The Endosymbiotic Relationship of Riftia pachyptila and Chemosynthetic Bacteria
Client: Kevin Brennan and Josh Bird
Audience: Undergraduate microbiology students

Jacqueline Mason

TRT: 1:30

1-1

The Endosymbiotic Relationship

AUDIO: *Music*

ANIM: Title screen fades in from black. The background appears first, then "The Endosymbiotic Relationship" fades in.

1-2

The Endosymbiotic Relationship of Riftia pachyptila and Chemosynthetic Bacteria

AUDIO: *Music*

ANIM: The remaining title screen text fades in.

1-3

AUDIO: Chemosynthetic bacteria...

ANIM: Scene fades into close-up of rod-shaped bacterial cell.

(Stewart/2005)

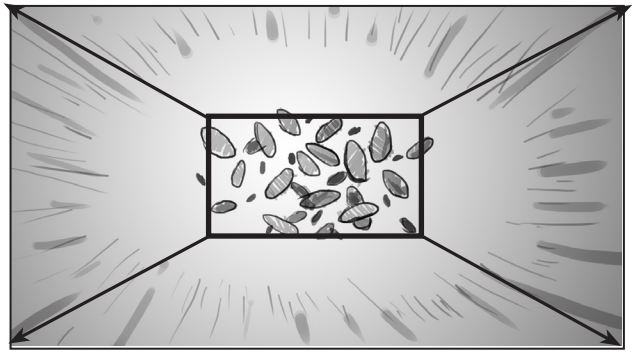
1-4

AUDIO: ...have co-evolved with the giant tube worm, Riftia pachyptila...

ANIM: Camera pulls back to reveal more bacteria.

(Stewart/2005)

1-5

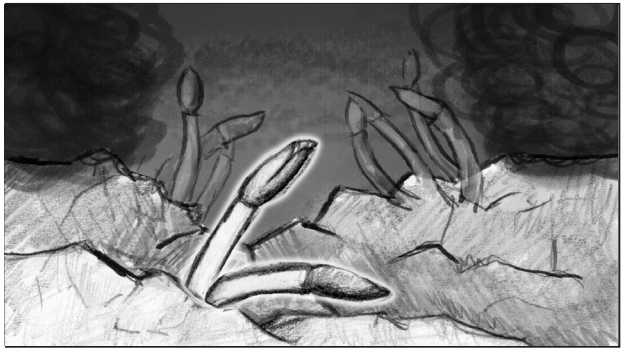


AUDIO: ...in order to survive the harsh environment...

ANIM: Camera quickly zooms out.

(Stewart/2005)

1-6



AUDIO: ...around deep ocean hydrothermal vents.

ANIM: Ocean floor environment comes into full view. Tube worms are seen moving gently in the current. Camera slowly pans left.

(Stewart/2005)

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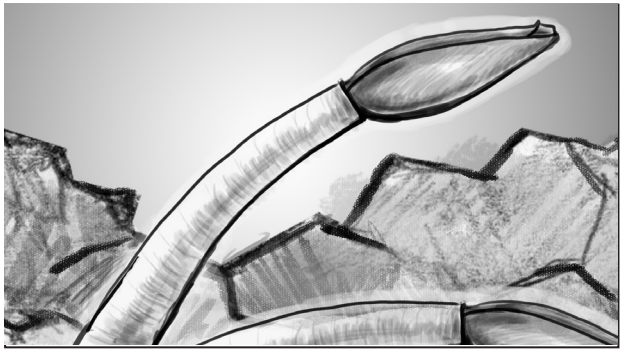
2-1

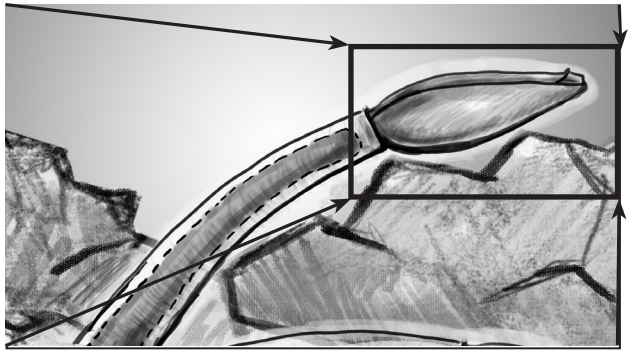


AUDIO: In order for biosythesis to occur...

ANIM: Scene cuts to close-up of worm. Camera slowly moves up and to the right.

(Anderson/2002)

2-2

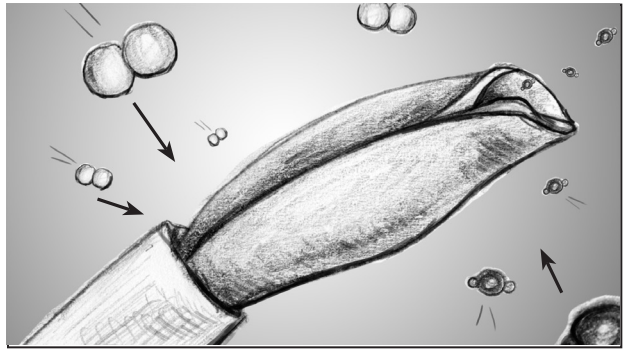


AUDIO: ...the worm must deliver key substrates to bacteria living inside the worm's trophosome.

ANIM: Outline of the trophosome breifly glows. Camera begins to zoom in to the branchial plume.

(Anderson/2002)

2-3

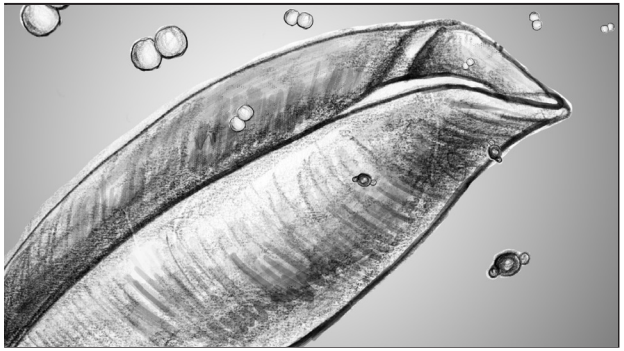


AUDIO: Hydrogen sulfide, oxygen, and carbon dioxide...

ANIM: Worm is out of focus. Substrate molecules float onto screen and are in focus, moving towards plume. Each group of substrates glow according to the narration.

(Anderson/2002)

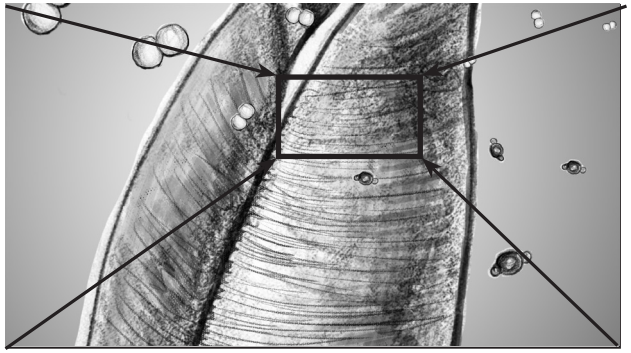
2-4



AUDIO: ...are taken in...

ANIM: Camera pushes in towards the plume. The substrates continue to move towards the plume.
(
Anderson/2002)

2-5

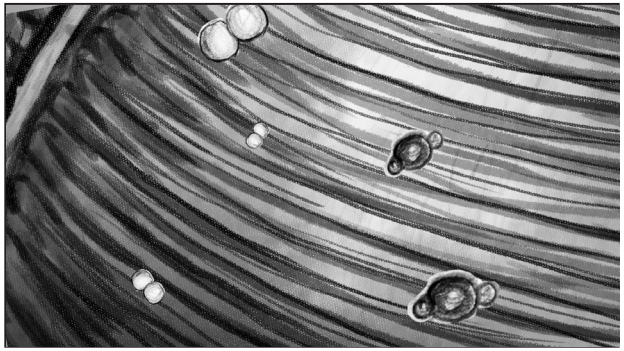


AUDIO: ...by the worm...

ANIM: Camera rotates slightly and assumes a more top-down view of the plume. The plume is now fully in focus. Camera then begins to zoom into plume.

(Anderson/2002)

2-6



AUDIO: ..through a highly-vascularized...

ANIM: Camea follows substrates into the plume. Blur-transition into the plume. The vessels are directly underneath this structure.

(Anderson/2002)

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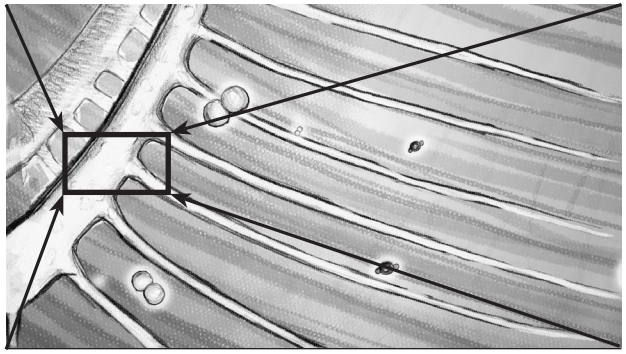
3-1

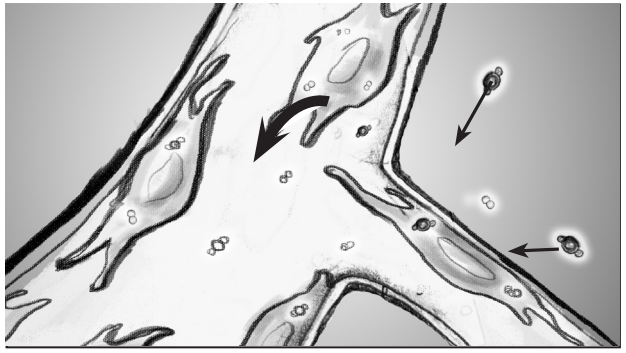


AUDIO: ...gill-like plume.

ANIM: New scene shows substrates entering blood vessel. Camera then zooms into vessel.

(Anderson/2002)

3-2

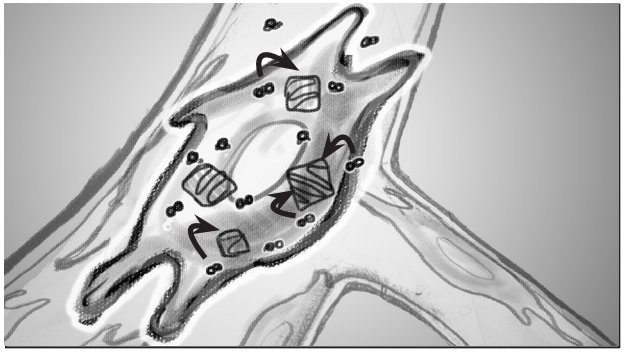


AUDIO: R.pachyptila has evolved...

ANIM: Hemocytes are seen inside the vessel. Substrates enter the blood stream. One of the hemocytes then flies forward toward the camera.

(Zal/1998)
(Stewart/2005)

3-3

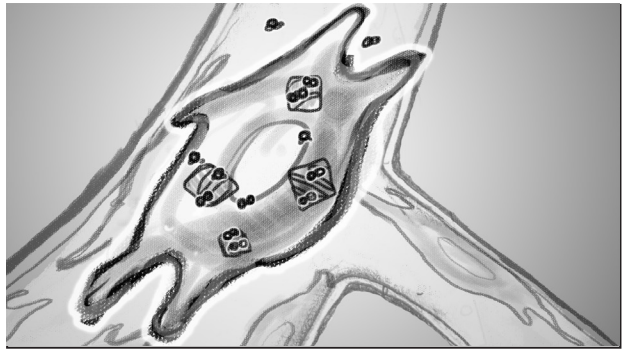


AUDIO: ...unique hemoglobins...

ANIM: The hemocyte is front and center and becomes semi-transparent. Hemoglobin molecules become visible with hydrogen sulfide (HS-) and oxygen (O2) moving toward them.

(Zal/1998)

3-4

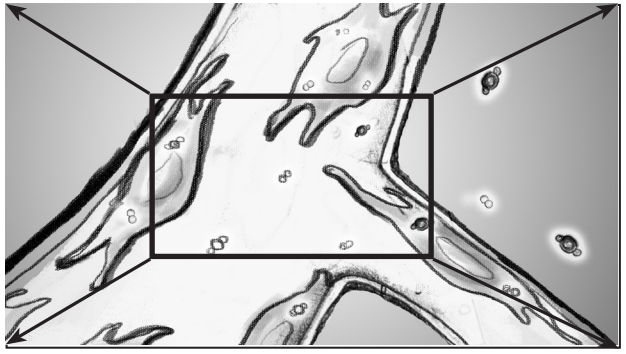


AUDIO: ...that allow it to bind both sulfide and oxygen.

ANIM: HS- and O2 glow as they bind to the hemoglobins. The hemocyte begins to glide back into the blood stream.

(Zal/1998)

3-5

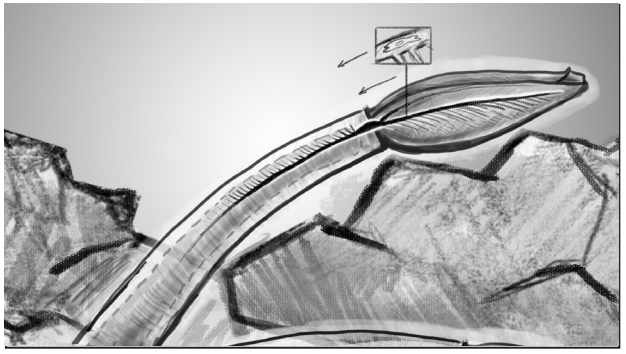


AUDIO: These substrates...

ANIM: Camera zooms out, but this scene remains visible, becoming a small snapshot in a larger scene.

(Zal/1998)

3-6



AUDIO: ...are delivered...

ANIM: The entire worm becomes visible in the scene. An outline of the worm's main blood supply becomes visible, and the blood vessel snapshot follows a hemocyte to the trophosome area of the worm

(Anderson/2002)

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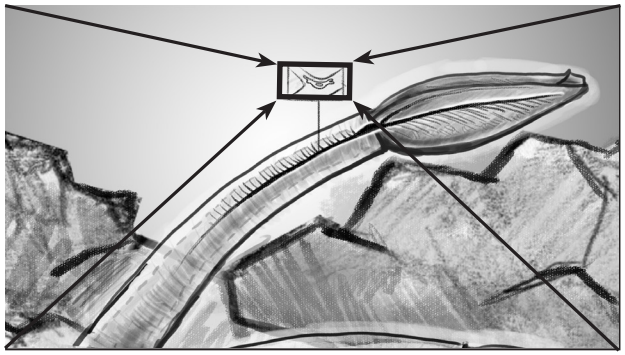
4-1

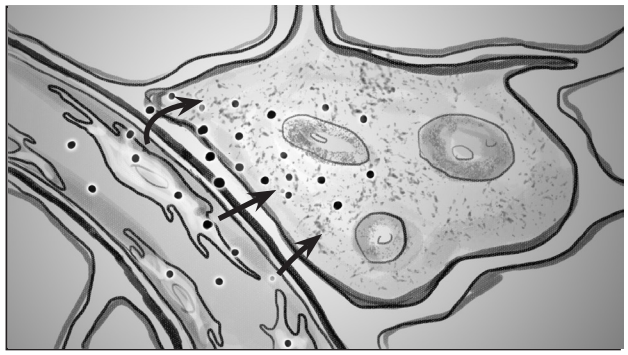


AUDIO: ...to specialized host cells called...

ANIM: Camera zooms back into the snapshot of blood vessel, which is now in the trophosome area.

(Anderson/2002)
(Bright/2003)

4-2

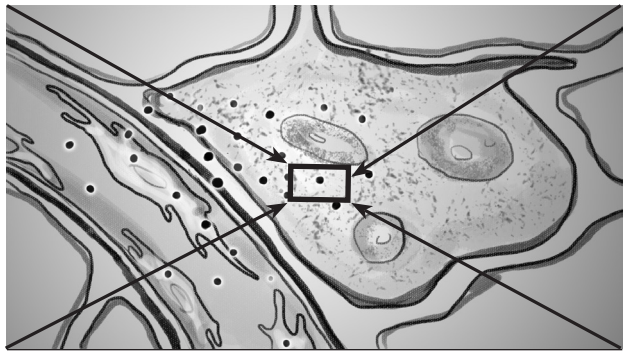


AUDIO: ...bacteriocytes, which contain...

ANIM: Camera zooms into a capillary. Substrates are seen diffusing into the bacteriocyte from the hemocytes.

(Bright/2003)
(Zal/1998)
(Stewart/2005)

4-3

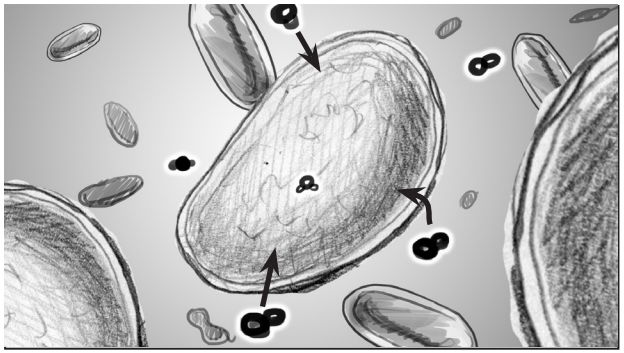


AUDIO: ...the...

ANIM: The virus makes contact with the cell surface.

(Bright/2003)
(Stewart/2005)

4-4



AUDIO: ...chemosynthetic bacteria
.

ANIM: Bacteria cells fill the scene. The camera is slowly moving to the bottom right, maintaining focus on the center cell. Substrates are seen flying in from behind camera and entering the bacteria.

(Bright/2003)

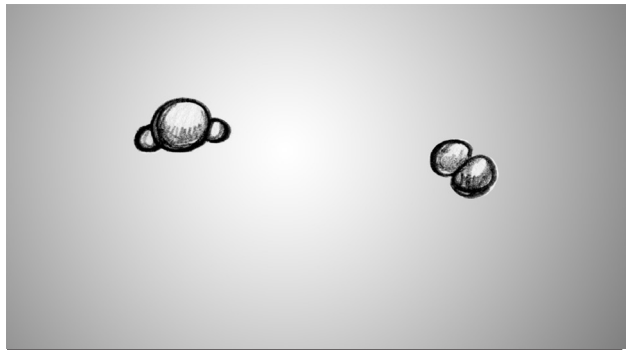
4-5

AUDIO: The chemosynthetic bacteria use...

ANIM: Camera follows an HS- molecules as it enters a bacterium.

(Stewart/2005)

4-6



AUDIO: ...hydrogen sulfide and oxygen...

ANIM: Camera pulls back to widen scene. O2 molecule enters.

(Stewart/2005)

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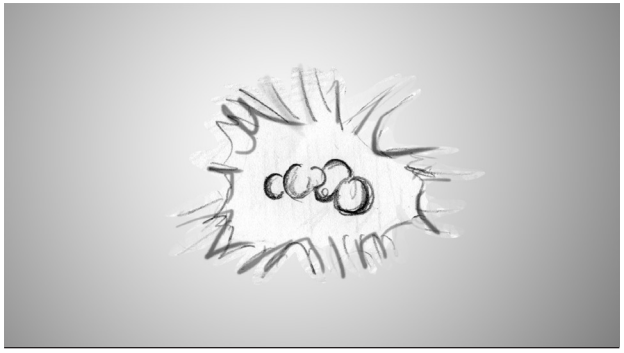
5-1

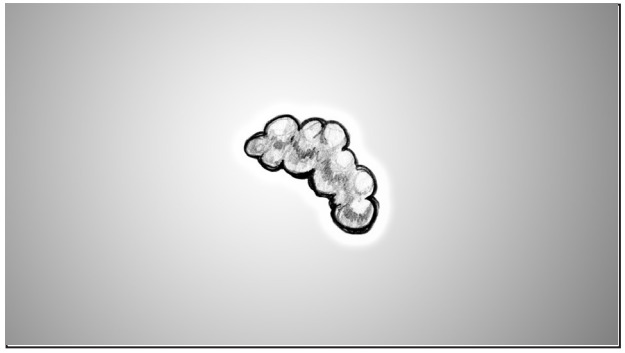


AUDIO: ...to produce energy...

ANIM: HS- and O2 combine and glow.

(Stewart/2005)

5-2

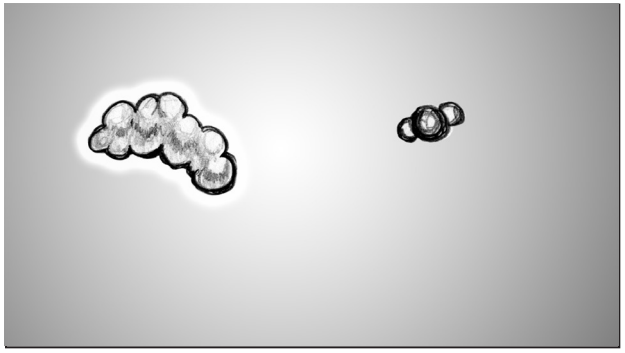


AUDIO: ...in the form of adensoine triphosphate.

ANIM: ATP is now formed and is slowly rotating.

(Stewart/2005)

5-3

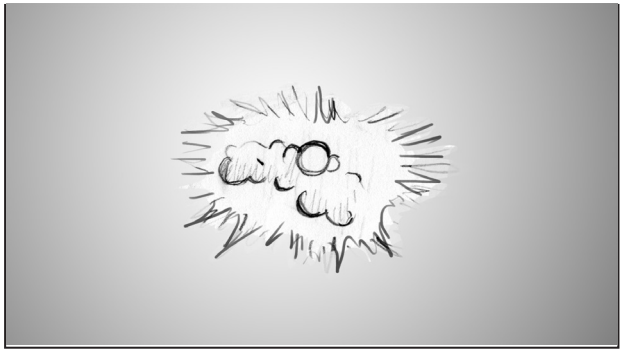


AUDIO: This energy is used to convert carbon dioxide...

ANIM: Camera gently pans to the right; CO2 molecule enters.

(Stewart/2005)

5-4

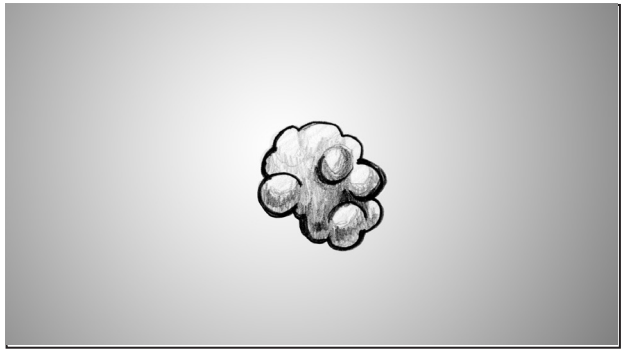


AUDIO: ...into...

ANIM: ATP and CO2 combine and glow.

(Stewart/2005)

5-5

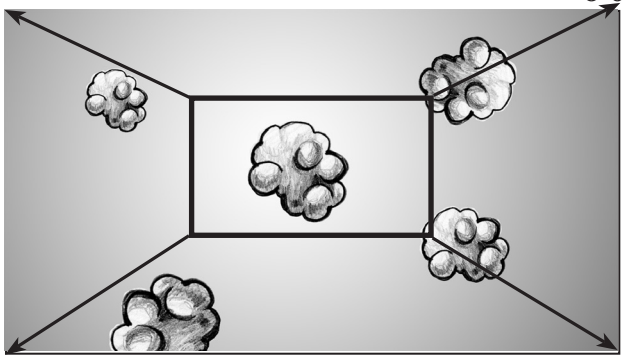


AUDIO: ...organic compounds.

ANIM: Glucose is now formed. Camera begins to slowly pull back.

(Stewart/2005)

5-6



AUDIO: These compounds are then...

ANIM: More glucose molecules float into the scene. Camera flash-zooms out of the bacterium.

(Stewart/2005)

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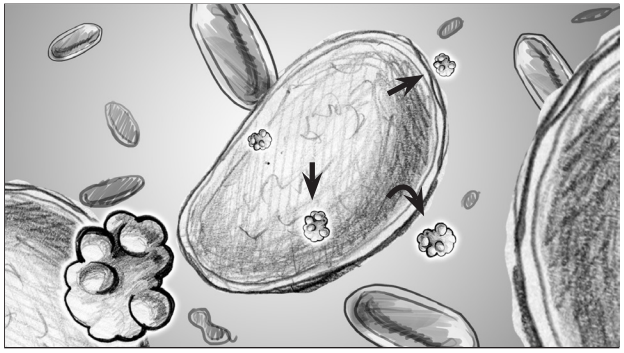
6-1

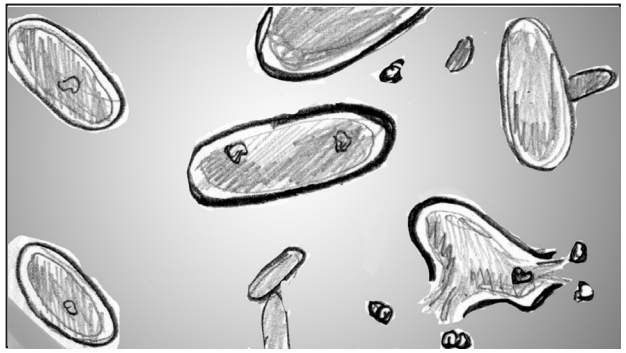


AUDIO: ...supplied to the host either through bacterial excretion...

ANIM: Glucose seen leaving the bacterium. Camera slowly pulls back.

(Stewart/2005)

6-2

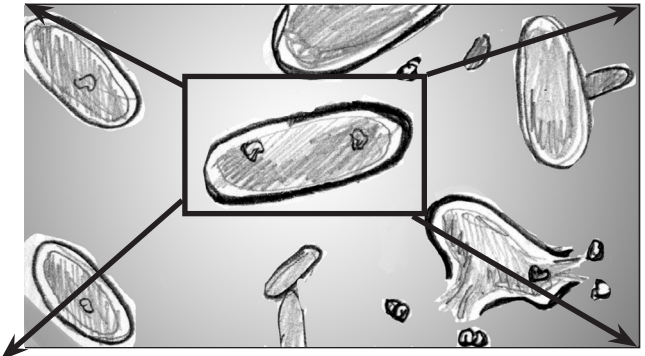


AUDIO: ...or direct digestion of the chemosynthetic bacteria.

ANIM: Camera continues to pull back. A bacterium undergoing lysis appears in the frame.

(Stewart/2005)

6-3

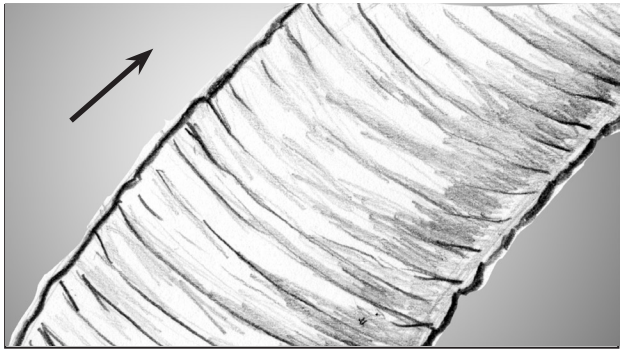


AUDIO: Chemosynthetic bacteria...

ANIM: Flash zoom out of the worm.

(Stewart/2005)

6-4

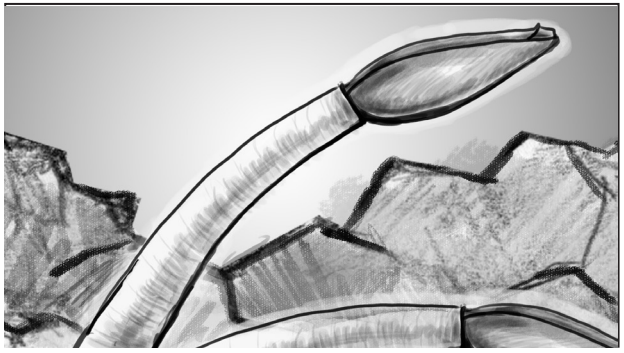


AUDIO: ...make life possible around hydrothermal vents...

ANIM: Trunk of worm appears in the frame. Camera slowly travels up the trunk while pulling back.

(Stewart/2005)

6-5

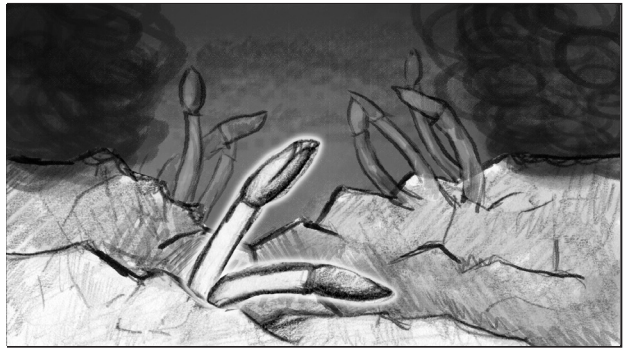


AUDIO: ...possible. This unique ecosystem can provide insights into the origin of life...

ANIM: Two tube worms appear in the frame as the camera continues to pull back.

(Stewart/2005)

6-6



AUDIO: ...and perhaps clues to possible life on other worlds.

ANIM:Full frame of ocean scene appears.

(Stewart/2005)

1. Andersen, A. C., Jolivet, S., Claudinot, S., & Lallier, F. H. (2002). Biometry of the branchial plume in the hydrothermal vent tubeworm Riftia pachyptila (Vestimentifera; Annelida). Canadian journal of zoology, 80(2), 320-332.

2. Bright, M., & Sorgo, A. (2003). Ultrastructural reinvestigation of the trophosome in adults of Riftia pachyptila (Annelida, Siboglinidae). Invertebrate Biology, 122(4), 347-368.

3. Markert, S., Arndt, C., Felbeck, H., Becher, D., Sievert, S. M., Hügler, M., ... & Hecker, M. (2007). Physiological proteomics of the uncultured endosymbiont of Riftia pachyptila. Science, 315(5809), 247-250.

4. Stewart, F. J., & Cavanaugh, C. M. (2005). Symbiosis of thioautotrophic bacteria with Riftia pachyptila. In Molecular basis of symbiosis (pp. 197-225). Springer Berlin Heidelberg.

5. Zal, F., Leize, E., Lallier, F. H., Toulmond, A., Van Dorsselaer, A., & Childress, J. J. (1998). S-Sulfohemoglobin and disulfide exchange: the mechanisms of sulfide binding by Riftia pachyptila hemoglobins. Proceedings of the National Academy of Sciences, 95(15), 8997-9002.