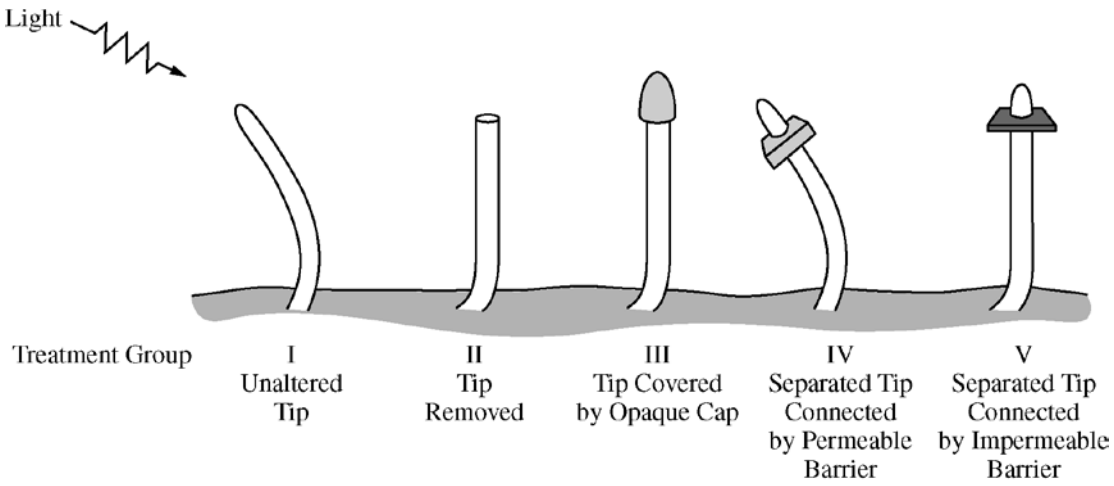
AP® BIOLOGY
2015 SCORING GUIDELINES

Question 5



Phototropism in plants is a response in which a plant shoot grows toward a light source. The results of five different experimental treatments from classic investigations of phototropism are shown above.

(a) **Give support** for the claim that the cells located in the tip of the plant shoot detect the light by comparing the results from treatment group I with the results from treatment group II and treatment group III.

Support (2 points maximum)

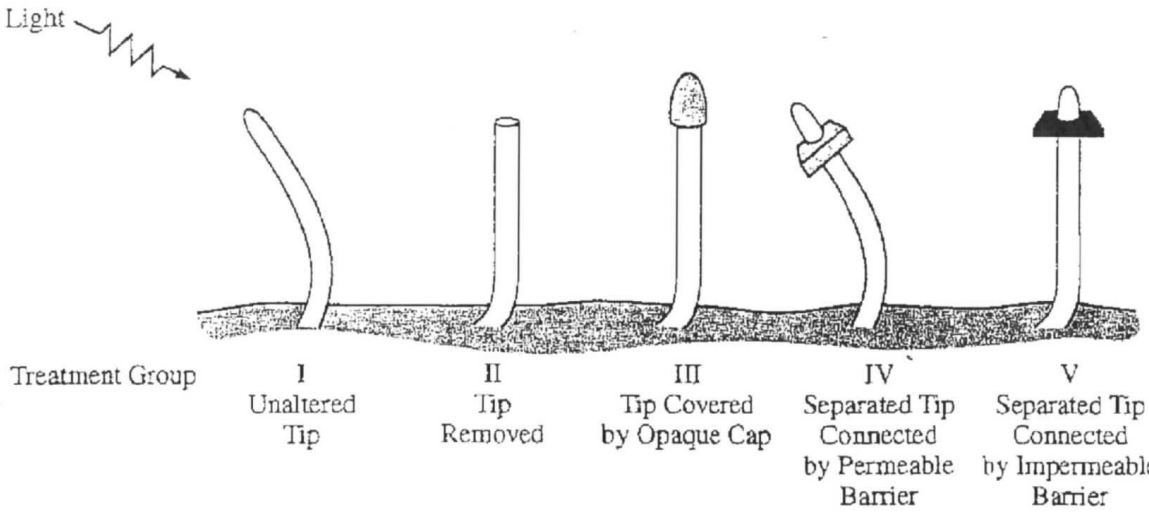
- In treatment II the tip is removed and the plant no longer bends toward light.
- In treatment III the cap blocks the light to the tip and the plant no longer bends toward light.

(b) In treatment groups IV and V, the tips of the plants are removed and placed back onto the shoot on either a permeable or impermeable barrier. Using the results from treatment groups IV and V, **describe** TWO additional characteristics of the phototropism response.

Description (2 points maximum)

- Tip produces a substance/signal/hormone (auxin) in response to light causing the plants to bend
- Substance must diffuse from the tip causing the plants to bend

5A



5. Phototropism in plants is a response in which a plant shoot grows toward a light source. The results of five different experimental treatments from classic investigations of phototropism are shown above.

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a) The plant with the unaltered tip grew towards the light but the plant with the tip removed did not, showing that only the tip and not the entire stem will respond to light and grow towards it. Even when the tip cells are not removed completely and the tip is covered so it is not exposed to light, the plant does not grow towards the light. This shows that the tip itself must be exposed to light in order for the plant to grow towards it.

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5A2

b) The tip sends the signal to the rest of the plant to grow towards the light. In group IV, the signal can be passed through the barrier so the plant grows towards the light. In group V, the tip is unable to pass the signal to the rest of the plant so it does not grow towards the light. This shows that growth of a plant in response to light does not just occur at the tip, but occurs at the entire stem.

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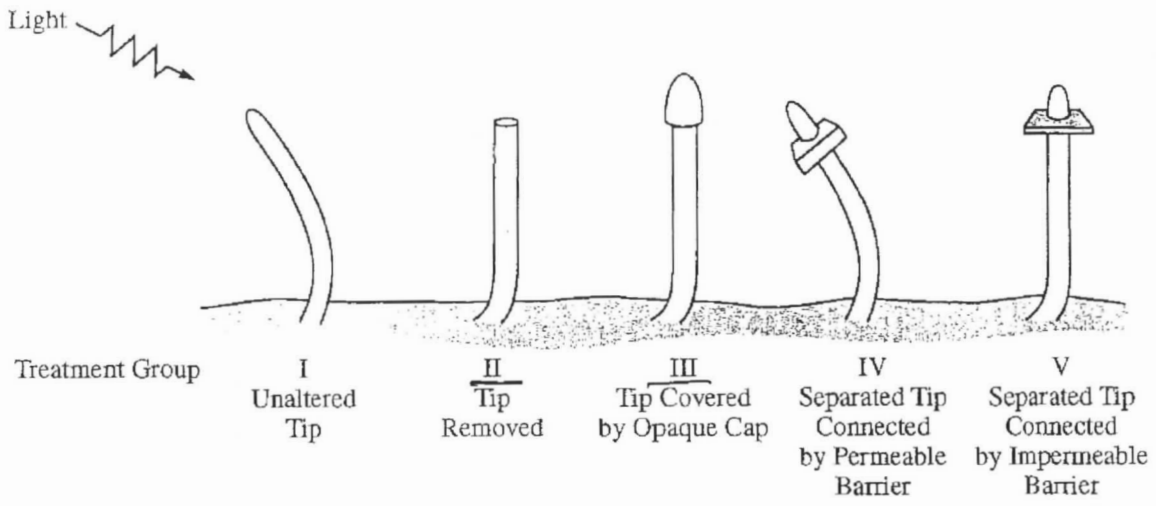
5B1



5. Phototropism in plants is a response in which a plant shoot grows toward a light source. The results of five different experimental treatments from classic investigations of phototropism are shown above.

   (a) **Give support** for the claim that the cells located in the tip of the plant shoot detect the light by comparing the results from treatment group I with the results from treatment group II and treatment group III.

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a) The results from the experiment support the claim that cells located at the tip of the shoot detect light. As seen ~~in~~ by the results of treatment group I, the ~~plant~~ shoot with the attached tip, it bent towards the light. In treatment groups II, the tip removed, and treatment group III, the tip covered with an opaque cap, the plant shoot did not bend towards the light. This provides evidence that ~~a~~ the ~~tip is necessary~~ attached to the plant is

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necessary ~~for~~ allowing ~~ee~~ ~~shoot~~ the plant to bend towards the light. This is the case since auxins are produced and reside in the tip ~~and~~ acting as chemical messengers that control the bending of shoots towards or away from light. When the tip is removed or covered, the message is unable to be transmitted and sent.

b) We can notice how phototropism doesn't occur when ~~a~~ a plant's tip has been removed and replaced with an impermeable barrier. Bending does occur when the tip has been removed and ~~the~~ a permeable barrier has been inserted. This is the ~~the~~ case because auxins, ~~are~~ or chemical messages are able to ~~be~~ pass through the permeable membrane, similar to that of passive transport, but cannot pass through when an impermeable membrane has been inserted between the tip and the shoot's stem.

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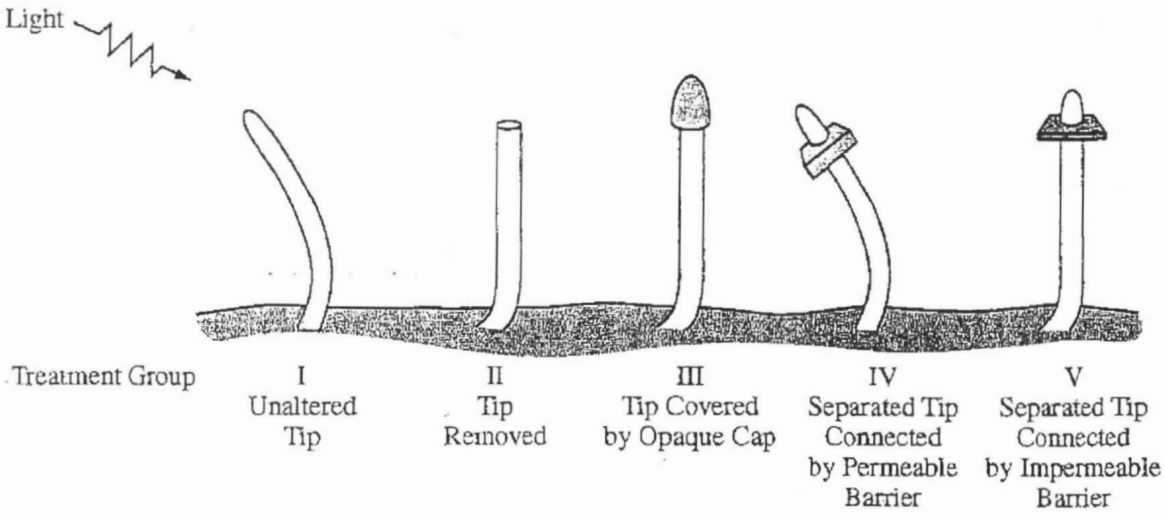
5c,



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(a) The unaltered tip grows slanted toward the light source, whereas the shoots with the tip removed and covered grow straight up. These cells in the tip cannot detect light because they are not present or covered.

(b) These treatment groups demonstrate that cells work together to achieve a common goal, that is, getting closer to the light source. It also shows that communication of cells runs throughout the shoot.

AP® BIOLOGY
2015 SCORING COMMENTARY

Question 5

Question 5 was written to the following Learning Objectives in the AP® Biology Curriculum Framework: 2.21, 2.22, and 2.24.

Overview

This question focused on the results from classic investigations into the phototropic response of plants. Students were provided with a figure illustrating the results from five treatment groups. Students were asked to analyze experimental results from three treatment groups to justify the claim that the phototropic response of plants is controlled by cells in the tips of the shoots. Students were then asked to describe two characteristics of the phototropism response in plants based on the results from two specific treatment groups where either a permeable barrier or an impermeable barrier separated the tip of the shoot from the rest of the plant.

Sample: 5A
Score: 4

The response earned 1 point in part (a) for supporting the claim by saying the plant in treatment group II did not grow toward the light because the tip was removed. The response earned 1 point for supporting the claim by saying that the plant in treatment group III did not bend toward the light because the tip is covered, so it is not exposed to light.

The response earned 1 point in part (b) for describing that the tip sends the signal to the rest of the plant. The response earned 1 point for describing that the signal passes through the permeable barrier to the rest of the plant in treatment group IV, but the plant cannot send the signal to the rest of the plant in treatment group V.

Sample: 5B
Score: 3

The response earned 1 point in part (a) for supporting the claim by saying that when the tip of the plant was removed the plant shoot did not shift toward the light.

The response earned 1 point for describing that auxins are the chemical messengers produced in response to light. The response earned 1 point for describing that the auxins can pass through the permeable membrane but not the impermeable membrane.

Sample: 5C
Score: 2

The response earned 1 point in part (a) for supporting the claim by saying that cells in the shoots with the tip removed cannot detect light so the shoots grow straight up rather than toward the light. The response earned 1 point for supporting the claim by saying that the cells in the shoots with the tip covered cannot detect light so the shoots grow straight up rather than toward the light.