutnut.com/specimen/728>

October caddisfly: Jason Neuswanger <http://www.troutnut.com/specimen/870>

Caddisfly larvae: Bob Henricks (CC BY-SA 2.0) [https://commons.wikimedia.org/wiki/File:Uenoid_case-maker_caddisfly,_Neophylax_consimilis_\(8238705594\).jpg](https://commons.wikimedia.org/wiki/File:Uenoid_case-maker_caddisfly,_Neophylax_consimilis_(8238705594).jpg) <http://bugasart.weebly.com/caddisfly-information.html>

Slide 36:

Moth: Alan Schmeirer (CC0 1.0) [https://commons.wikimedia.org/wiki/File:MOTH_\(Hemileuca_tricolor\)_12-22-12\)_78_circulo_montana_patagonia_lake_ranch_estates_scc_az_-01_\(8307242192\).jpg](https://commons.wikimedia.org/wiki/File:MOTH_(Hemileuca_tricolor)_12-22-12)_78_circulo_montana_patagonia_lake_ranch_estates_scc_az_-01_(8307242192).jpg)

Sphinx moth: Charles J. Sharp (CC BY-SA 4.0) [https://commons.wikimedia.org/wiki/File:Sphinx_moth_\(Adhemarius_gannascus\).jpg](https://commons.wikimedia.org/wiki/File:Sphinx_moth_(Adhemarius_gannascus).jpg)

Comma butterfly: Charles J. Sharp (CC BY-SA 4.0) [https://commons.wikimedia.org/wiki/File:Comma_butterfly_\(Polygonia_c-album\)_ab_hutchinsoni.jpg](https://commons.wikimedia.org/wiki/File:Comma_butterfly_(Polygonia_c-album)_ab_hutchinsoni.jpg)

Butterfly Scales: USFWS (CC BY 2.0) [https://commons.wikimedia.org/wiki/File:Butterfly_scale_pattern_\(6293105393\).jpg](https://commons.wikimedia.org/wiki/File:Butterfly_scale_pattern_(6293105393).jpg)

Slide 37:

Long-legged fly: <https://www.whatsthatbug.com/category/flies/long-legged-flies>

Black fly: kallerna (CC BY-SA 3.0) https://commons.wikimedia.org/wiki/File:Black_fly_Isoj%C3%A4rvi.JPG

Chironomid larvae: Frank Fox (CC BY-SA 3.0) <https://commons.wikimedia.org/wiki/File:Mikrofoto.de-Zuckmueckenlarve3.jpg>