HAIGLER PROTOCOL FOR VIEWING CROSS SECTIONS OF PLANTS

Materials (per student team):

Plants
Double-edged razor blades (split into two as demonstrated by the teacher)
Masking tape for razor blade handle
Spot Plate
Carrot slices
Knife
Paint brush (small with some bristles removed)
Bottle of distilled water
Glass slides
Microscope
Toluidine Blue Stain

Procedure:

1. Collect plant material to be observed, immersing cut stems in water.

2. Place a small section of the stem of a plant on a glass cutting plate or slide. Using a very sharp side of a double-edged razor blade, cut at a slight slant and take as thin a section as possible (0.5 – 1 mm). **See Diagram 1**.

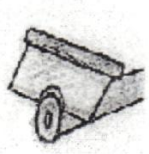


Diagram I

3. For softer tissue, make a small slit in a slice of carrot to hold a small piece of plant stem. Insert the plant tissue in the carrot. Using a very sharp razor blade, take a very thin section of the plant at an angle.

Attention: Keep the razor wet at all times by dipping it in water before each cut.

4. Immerse the sections in distilled water in the first well of the spot plate. See **Diagram II**.

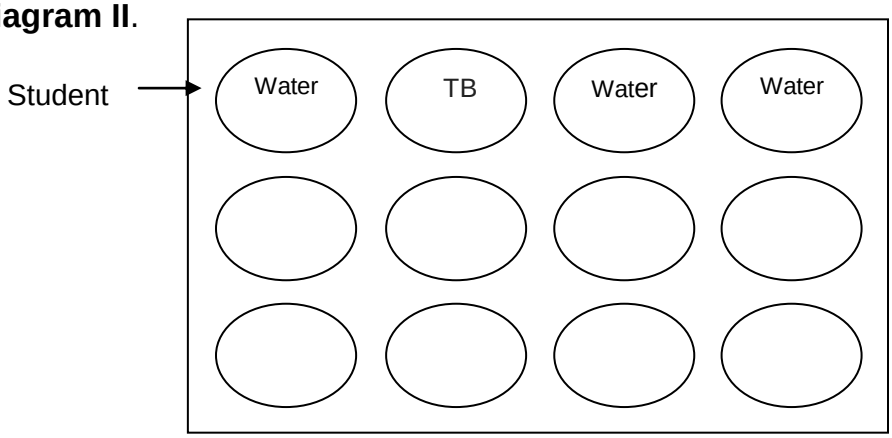


Diagram II

5. Move several sections into the second well that contains a few drops of Toluidine Blue.

6. After 30 seconds, move the tissue to the third well to rinse and follow with the fourth well for a final rinse.

Hint:

- Times may need to be adjusted slightly for different plants.

7. With a paintbrush, lift the section out of water and place it, fiat side down, on the center of the slide. Never use forceps to handle the sections. The water surrounding the section should allow it to adhere to the slide. Water should not drip from the slide; blot off extra water if needed.

8. Move the condenser downward to allow room for the inverted section. Place the slide, SECTION SIDE DOWN, on the microscope stage so that the adhering section is in the center of the stage and positioned over the center of the condenser. See **Diagram III.**

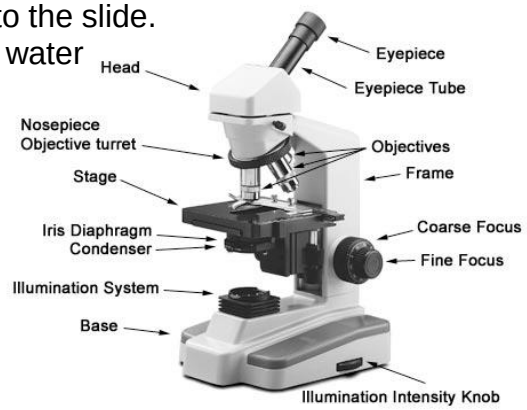


Diagram III

9. Focus on the plant section while looking through the slide. Do this on the lowest magnification objective available. Start with the objective positioned high above the slide and slowly move it toward the specimen to find the focus. TAKE CARE not to ram the objective into the slide.

10. The cellular anatomy should come into focus very clearly. Different magnifications can be used to observe different levels of detail. (If bubbles appear, they can be minimized by carefully removing and reapplying the section. Do not confuse bubbles with cells!) Refer to **Table I** to identify cell types and tissues.

11. If the slide begins to dry out, add a small amount of water around the section. Place a small drop of water to one side of the section and then placing tissue or filter paper on the other side of the section, drawing the water across the section. See **Diagram IV.**

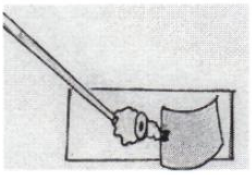
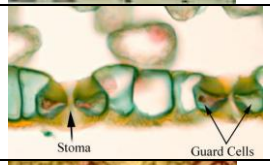
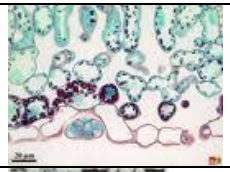
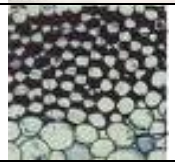


Diagram IV

Table I

Tissue Element or Structure	Color Developed by Toluidine Blue
Xylem	Green or Blue-green
Phloem	Red
Schlerenchyma	Blue-green, sometimes green
Collenchyma	Red-Purple
Parenchyma	Red-Purple
Cellulose, Starch	Unstained
DNA	Blue

Elaboration: The table below shows plant adaptations observed at the microscopic level. Descriptors, images and functions are given in addition to modifications observed in specified environments. Xerophytic plants have adaptations for dry climates, mesophytic plants grow in moderate climates (not extreme) and hydrophytic plants grow in water environments.

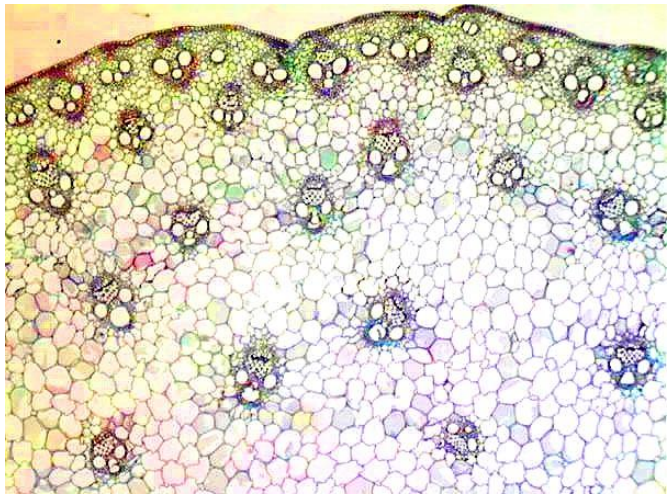
Anatomical Adaptations in Plants				
Description of Plant Structure	**Image**	**Function**	**Modification of Structure**	**Adaptation Environment**
Cuticle: waxy coating on the surface of leaves and stems		Protects structure from water loss and serves as defense (bacteria and viruses)	Thick cuticle to prevent water loss sometimes present	Xerophytic
			Thick cuticle on top of floating leaves—water rolls off	Hydrophytic
Epidermal Layer: outer layer of cells covering leaves, stems and roots		Protects inner tissue; regulates gas and water exchange; produces cuticle	Multiple layers in leaves with many chloroplasts (sunny locations); same plant can have reduced layers in a shaded leaf	Xerophytic
Trichomes: small hair-like structures on leaves and stems		Traps moisture; can give a silver coloration that reflects light	Abundant	Xerophytic
			Present	Hydrophytic Mesophytic
Stoma: (also stomata) microscopic pores in the epidermal layer surrounded by guard cells		Allows gas exchange between the environment and the interior of the plant	Sunken; often closed and on the bottom side of the leaf	Xerophytic
			On top of leaf; increased and open most of the time	Hydrophytic
Air spaces: intercellular spaces between mesophyll or other parenchyma cells		Holds gases and water vapor for gas exchange and buoyancy	Large spaces	Xerophytic (succulent)
			Large spaces	Hydrophytic
Collenchyma cells: plant cells with thickened, uniform walls		Helps stems in soggy or windy conditions to maintain strength	Abundant just inside the epidermis	Xerophytic
				Hydrophytic

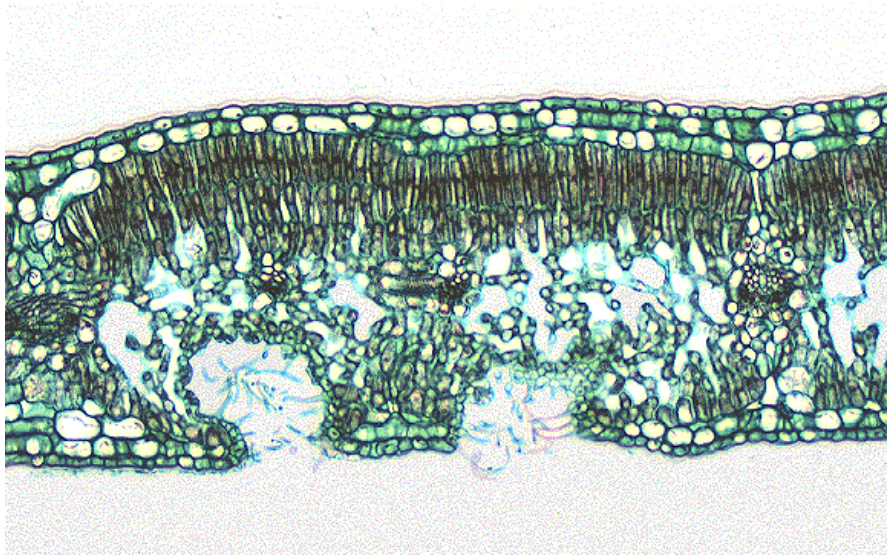
Name_____

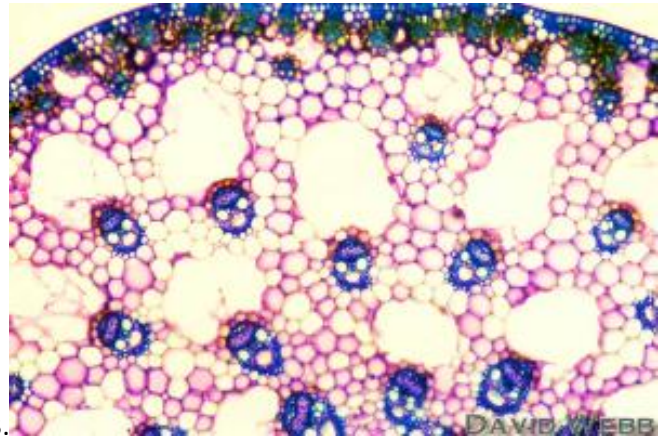
What Does the Plant Image Tell?
Finding the Environment from Anatomical Structures

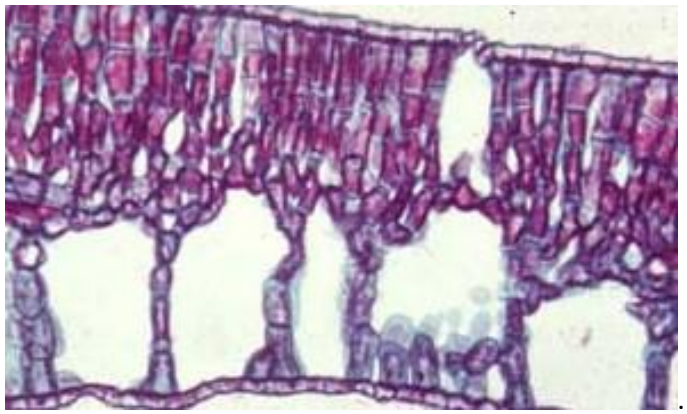
For each microscopic image provided, describe anatomical characteristics that provide clues on the plant's environment. Analyze the information and derive the climate where the plant would grow (xerophytic, mesophytic or hydrophytic).

Unknown	Characteristics	Environment
#1		
#2		
#3		
#4		

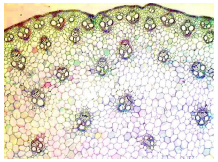
1. 

2. 

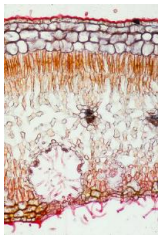
3. 

4.  .

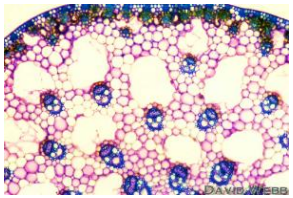
Teacher Key for Unknowns

1. 

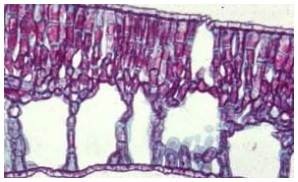
Typical monocot: corn (mesophytic)

2. 

Dicot: Oleander (xerophytic: thick cuticle, many layered epidermis, succulent with space for water, sunken stomata surrounded by trichomes to hold moisture)

3. 

Monocot: Cypress Plant (hydrophytic: thick cuticle, layers of collenchyma to provide support, air spaces for buoyancy)

4. 

Dicot: Water Lily (hydrophytic: air spaces for buoyancy and stoma with guard cells on the top side)

References for Anatomical Adaptations in Plants

Cuticle:
clivia **cuticle** jpg 804x556 - jpeg
804 × 556 - 32k - jpg
images.xoila.com

Air spaces:
intercellular **space** below
512 × 382 - 25k - jpg
vcbio.science.ru.nl

Trichome:
Aerenchyma with lignified "inner hairs" *(Nymphaea spec.)*: section through the leaf stalk. Staining with phloroglucin-HCl. (photo by W. KASPRIK).
www.biologie.uni-hamburg.de/b-online/e05/05a.htm

Collenchyma:
pharamcytimes.wordpress.com/2009/04/page/2/

Epidermis:
1 upper **epidermis**
290 × 512 - 23k - jpg
vcbio.science.ru.nl

Epidermis:
1000 × 356 - 67k - jpg - botit.botany.wisc.edu/.../images/epidermis.jpg
Image may be subject to copyright.
Below is the image at: botit.botany.wisc.edu/courses/botany_130/anat...

Corn cross section:
www.lima.ohio-state.edu/.../archive/stems.html

Hydrophytic plant:
http://botweb.uwsp.edu/anatomy/dicotleafxs.htm

Where's Home?

Background Information: Students apply information from previous activities to look for patterns and decide where plants live. They should build an understanding of plant adaptations as they move through the unit.

Purpose: The purpose of this activity is to compare adaptive characteristics of plants at the tissue level to determine where they live**.**

Objectives:

- The student will derive the habitat of a plant by generalizing from patterns.

Age Appropriateness: Grades 9-10

Time Requirements: 20minutes

Materials:
Student Sheets
Transparencies of leaf cross sections

Preparation and Procedure:

1. Copy student sheets.
2. Have students compare the examples provided to "typical examples" on the student sheet to determine the habitat of each.

Questions to Ask:

1. Look at each example that shows an adaptation. How does it look different from the "typical" plant?

2. What could be the purpose for the change?

3. If structure relates to function, how do you think the structure could help the plant survive?

4. Infer where the plant lives.

WHERE'S HOME?

Purpose: The purpose of this activity is to compare adaptive characteristics of plants at the tissue level to determine where they live**.**

Materials:
Illustrations of plant microscopy slides

Procedure:

1. Observe the examples given in the illustrations. Compare the typical leaves to examples that have special adaptations.
2. Look for overall patterns and predict where each example lives. Select and answer, and justify your response.

PLANT CROSS SECTIONS

1. The example provided is a typical dicot leaf. What are some clues that help you to identify this cross-section?

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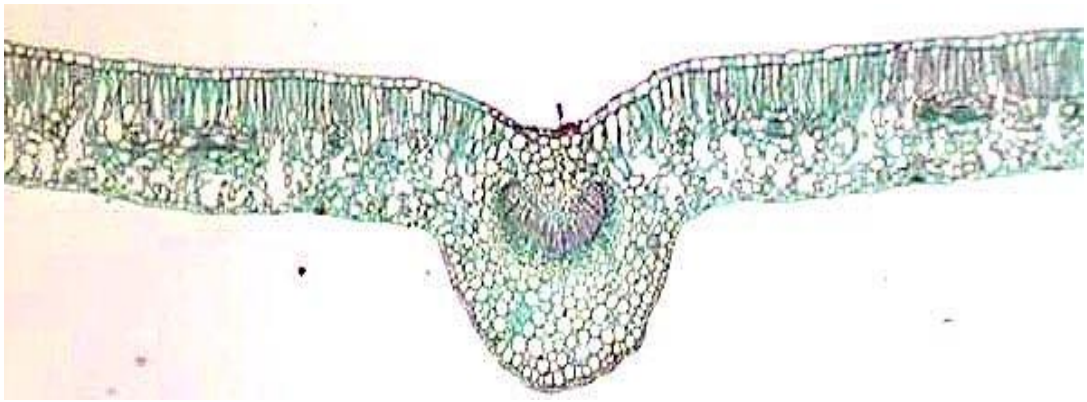
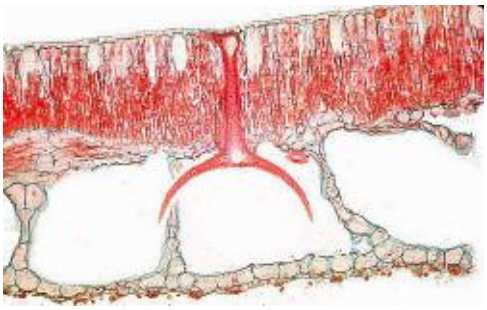


2. Observe the cross-section below. The adaptations indicate the plant grows in a



a. desert
b. rainforest
c. lake
d. tundra

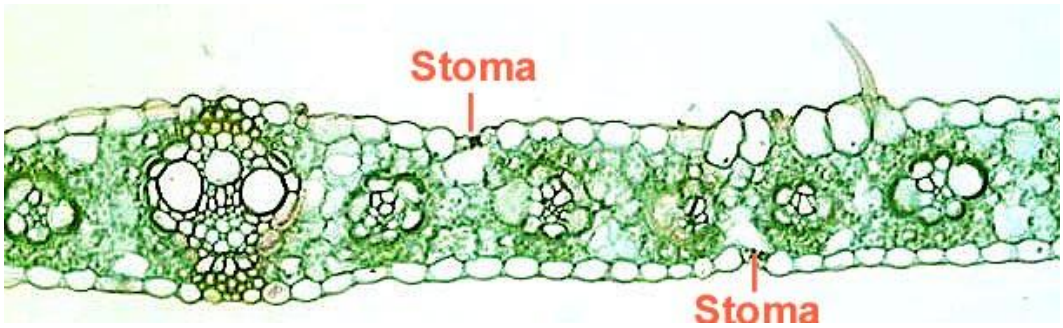
Justify your answer.

3. Where would this plant grow?

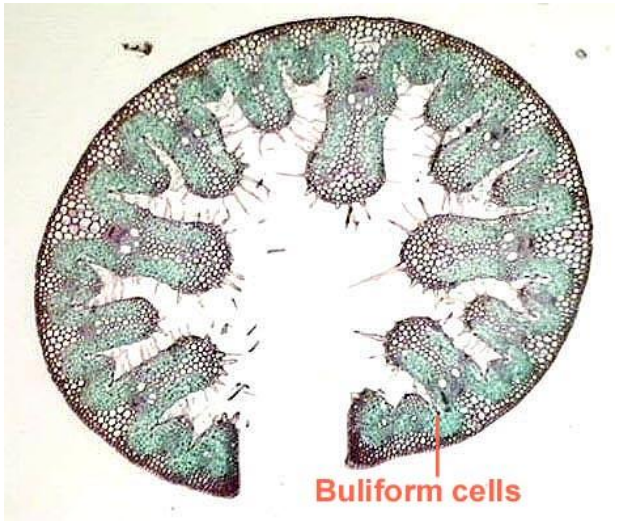
a. forest
b. desert
c. rainforest
d. pond

Justify your answer.

4. The cross-section below is a typical monocot leaf. What are some clues that help you to identify this cross-section?



5. Look at the cross-section below. In what climate would the plant grow?



a. arid
b. rainforest
c. pond
d. tundra

Justify your answer.

1. The example provided is a typical dicot leaf. What are some clues that help you to identify this cross-section?

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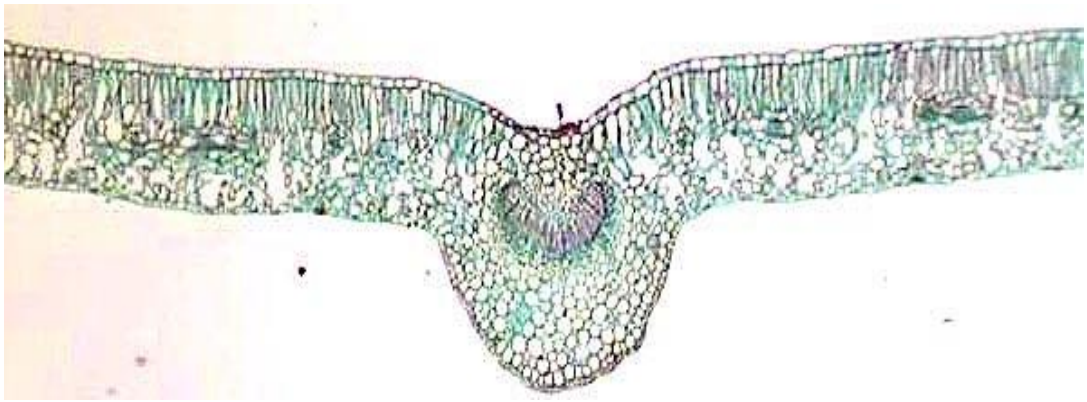
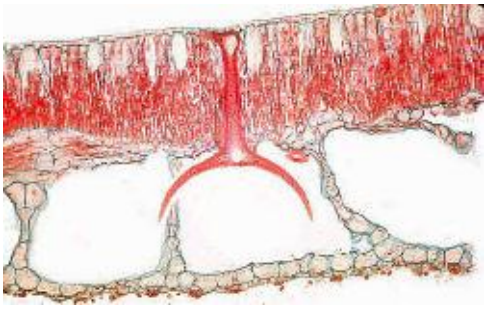


Response:
Top and bottom are evident (palisade and spongy mesophyll)
Vein in the middle indicates a vein
Pattern of the vascular bundle is not a monkey face

2. Observe the cross-section below. The adaptations indicate the plant grows in a



e. desert
f. rainforest
g. lake
h. tundra

Response: Lake
The plant has air pockets to float and stomata on top rather than on the bottom.

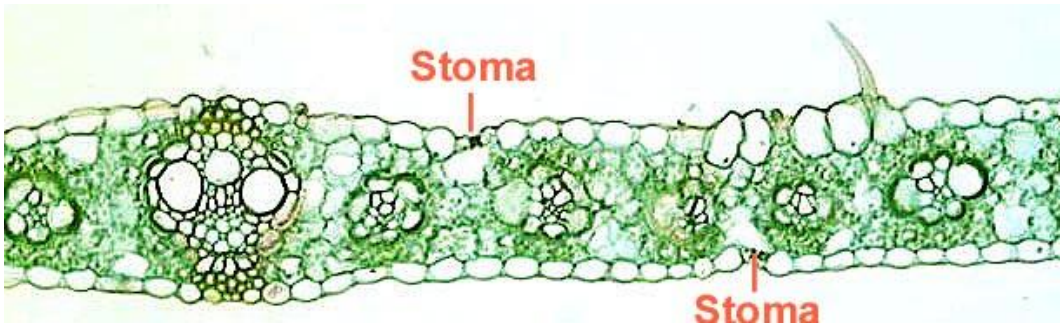
3. Where would this plant grow?

e. forest
f. desert
g. rainforest
h. pond

Justify your answer

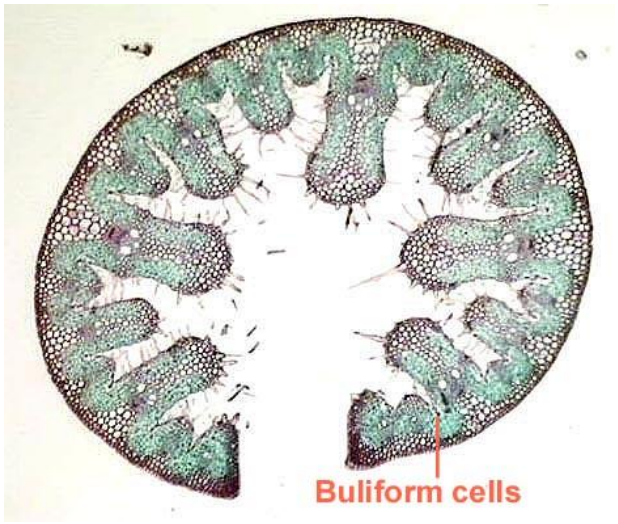
Response: Desert
The plant has multiple epidermal layers on top for protection with a thick cuticle. The spaces within show it is a succulent. The stomata are within special enclosed structures that prevent water loss from the stomata. Trichomes (hairs) are abundant to keep water near the surface.

4. The cross-section below is a typical monocot leaf. What are some clues that help you to identify this cross-section?



Response:
Top and bottom look the same (if it were turned upside down, you could not tell)
Veins are looking at you (parallel is often observed)
Veins are monkey faces

5. Look at the cross-section below. In what climate would the plant grow?



e. arid
f. rainforest
g. pond
h. tundra

Justify your answer.

Response: arid
The leaf rolls to prevent water loss and the trichomes help to hold moisture. Also, the leaf has a thick cuticle.