

## For classes using the print-based version of this activity

### Activity 2: Humanity Against Hunger

- For this activity, divide the class into groups of 3 students. Each group will receive 3 case studies to evaluate.
- Display a transparency of Master 4.2, *Humanity Against Hunger* and ask for a volunteer to read it aloud.
- Explain to the students that they will review information sent in by local farmers who suspect that their crops suffer from a nutrient deficiency. Students will be provided with photographs and brief descriptions of 4 different nutrient deficiencies. Using this information, they will be challenged to diagnose the specific nutrient deficiency affecting each of their crop plants.
- Pass out to each group 1 copy of *Primary Information* for each case study that they are to evaluate. *Primary Information* is found on the top portions of Masters 4.3a–c, *Corn Case Studies*. Ask students to read *Primary Information* for their case studies.
  - Each group receives the top portions of Masters 4.3a, 4.3b, and 4.3c, *Corn Case Studies*. Each student is responsible for 1 of the case studies.
- Pass out to each student 1 copy of Master 4.4, *Plant Doctor Evaluation Form*. Instruct students to write down in the appropriate space what they consider to be the important information related to their case study.
- Pass out to each group 1 copy of Masters 4.5a–d, *Plant Doctor Reference Manual*. Instruct students to make a preliminary diagnosis for their case studies by using the information contained in the reference manual. Have students enter their initial diagnoses in the appropriate spaces on their evaluation forms.
  - Remember, each student in the group is responsible for 1 of the 3 case studies. Students should list symptoms of the nutrient deficiencies that match the important information of their case studies.
- Ask students if they are certain of their diagnoses.
  - Some students may indicate that they have correctly diagnosed their case studies. Ask them what additional information would help them confirm or refute their diagnoses.
- Explain to the class that some additional information about their case studies has come to light. Give each group the bottom portions of Masters 4.3a–c, *Corn Case Studies*, which contain Secondary Information.
- Ask students to read Secondary Information for their case studies and use this information to reevaluate their diagnoses. They should indicate on the evaluation form whether they want to confirm their initial diagnoses.
- If students have changed the diagnosis, they should enter the new diagnosis, together with the reason for the change, in the appropriate spaces on the evaluation form.
- Reconvene the class and discuss each case study in turn, asking students how they arrived at their diagnoses.
  - Write the students' diagnoses on the board or an overhead transparency.
- Ask students how they could correct these nutrient deficiencies.
  - Students should mention adding fertilizer to the soil. Some students may specify commercial or organic fertilizers. Explain that they will explore the advantages and disadvantages of these fertilizers in the next lesson.

Answers to the case studies:

#### ***Corn Case Study 1***

<i>From Primary Information</i>	
Important information	Stunted, yellow leaves; sandy soil
Diagnosis	These symptoms are consistent with either nitrogen or potassium deficiency. The yellowed leaves seem to have the V-shaped pattern associated with nitrogen deficiency.
Matching symptoms	Stunted, yellowing leaves; sandy soil
<i>After reading Secondary Information</i>	
Is your initial diagnosis confirmed?	Answers will vary.
If not, what is your new diagnosis?	Answers will vary.
If not, what caused you to change your diagnosis?	The second photograph shows a leaf with the V-shaped pattern of yellowing that is consistent with nitrogen deficiency. The fact that the fields have been exposed to heavy rains further supports the nitrogen-deficiency diagnosis. If not, what caused you to change your diagnosis?

### Corn Case Study 3

From Primary Information	
Important information	Stunted, compacted (dense) purple color on some leaves
Diagnosis	The symptoms are consistent with phosphorus deficiency.
Matching symptoms	Stunted, compacted (dense) soil; purple color on leaves
After reading Secondary Information	
Is your initial diagnosis confirmed?	Answers will vary.
If not, what is your new diagnosis?	Answers will vary.
If not, what caused you to change your diagnosis?	Plants mature later than normal. The second photograph of a leaf shows distinct purple coloration, which is characteristic of phosphorus deficiency.

### Corn Case Study 2

From Primary Information	
Important information	Stunted, yellow leaves; sandy soil
Diagnosis	These symptoms are consistent with either nitrogen or potassium deficiency.
Matching symptoms	Stunted, yellowing leaves; sandy soil
After reading Secondary Information	
Is your initial diagnosis confirmed?	Answers will vary.
If not, what is your new diagnosis?	Answers will vary.
If not, what caused you to change your diagnosis?	The second photograph shows a yellowed leaf with dried edges that are consistent with potassium deficiency. The fact that the plants have weak stems further supports the potassium-deficiency diagnosis.



**Y**ou have been selected to join Humanity Against Hunger, an international effort dedicated to fighting hunger around the world. Your first assignment is to travel to Africa and help farmers from a small village.

In sub-Saharan Africa, nearly one-third of the population, almost 200 million people, lacks enough food to lead healthy, productive lives. Although some areas of Africa have rich soil and support plant growth, other areas do not. Growing food for the increasing human population is an important challenge. African farmers have traditionally cleared land, grown and harvested their crops, and then moved on to clear more land for the next planting. After harvesting their crops, the farmers left the land alone so that it would eventually regain its fertility.

However, increasing population growth has limited this traditional farming practice, which worked so well in the past. Today, farmers often grow crop after crop on the same land, “mining,” or depleting, the soil of its nutrients. Most of them realize that they need to replenish the soil, but often they lack the knowledge or the money needed to do so. If this trend continues, by the year 2010 Africa will have almost two-thirds of the world’s under-nourished people.

Your task is to help the local farmers diagnose nutrient deficiencies among their crops. Then you will make recommendations on how to restore nutrient balance to the soil and improve crop yields.

## Corn Case Study 1

### *Primary Information*

The farmer reports that his corn grows in sandy soil. The plants are stunted and have yellow leaves. They are free of pests, and the fields are free of weeds. The farmer provided the following photograph.



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## Corn Case Study 1

### *Secondary Information*

The farmer sent this additional photograph of an affected leaf. He reports that his fields have been exposed to heavy rains and higher than normal temperatures.



## Corn Case Study 2

### *Primary Information*

The farmer reports that the plants are stunted. Her corn grows in sandy soil. Some weeds are present in the fields. She provided the following photograph, which shows some yellowing of leaves.



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## Corn Case Study 2

### *Secondary Information*

The farmer sent this additional photograph of a leaf from an affected plant. She also reports that some of her plants have stems that aren't strong enough to support the ears of corn.





## Corn Case Study 3

### ***Primary Information***

The farmer reports that her plants are stunted. Her fields are composed of compacted (dense) soil and are free of weeds. She provided the following photograph of two affected plants.

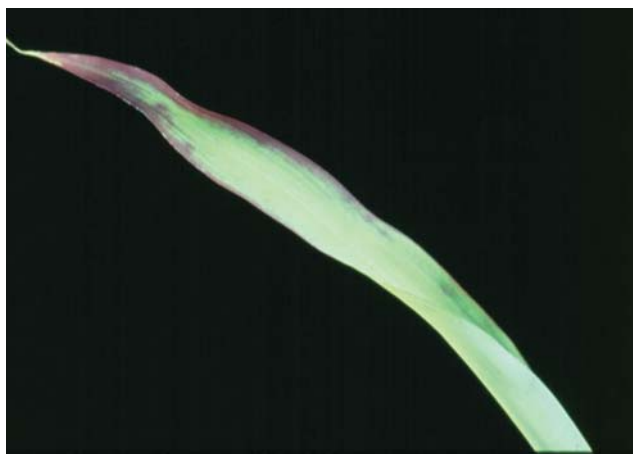


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## Corn Case Study 3

### ***Secondary Information***

The farmer sent this additional photograph of a leaf from an affected plant. The discoloration seen near the tip of the leaf is purplish. She reports that her corn is maturing later than it should and that she is beginning to see some weeds growing in her fields.



## Master 4.4, Plant Doctor Evaluation Form

Name \_\_\_\_\_

Date \_\_\_\_\_

**Case study number:** \_\_\_\_\_

### Instructions

**Step 1.** Complete 1 evaluation form for each case study.

**Step 2.** After reviewing *Primary Information*, record your responses in the following spaces.

<b>Important Symptoms</b>
<b>Initial Diagnosis</b>
<b>Symptoms that Match the Nutrient Deficiency</b>

**Step 3.** After reviewing *Secondary Information*, record your responses in the following spaces.

<b>Important Symptoms</b>
<b>Is your initial diagnosis confirmed?</b> <input type="checkbox"/> Yes or <input type="checkbox"/> No
<b>If not, what is your new diagnosis?</b>
<b>If not, what caused you to change your diagnosis?</b>

# Introduction

Like humans, plants need a proper diet to be healthy. Unlike humans, however, plants cannot move to find food. They can only take up nutrients available in the soil, or in the case of legumes, from the atmosphere. Different species of wild plants are adapted to different levels of nutrients and many thrive in low nutrient soils. However, when growing most crop plants, if a nutrient is missing, or present in a lesser amount than is needed, then the crop plant cannot reach its maximum growth potential. The consequences of nutrient deficiencies can be moderate or severe, depending on the extent of the deficiency. The symptoms displayed vary depending on the type of plant and which nutrient is lacking. Sometimes, a nutrient deficiency causes the plant to become more susceptible to disease, similar to a person who has a weak immune system. A plant doctor (called an agronomist) determines which nutrient is deficient and recommends using a fertilizer that contains enough of the nutrient to restore the plant to good health. This manual describes the symptoms associated with nitrogen, phosphorus, potassium, and zinc deficiencies for corn plants. Photographs are supplied to help diagnose the deficiencies.

## Nutrient Deficiencies of Corn

### ***Nitrogen Deficiency***

The major symptom of this problem is a general yellowing of the plant. The yellowing begins at the leaf tip and gradually works its way down to the base of the leaf. Older leaves show a V-shaped yellowing of the inner leaves, with the leaf edges remaining green in a V pattern. The plants may appear stunted and spindly. Symptoms of nitrogen deficiency are most noticeable in plants growing in lower, poorly drained parts of the field. Nitrogen deficiency also can result after heavy rains remove nitrogen from sandy soils. Nitrogen is an important building block used by plants for many aspects of growth. Restoring nitrogen to the soil will improve crop yields.

A normal leaf is seen on the right. Leaves from increasingly nitrogen-deficient plants are on the left.





## Nutrient Deficiencies of Corn

### ***Phosphorus Deficiency***

Plants that lack phosphorus show stunted growth and mature later than healthy plants. Late-maturing crop plants are more susceptible to frost, harvest damage, disease infection, and summer drought. The leaves and stems often show purpling or reddening.

Phosphorus deficiency can result when soil phosphorus levels have declined due to nutrient removal. It can also occur in cool conditions that reduce diffusion to the root. As a result, many farmers apply some phosphorus with the seed to support early growth when the soil is cool. Restoring phosphorus to the soil allows crop plants to mature properly and be better protected from disease, drought, and frost.



These phosphorus-deficient corn plants show the characteristic darkening of the leaves.

## Nutrient Deficiencies of Corn

### ***Potassium Deficiency***

Plants that lack potassium show stunted growth and mature later than normal plants. Potassium deficiency results in yellowing and drying of the leaf edges, especially on older leaves. The death of cells in the leaves may be visible as a dark discoloration. The stems of potassium-deficient plants are weak and often break below the ears.

Potassium deficiencies happen most often in soils that are sandy, wet, or compacted (dense) or when potassium has been removed through repeated cropping and natural levels are low. Restoring potassium to the soil will help the plants better absorb water and prevent wilting and dry leaves.



a



b

The older leaves of potassium-deficient corn plants yellow and die around the edges (a), while areas of cell death on leaves may appear as dark spots (b).

## Nutrient Deficiencies of Corn

### ***Zinc Deficiency***

Plants lacking zinc show pale- to whitish-colored bands located between the veins of the leaves. The plants may be stunted. Zinc deficiency is associated with soils that are alkaline and contain little organic material.



Leaves from zinc-deficient plants show pale stripes on their leaves.