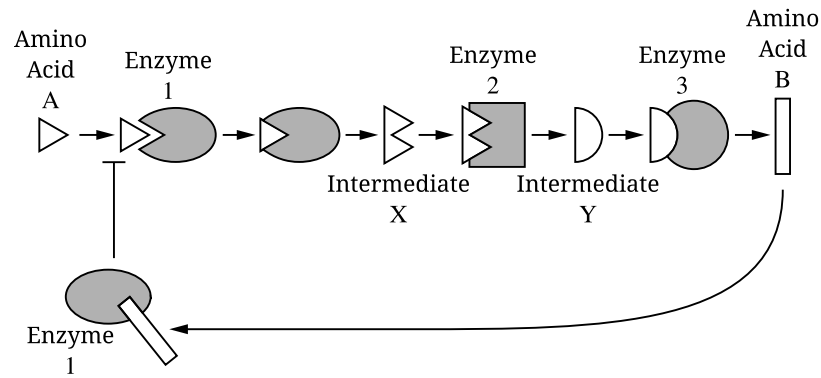


5. Figure 1 shows the reactions of the metabolic pathway used to synthesize amino acid B from amino acid A in cells.

Figure 1. Synthesis of amino acid B from amino acid A



- A. Describe** a characteristic of an enzyme's active site that allows it to catalyze a specific chemical reaction.
- B. Based on Figure 1, explain** how the binding of amino acid A to enzyme 1 is regulated by amino acid B.
- C. Using the information in Figure 1, identify** the product of the reaction catalyzed by enzyme 2: intermediate X, intermediate Y, or amino acid B.
- D. Based on Figure 1, explain** how a change in pH could affect enzyme 3 in such a way that amino acid B cannot be produced.

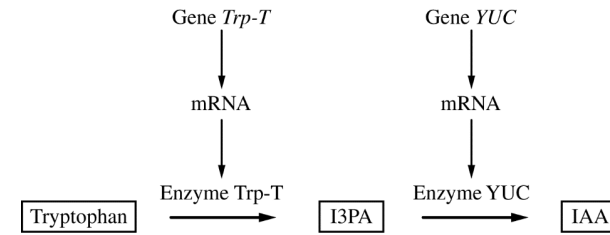


Figure 1. Model of two-step enzymatic plant pathway for synthesis of IAA from tryptophan

1. Auxins are plant hormones that coordinate several aspects of root growth and development. Indole-3-acetic acid (IAA) is an auxin that is usually synthesized from the amino acid tryptophan (Figure 1). Gene *Trp-T* encodes an enzyme that converts tryptophan to indole-3-pyruvic acid (I3PA), which is then converted to IAA by an enzyme encoded by the gene *YUC*.
- (a) **Circle ONE** arrow that represents transcription on the template pathway. **Identify** the molecule that would be absent if enzyme YUC is nonfunctional.
- (b) **Predict** how the deletion of one base pair in the fourth codon of the coding region of gene *Trp-T* would most likely affect the production of IAA. **Justify** your prediction.
- (c) **Explain** one feedback mechanism by which a cell could prevent production of too much IAA without limiting I3PA production.
- (d) Rhizobacteria are a group of bacteria that live in nodules on plant roots. Rhizobacteria can produce IAA and convert atmospheric nitrogen into forms that can be used by plants. Plants release carbon-containing molecules into the nodules. Based on this information, **identify** the most likely ecological relationship between plants and rhizobacteria. **Describe ONE** advantage to the bacteria of producing IAA.
- (e) A researcher removed a plant nodule and identified several “cheater” rhizobacteria that do not produce IAA or fix nitrogen. **Describe** the evolutionary advantage of being a bacterial cheater in a population composed predominantly of noncheater bacteria. Plants can adjust the amount of carbon-containing molecules released into nodules in response to the amount of nitrogen fixed in the nodule. **Predict** the change in the bacterial population that would cause the plant to reduce the amount of carbon-containing molecules provided to the nodule.

8. Acetylcholine receptor (AChR) proteins are found at the synapse between neurons and skeletal muscle cells. Acetylcholine released from neurons binds to a specific site on the receptor proteins, which causes an ion channel in the receptors to open and allow sodium ions (Na^+) to enter muscle cells. The resulting depolarization of muscle cells initiates muscle contractions. Another molecule, nicotine, can also bind to certain types of AChR proteins and activate the receptors.

A researcher is investigating two different types of AChR proteins: type 1 and type 2. To determine which stimuli activate the receptors, the researcher exposes muscle cells expressing the different types of receptor proteins to stimuli and observes the results indicated in Table 1.

TABLE 1. RESPONSE OF AChR PROTEINS TO DIFFERENT STIMULI

AChR Protein Type	Acetylcholine	Nicotine
Type 1	+	+
Type 2	+	–

+ indicates activation

– indicates no activation

- (a) **Describe** the difference in the structure AND function between AChR type 1 and AChR type 2.
- (b) Acetylcholinesterase is an enzyme that breaks down acetylcholine in the synapse. **Describe** the effect of inhibiting acetylcholinesterase on the muscle cells with AChR type 2.

STOP

END OF EXAM