

The Activity of the Urease Enzyme in Soy Seeds

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What's our plan for today?

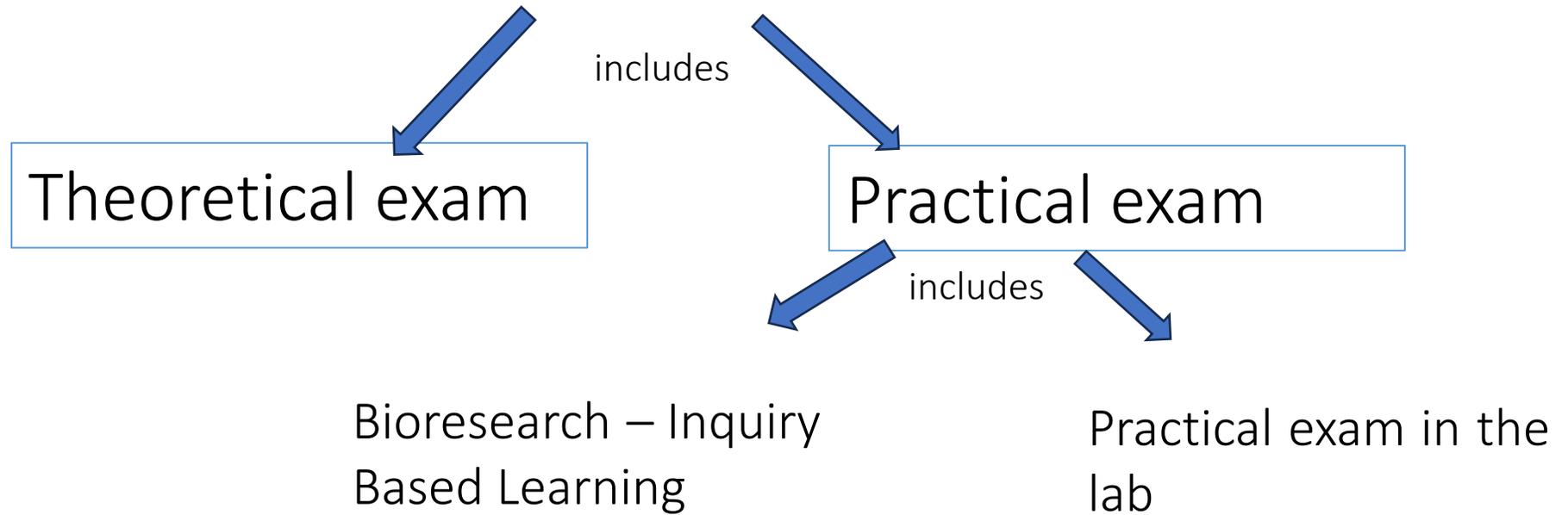
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Experiment part A +discussion	Testing for the presence of proteins in soy seeds	25
Experiment part B +discussion	Testing the activity of the enzyme urease in soy seeds filtrate and the effect of an inhibitor on the enzyme's activity	35
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Israeli Highschool Curriculum

In Israel, students are tested in national final exams.

Each student specializes in one or more subjects taught at a high level.

The Biology Curriculum



Inquiry-Based Learning

varies



in the amount of autonomy given to students

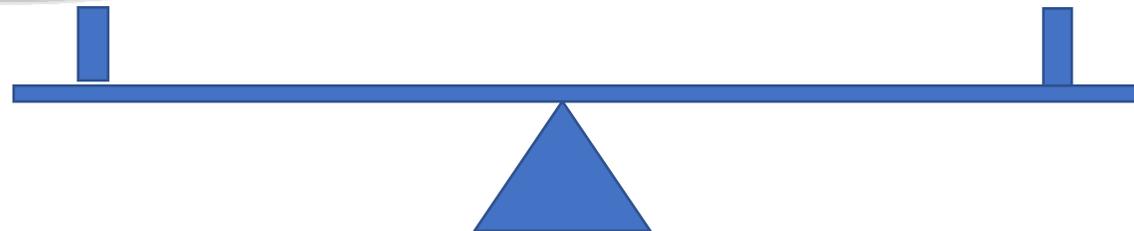
Structured inquiry



Guided inquiry

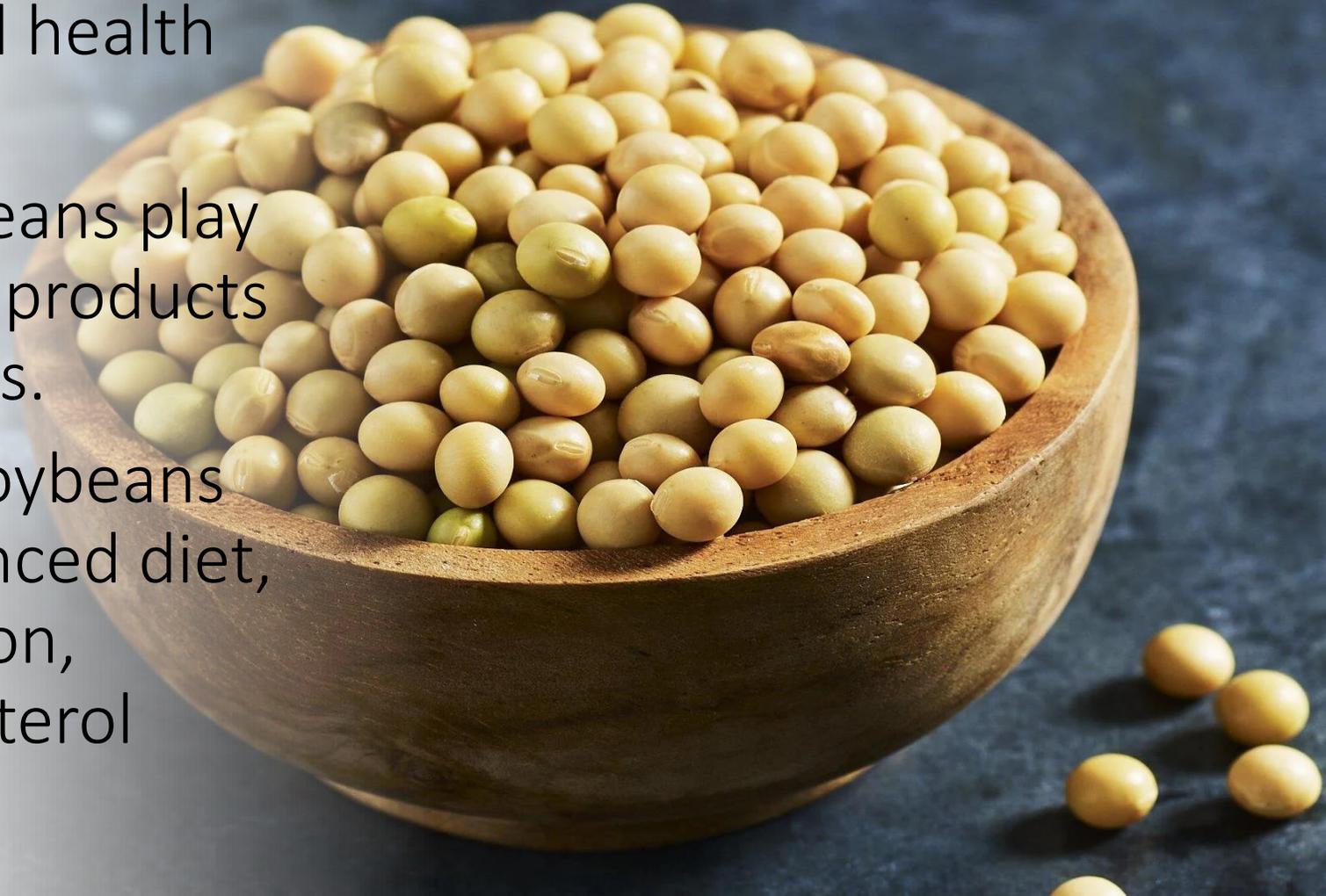


Open inquiry



Soy seeds

- Soy seeds are nutrient-rich legumes with high-quality protein, essential amino acids and health benefits.
- Globally significant, soybeans play a key role in diverse food products and industrial applications.
- Crucial for vegetarians, soybeans contribute to a well-balanced diet, offering disease prevention, dietary fibers, and cholesterol management.



Discussion

Testing for the Presence of Proteins in Soy Seeds -

Protein is still a protein even after denaturation

$\text{NaOH} + \text{CuSO}_4$
light blue

In this part we test the student's understanding of what a protein is and not just knowledge of protein activity
understand the primary structure

We expect the students to understand the difference between the primary structure (a result of a covalent bond) and the secondary and tertiary structure (a result of hydrogen bonds)

$\text{NaOH} + \text{CuSO}_4$
+Peptide
purple

The reagent

להוסיף תמונה
על הקשרים
הכימיים

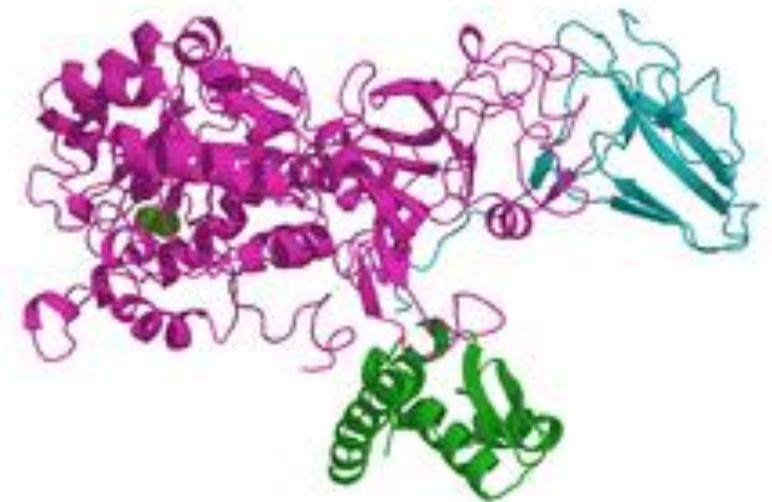
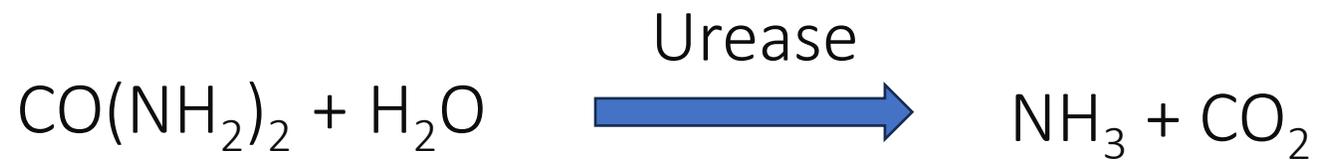
The connection between the two parts of the experiment

In part A we examined the proteins in Soy seeds

In part B we will focus on one proteins in Soy seeds -Urease

Urease enzyme

- Urease is an enzyme that catalyzes the hydrolysis of urea into ammonia and carbon dioxide.
- Produced by various microorganisms, plants, and some animals, urease plays a crucial role in nitrogen metabolism.



"The crystal structure of urease from Klebsiella aerogenes".

[doi:10.1126/science.7754395](https://doi.org/10.1126/science.7754395). PMID 7754395.

Discussion:

Testing the activity of the enzyme urease in soy seeds filtrate and the effect of an inhibitor on the enzyme's activity



Phenol red

להוסיף ציור
מבחנה עם
בסיס

What level of guidance is required to facilitate the experiment for the students?

To what extent is students' understanding of acid/base concepts crucial for this task?

How essential is the comprehension of acid/base concepts for students in completing this task

In the exam format, the chemical formula for urea catalyzes was omitted to prevent students from associating carbon dioxide with greenhouse gas and acid production. How should we address this in the classroom?

ניסוי של פירוק קשר
פפטידי בלי אנזים
בגרות ישנה עם מיצוימ
כרוב

Prof. Rabi, was once asked, "Why did you become a scientist, rather than a doctor or lawyer or businessman, like the other immigrant kids in your neighborhood?"

"My mother made me a scientist without ever intending it. Every other Jewish mother in Brooklyn would ask her child after school: 'So? Did you learn anything today?'

But not my mother. She always asked me a different question. 'Izzy,' she would say, 'did you ask a good question today?' **That difference - asking good questions -made me become a scientist!"**

Isidor I. Rabi, the Nobel laureate in physics in 1944



From Structured Inquiry to Open Inquiry

Asking following questions

Part A-Testing for the presence of proteins in soy seeds

- Is there a temperature or extreme conditions which the peptide bonds will break down without an enzyme?
- What is the relationship between the type of food and the presence of protein in the food? How much protein is there in food?

Part B-Testing the activity of the enzyme urease in soy seeds filtrate and the effect of an inhibitor on the enzyme's activity

- To check under which conditions the enzyme is still active:
- What is the effect of temp (in pre-treatment) on the rate of enzyme activity?
- activity?
- What is the effect of temperature (until denaturation) on the rate of enzyme activity?
- What is the effect of different concentrations of copper sulfate on the rate of germination and the rate of enzyme activity?

Discussion

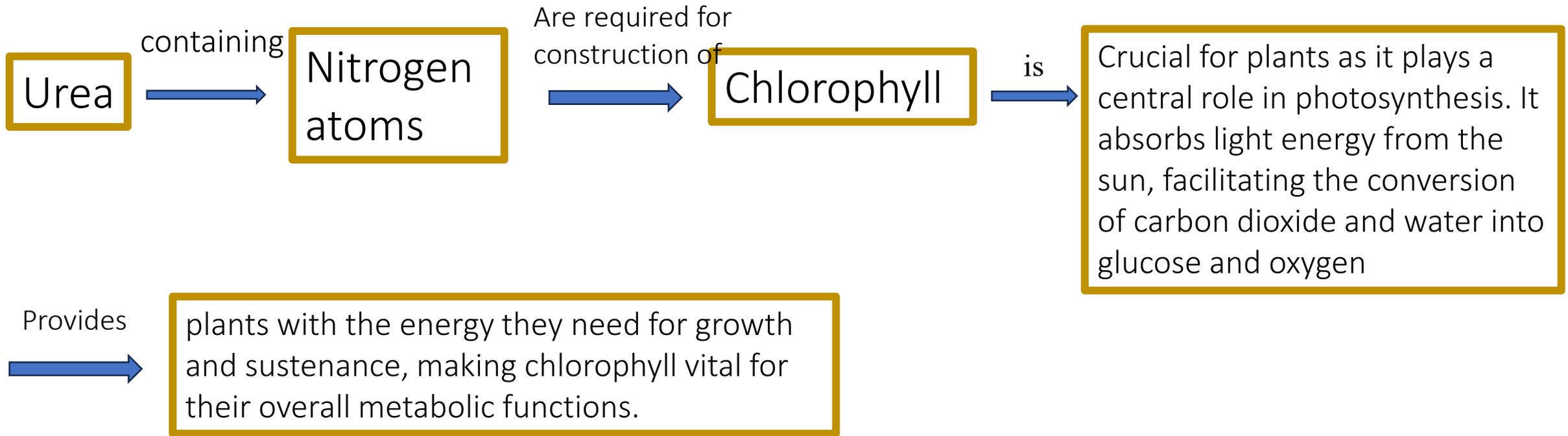
The use of urea and a urease enzyme inhibitor in agriculture

Analyzing research results

Chain questions - Answer of Cause and Effect

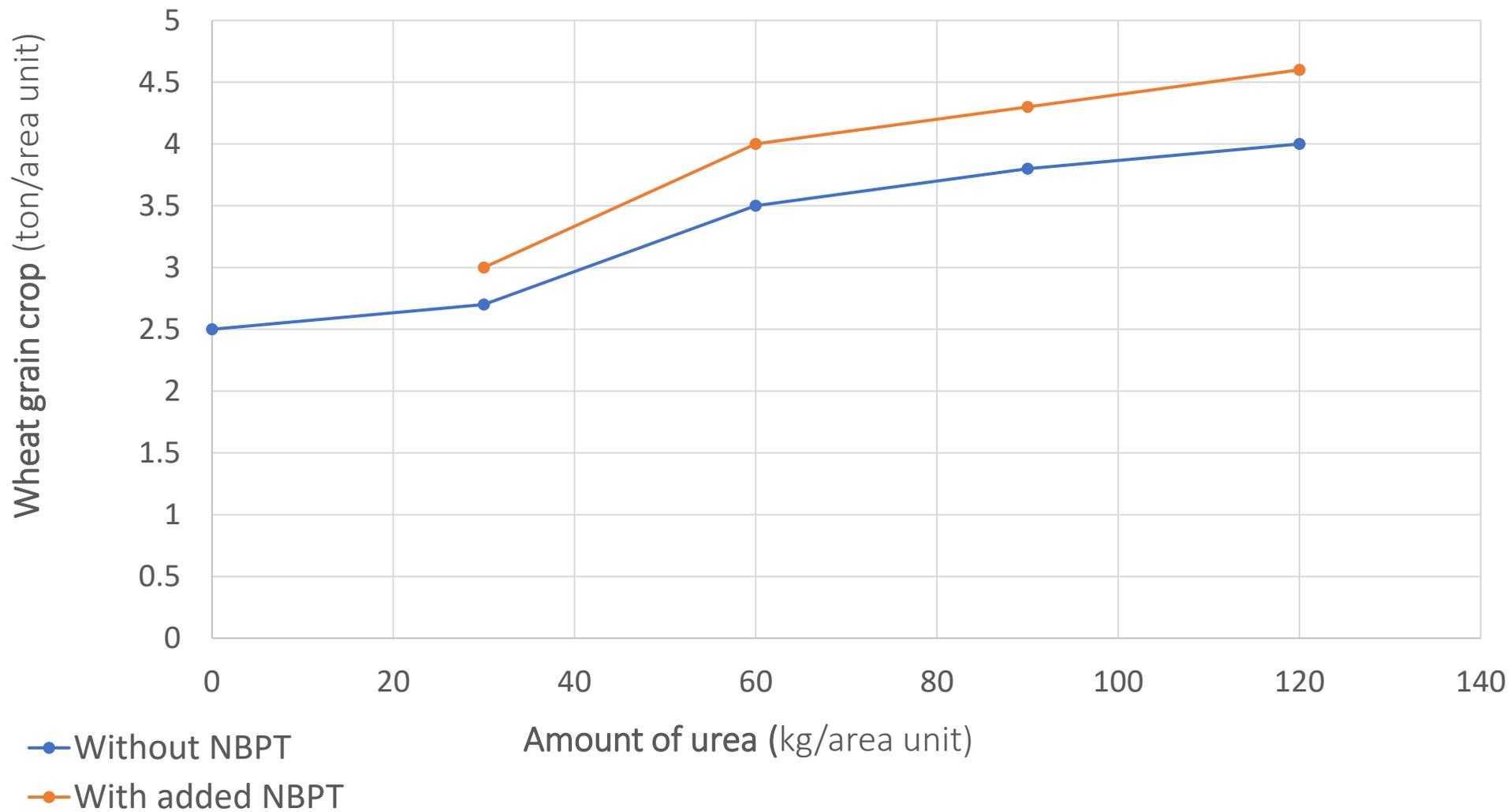
Use the information about chlorophyll given in the introductory passage above to **and** explain the results of the experiment in Plot 1B

An **increase** in the concentration of **urea** in the soil leads to an **increase** in the **wheat grain crop**



Therefore, an increase in the concentration of urea is needed in the soil so that the plant can absorb nitrogen and produce chlorophyll

The affect of urea concentration with or without NBPT on wheat grain crop



The affect of adding NBPT on wheat grain crop in different urea concentration

