Title of the Lesson Plan:

- **Can you spot the difference? Comparing stages of Two Killifish Species.**

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Intended School Year and Marking Period: 2026, fourth marking period

Subject and Grade Level: Science 101, Biology Term, 9th grade

Overview:

1.Students will watch a video of the life cycle of annual and non-annual killifish. While watching they will answer questions that go with the video.
2.They will observe two sets of cards that have the embryological development of each species, and they will make observations of each.
3. They will then get a photo and must decide what stage is it in. They will need to defend their answer and compare it with the answers of others in their group.
4. From there they will get to look at real Killifish under the microscope. They will have to decide what species they are looking at and at what stage it is in.

Essential Standards:

HS-LS1-1 Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

We will be doing this lab as a phenomena lab before we start the genetics unit.

Learning Objectives: Students will be able to make observations of embryologic development in pictures, compare two different species, and use a dissection microscope.

Length of Lesson: 55 min

Introduction/Background: This will be a phenomena lab, students will only have to be able to use the microscope and make observations.
Students will watch a video of the life cycle of annual and non-annual killifish. While watching they will answer questions that go with the video.

Key Concepts and Terms Covered:

Diapause
Staging
Observation

Materials:

- A way to watch the YouTube video
- Staging cards
- Dissection microscope
- Killifish Embryos

Activities of the Session:

1. Video and worksheet
2. Embryo Development cards
3. Observations of real embryos

Engagement: Students enjoy working with a microscope. I think the added piece of looking at a living organism will keep the students engaged. Since that is the last thing, we get to in the lesson, they should have good incentive to keep going.

Evaluation: Since this will be used as a phenomena to set the stage for our genetics unit, I will only be evaluating them on participation and if they did the worksheets that went with this lab.

Extensions and Modifications: If students are struggling with the microscope, I have an attachment that can connect to my phone so we can look at the embryos together and I can point out some of the features that they should be look at. I usually pair up the higher and lower students together for microscopes since we only have 1 microscope for every 2 students. This helps everyone since it's hard for me to get around to each microscope quickly.

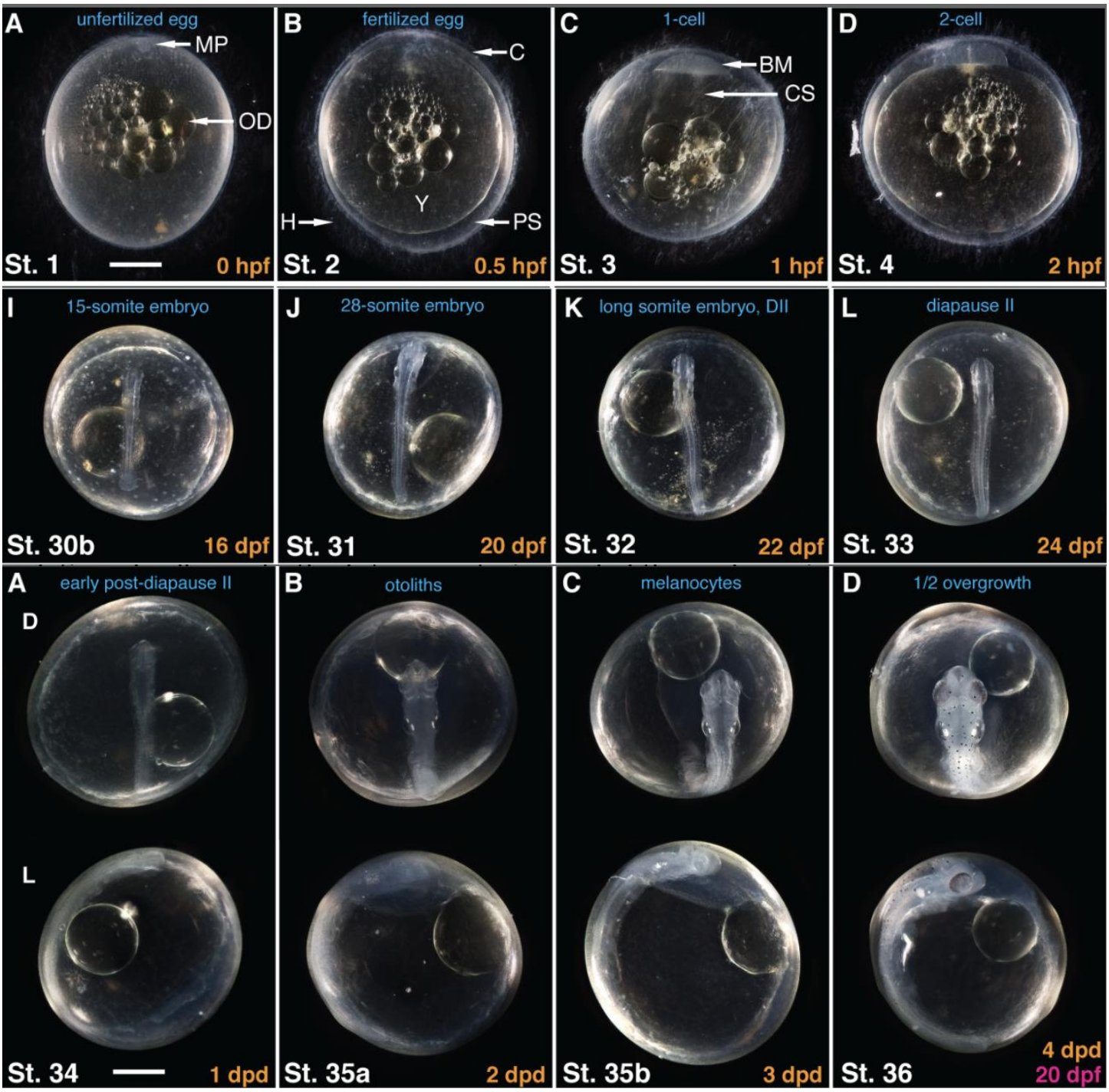
Application: We will be spending a lot of time talking about genetics in general this will be a great example of how we do real research and why would anyone use this fish for studies.

Resources:

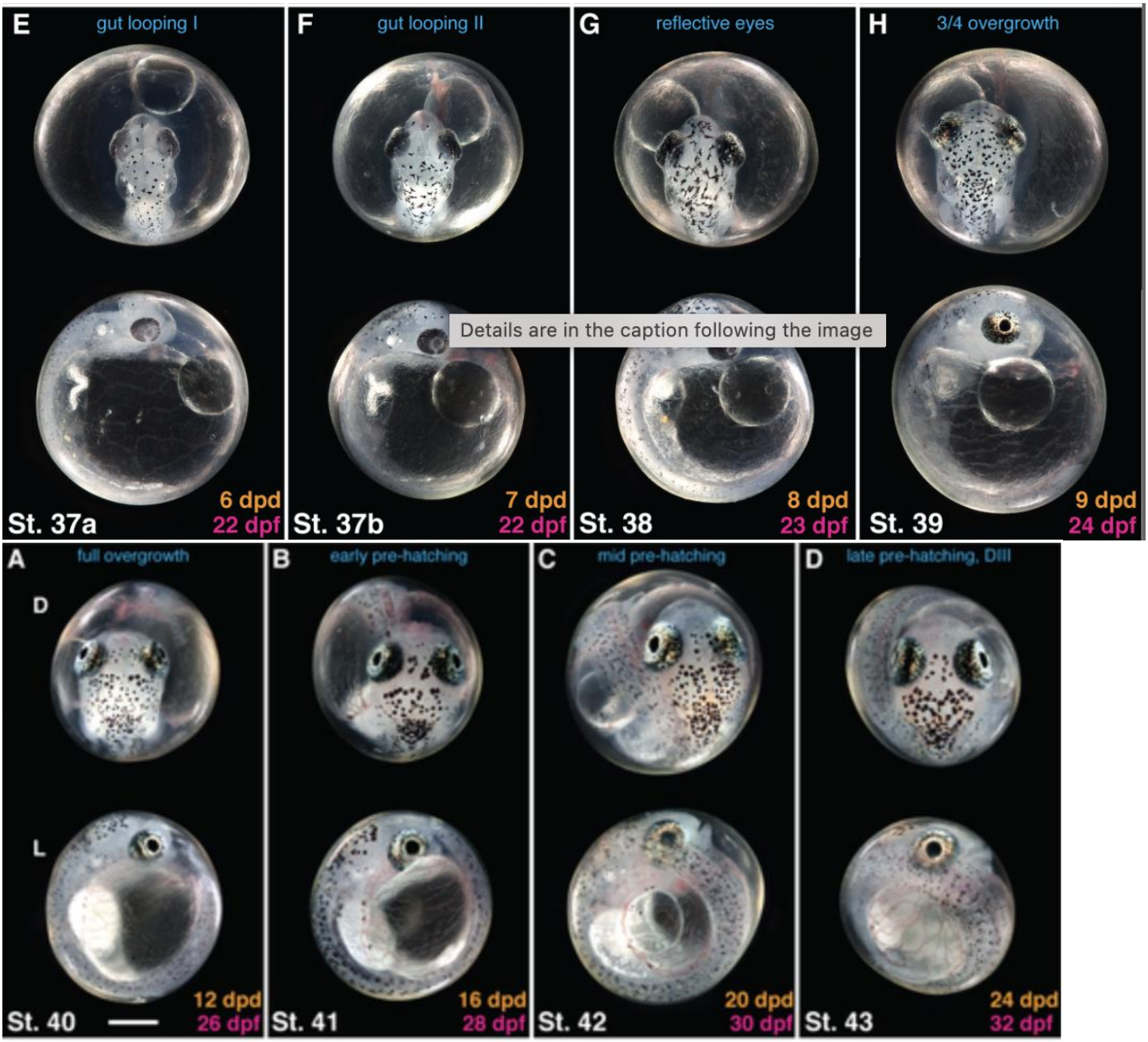
Podrabsky, Jason E., et al. "Embryonic Development of the Annual Killifish Austrofundulus Limnaeus : An Emerging Model for Ecological and Evolutionary Developmental Biology Research and Instruction." *Developmental Dynamics.*, vol. 246, no. 11, 2017, pp. 779–801, https://doi.org/10.1002/dvdy.24513.

https://www.youtube.com/watch?app=desktop&v=mlEv1oYbwyI&t=38

Embryological Stages for Annual Killifish: *Austrofundulus limnaeus*



Photos from: Podrabsky, Jason E., et al. “Embryonic Development of the Annual Killifish Austrofundulus Limnaeus : An Emerging Model for Ecological and Evolutionary Developmental Biology Research and Instruction.” *Developmental Dynamics.*, vol. 246, no. 11, 2017, pp. 779–801, https://doi.org/10.1002/dvdy.24513.



Photos from: Podrabsky, Jason E., et al. “Embryonic Development of the Annual Killifish Austrofundulus Limnaeus : An Emerging Model for Ecological and Evolutionary Developmental Biology Research and Instruction.” *Developmental Dynamics.*, vol. 246, no. 11, 2017, pp. 779–801, https://doi.org/10.1002/dvdy.24513.

Embryological Stages for Non-Annual Killifish: *Rivulus cylindraceus*

Comparing stages of Two Killifish Species

Background Information: What is a Killifish?

Directions: As you watch the video listen for the following information. Record your answers below.
https://www.youtube.com/watch?app=desktop&v=mlEv1oYbwyI&t=38

1. What does an annual killifish life cycle look like? Sketch or write.

2. Where do annual killifish live (type of environment & on what continents)?

3. What is diapause?

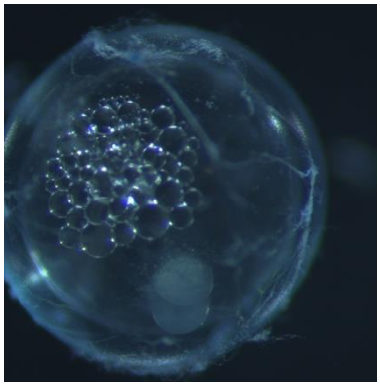
4. Why does the annual killifish do this?

5. How is a non-annual killifish's life cycle different than an annual species?

6. Where do non-annual killifish live?

Learning to stage Killifish

Directions: In this step you are going to be looking at 4 different pictures. You will need to decide first on your own which stage you think this fish is at. Use the staging guides to help you. All the pictures are of *Rivulus cylindraceus,* but both guides can be used to help you.



1. What stage do you think this is?

_____

List at least one observation of why you think that.

_____

_____

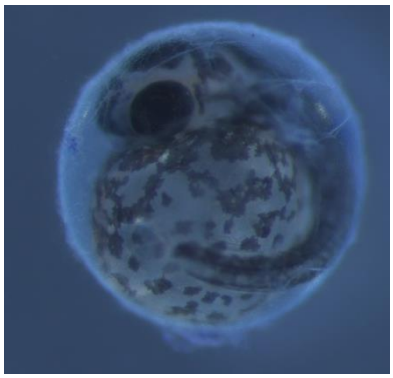
2. What stage do you think this is?

_____

List at least one observation of why you think that.

_____

_____



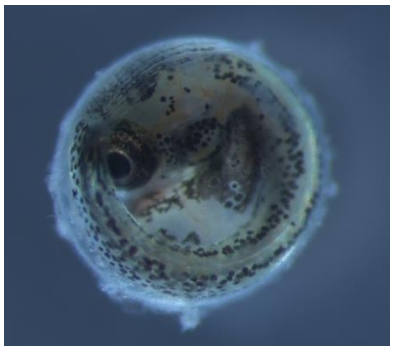
3. What stage do you think this is?

_____

List at least one observation of why you think that.

_____

_____



4. What stage do you think this is?

_____

List at least one observation of why you think that.

_____

_____

Comparing your results

Work with others at your table to discuss what stage you each picked for 4 pictures. Have each person describe their observations and reasons. Decide as a group at what stage each of the embryo pictures are at.

Group Consensus

Picture 1. _____ Picture 2. _____ Picture 3. _____ Picture 4. _____

Real Killifish

Directions: There are stations set up around the room. You will need to visit at least 4 of them. Your goal is to draw or describe as best as you can what you see under the microscope. Then using the same guides from earlier decide what stage of development you think the embryo is in.

Warning:
These are alive, any mistreatment will result in your immediate removal from this lab.

Station _____

What stage is it in? _____

Station _____

What stage is it in? _____

Station _____

What stage is it in? _____

Station _____

What stage is it in? _____