TOEBI MAKERS Research

WRO India 2016 - OPEN CATEGORY

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Introduction

Mostly, you have never known the consequences when you throw something you're done with. When it's gone to the landfills the biodegradable materials decompose and release methane which leads to global warming and climate change, food loss accompany water loss and money loss, almost half of what is produced is wasted. Without mentioning details about the unpleasant smells and the diseases that spread in the air, It also takes place (the landfills) that can better be used by humans .

That was the start of our project to solve all these problems by recycling food waste into Compost in a simple way that can reduce the waste and make it something useful and easy to do by using robots instead of human hands.

Who we are?

Ezadeen Hayariah: 18 years.

Ezadeen has graduation from high school this year, and he started to study Computer Science.
Also he loves photography and most of the pictures in this research are captured by him.

Hussam Taleb: 17 years.

Hussam has won so many national Swimming championships in the last 5 years, and he have big passion about Mechanical and hardware work.

Mirna Al Noukari: 17 years.

Mirna has a great experience in robotics for almost 6 years. With her skills in mechanisms, research and finding informations she is a complementary member in the team.

How we chose this idea?

It took us almost 3 weeks to decide the idea after doing some researches about recycling wastes in general including full automatic sorting which we found so hard to do without human intervention. Most countries recycle plastics and metals but the problem is that we can't recycle them without heat and it's hard to melt materials by using simple equipments because we wanted to apply it.

After thinking about a real world problem that most countries around the world have and we, ourselves have, we found that food waste is a really big problem more than we could ever imagine.

Why we chose this idea?

We wanted to have a real solution that can be applied to solve an important problem with what we have with no simulation, something to develop permanently and can be useful in our local area, and in the world.

The world is producing more than enough food, The food discarded by retailers and consumers in the most developed countries would be more than enough to feed all of the world's 870 million hungry people, according to the Food and Agriculture Organization of the United Nations.

The initial most basic goal of composting is transformative, turning waste into stabilised value added product.

How important is this idea?

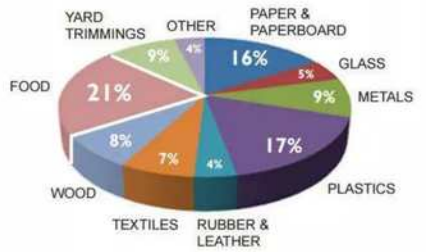
Most food waste is thrown away in landfills, where it decomposes and emits methane, a potent greenhouse gas. Globally, it creates 3.3 billion metric tons of greenhouse gases annually, about 7 percent of the total emissions, and has 21 times the global warming potential of carbon dioxide.

Locally: our country were more than 30% farm lands, but during the war it diminished, therefore recycling food waste and other biodegradable materials into compost is essential in rebuilding our country's agriculture, because to rebuild a country you have to had an agriculture to make sure there's food security for the people.

Recovering just half of what is lost or wasted could feed the world alone.It has been estimated that between 1/3rd and 1/2 of all food produced around the world is lost or wasted (i.e up to 2 billion tonnes of food).

The project is Not only reducing food waste, it also reduce all the materials that can be compostable. Which is 50% or more of the trash in your garbage. Compostable materials are food waste, wood, papers, and yard trimming. So it is almost a recycling for 54% of the trash.

Figure 1. Percent of Total Waste Generation and Disposal of Municipal Solid Waste in the U.S. in 2010



How much food waste are thrown in landfills?

The total cost of that food waste could be as high as $400 billion a year. Reducing food waste from 20 to 50 percent globally could save $120 billion to $300 billion a year by 2030.

The problem is expected to grow worse as the world's population increases, the New York times report found.

By 2030, when the global middle class expands, consumer food waste will cost $600 billion a year, unless actions are taken to reduce the waste

Getting food from the farm to our fork eats up 10 percent of the total energy budget, uses 50 percent of land, and swallows 80 percent of all freshwater consumed in the United States. Yet, 40 percent of food in the United States today goes uneaten. All of that and we haven't talked about other countries yet.

Each year countries around the world produce some four billion tonnes of food. Between 30% and 50% of this total, amounting to 1.2 to two billion tonnes, never gets eaten, says the report Global Food; Waste Not, Want Not.

When we waste food, we waste water. With water so scarce in parts of the U.S. and globally, this is more apparent (and important) than ever. Access to water is one of the major issues of our time, and it will become a key part of the food waste discussion.

In the US, 68m tonnes of food waste are produced each year, with around 39.7m tonnes going to landfill or incineration.

"It is also an unnecessary waste of the land, water and energy resources that were used in the production, processing and distribution of this food."

30% of food never even reaches the market because it doesn't look right

Up to 30% of vegetable crops are not harvested because their physical appearance fails to meet the exacting demands of consumers. As much as half of all the food produced in the world - two billion tonnes worth - ends up being thrown away, according to "staggering" new figures.

Around 88 million tonnes of food are wasted annually in the EU, with associated costs estimated at 143 billion euro's, food waste is expected to rise to about 126 million tonnes a year by 2020, unless action is taken to halt this trend.

The demand for water in food production could reach 10 to 13 trillion cubic metres a year by 2050.

This is up to 3.5 times greater than the total amount of fresh water used by humans today, raising the spectre of dangerous water shortages.

What is compost?

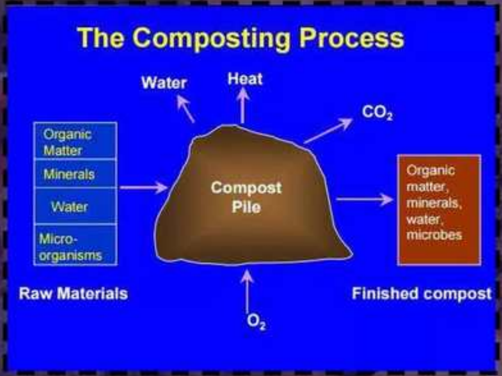
Composting is nature's way of recycling. In this process, organic waste, such as food waste and garden clippings, is biodegraded and turned into valuable fertilizer. it's considered as the "black gold" to the plants because of the nutrient balance it has In its simplest form, the advantages to composting are twofold; it reduces the amount of solid waste in your trash and, when used in a garden, it fertilizes the soil.

providing optimum conditions so that organic matter can break down more quickly. As you dig, turn, layer and water your compost pile, you may feel as if you are doing the composting , but the bulk of the work is actually done by numerous types of decomposer organisms.

Usually the process to do compost is manually done with human hands, but we decided to make a new step forward in the composting system to make it easier, faster, and a better choice rather than throwing trash away or suffer from doing your compost by yourself.

In these processes, bacteria, fungi, molds, protozoa, actinomycetes, and other saprophytic organisms feed upon decaying organic materials initially,

while in the later stages of decomposition, mites, springtails, and earthworms further breakdown and enrich the composting materials. The organisms will vary in the pile due to temperature conditions, but the goal in composting is to create the most favorable environment possible for the desired organisms.



What compost can do for the environment?

- Compost saves water needed to grow food
- Reduces the need for fertilizers and pesticides
- Promotes a healthy agricultural system
- Closes the circle: uses food waste to create nutrient-rich soil amendments, which in turn grow healthy food
- Reduces methane and leachate formation in landfills
- Rapid composting kills all plant disease producing organisms if done as described. It does not inactivate heat resistant viruses such as tobacco mosaic virus.
- Insects do not survive the composting process. Though some may be attracted to the pile, if they lay their eggs in the compost will destroy them.
- Improves soil tilth condition, and structure;
- Increases the soil's ability to hold water and nutrients;
- Supports living soil organisms.
- Helps dissolve mineral forms of nutrients;
- Buffers soil from chemical imbalances;
- May provide biological control of certain soil pests.
- Helps return organic materials to the soil, and keeps them out of landfills and waterways.

Our Project

The process to make compost

Starting from the **shredder** where you put your materials (which are your daily trash) there are two: one for the Nitrogen rich materials (like vegetable and fruit peels, egg shells, tea and coffee dregs, and green leaves) usually you can know the nitrogen materials from the Green color or they're fresh and moisture.

And one for the carbonic rich materials (like cartons, newspapers, and dry leaves) usually we know carbonic materials from their Brown color and dryness.

Each one of the shredders have two processes, they're cut to small pieces, moved to shred it again with razors, because it's important to have small pieces.

We made these shredders as the first process because it's essential to have small pieces so you can avoid rot and insects and to speed up the breakdown of organic materials.

To keep the materials balanced, we have the **temporary storage** to calibrate the volume of materials in the storage before it opens mechanically and drop the materials down to the bucket. The mechanism of the holes below the storage is set to carry the whole weight and to open and close easily.

This step is important for the C:N ratio, as the first storage opens its weighted in the Bucket with a weight sensor.

This makes it able to calculate every gram of food it storages and make it more accurate.

The user will choose from the 5 types:

1. fruit
2. vegetables
3. woods and cartons
4. leaves
5. other

And according to these inputs the ratio varies from $\frac{1}{2}$ to $\frac{1}{2}$ or $\frac{1}{3}$ to $\frac{2}{3}$ And so the sensor that weight and the opening mechanism will work according to the inputs.

Note: the user will identify the percentage of the inputs.

And to make sure that the C/N ratio is perfect to have a faster and a high quality compost without making it hard for the user, we used an ipad so you can choose the percentage of the materials by our app!

This trash has it's own character, Toebi have her own emotions and can talk about herself. It even can walk!

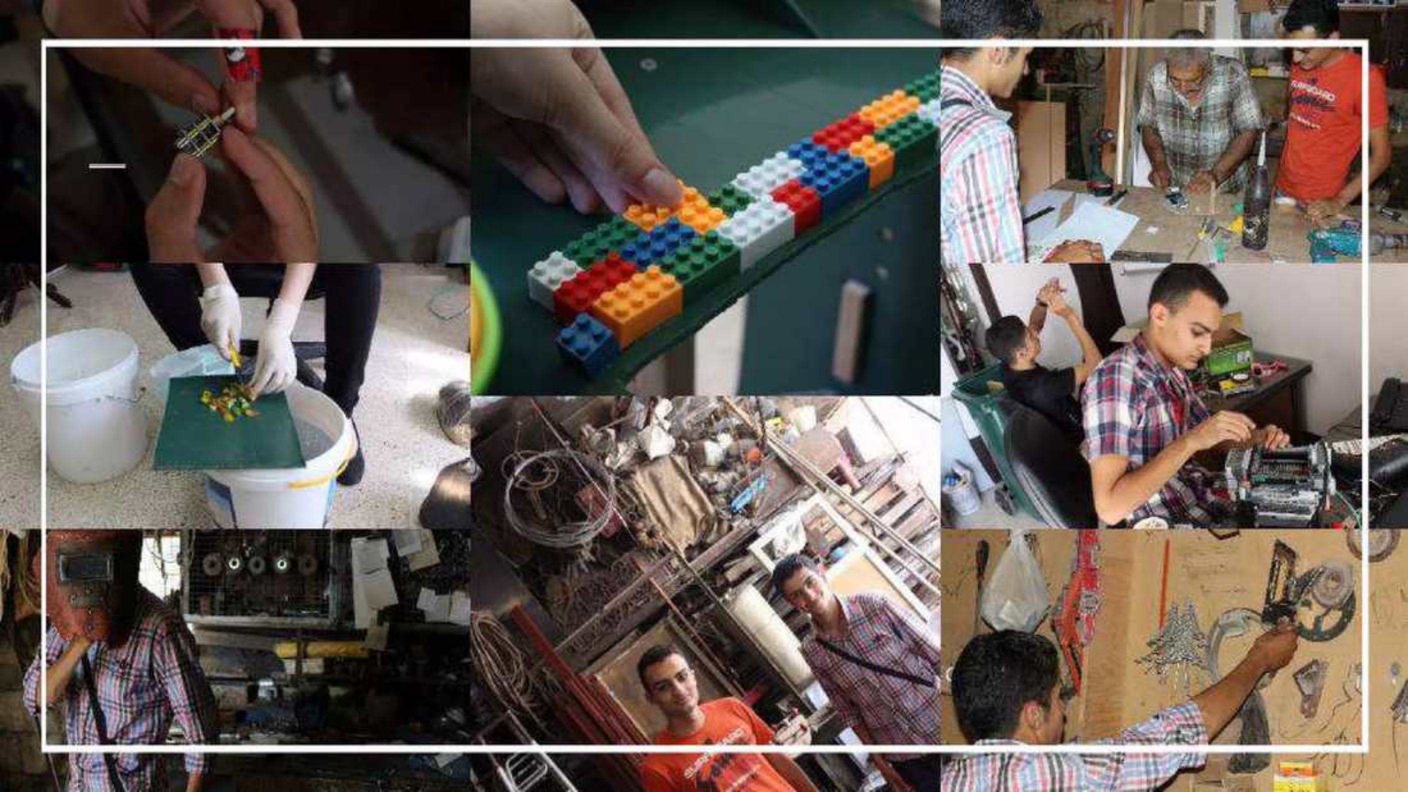
All of that makes this container so funny and easy to use.

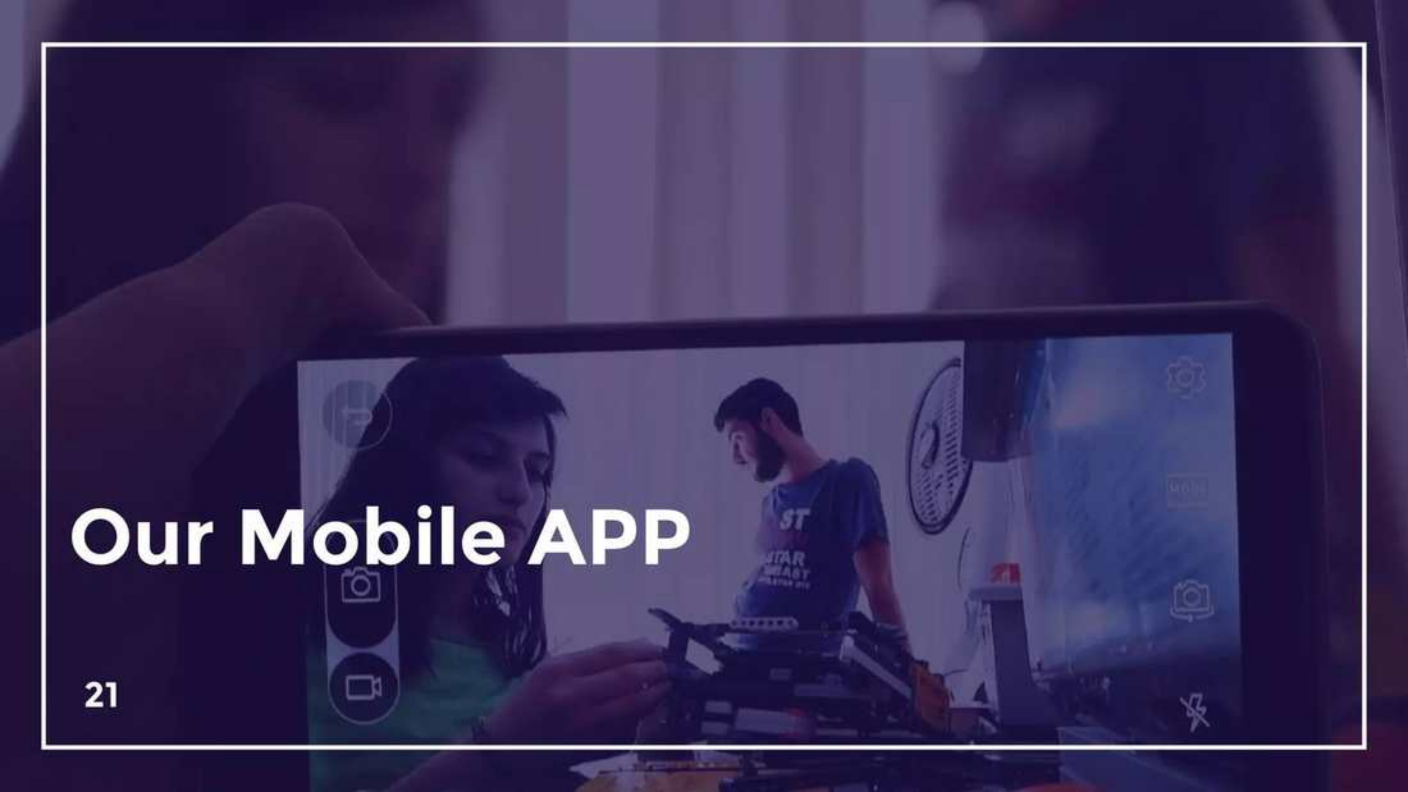

The photos are taken at the first stages of designing and building the project

In the **bucket**, where the mixing works to make sure that there's enough oxygen for the composition. Air is really essential in the process because when oxygen level fall to less than 5% anaerobic bacteria takes the place of aerobic bacteria and ammonia is released and there will be a stinky smell in the pile. Before we made the metal arm we made a wood sample to make sure that all the parts are reached and mixed and the material the arm is made from won't get damaged because of the decomposition.

Moisture is important in the process too, because chemical interaction needs water to start. So we have temperature and humidity sensor in the bucket with a small washer. The moisture content should be 40-60%. When moisture levels are less than 40%, the washer will run until it reaches the right percentage.


YES
NO
Fruit Peels/ Rinds
Tea Bags
Vegtable Scraps
Plant Trimmings
Weeds with Set Seeds
Meat
Large Wood Pieces
Cat Litter
Dried Leaves
Egg Shells
Coffee Grinds
Shredded paper
Coal/ Ash
Fish
Dairy Products
Sawdust
Straw/ Small Branches
Cardboard
Animal Manure
Natural Fibres
Walnuts
Citrus Fruit Insides
Fruit Stones
Non-Biodegradable Products





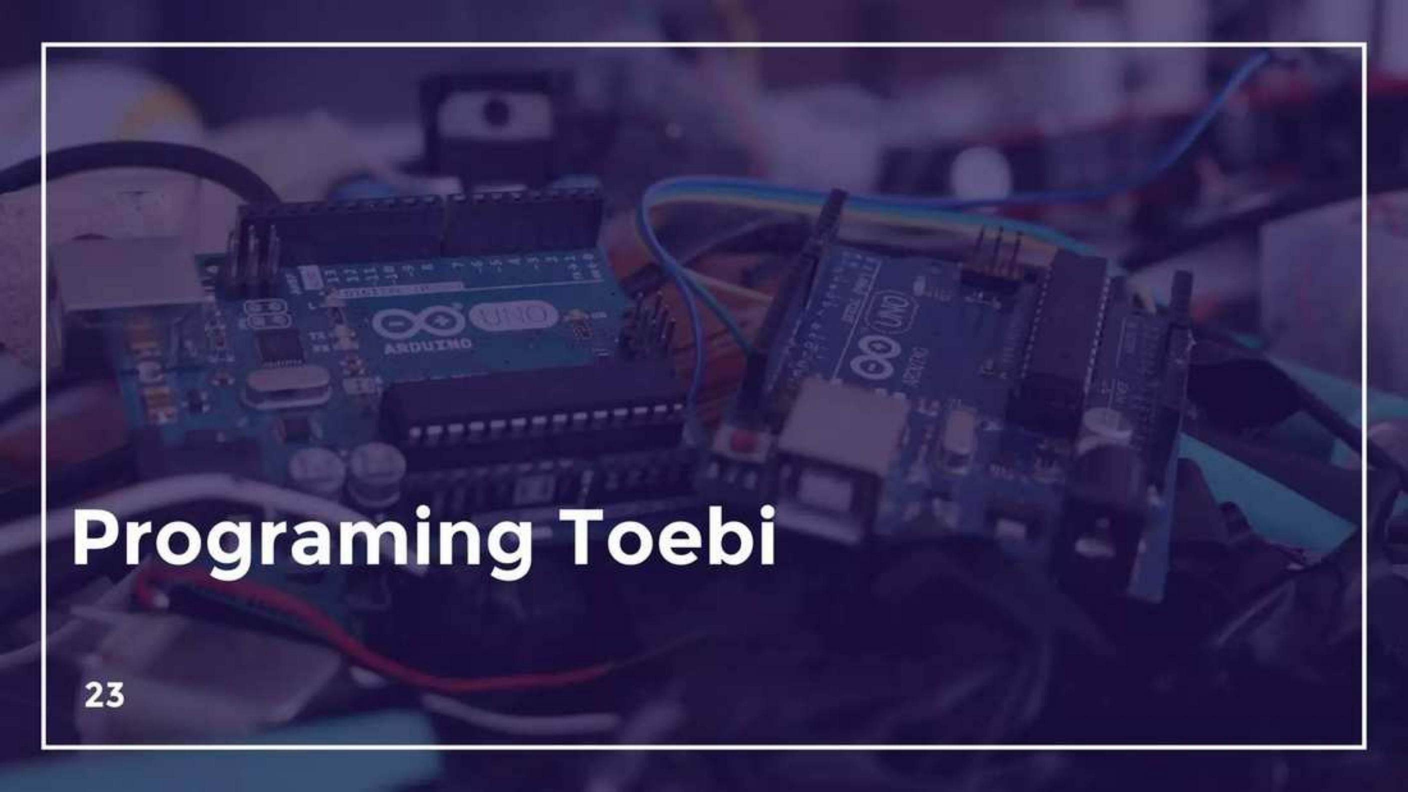
Our Mobile APP

In our process we have a lot of connections between controllers, the shredder, temporary storage, and the bucket.

Plus, the compost needs some time to be done, and we thought that the user should know what is happening in the process, like the battery is dead,.... the washer is empty and needs water, ...the bucket is full,.... the compost is done by time,..... or any error that could happen.

But how would you know about all those things!? You sure not going to memorize them and count the days. So the best thing we can do is to have an IP address for the container that is connected to the cloud with an app to send you all the notifications you should know. Plus, this helps to calculate the C/N ratio of your inputs through the app, all you have to do is to chose the percentage of the materials and the process of the container will work perfectly.

And if you wanted more info you can see more details about everything that's happening in the same app!



Programing Toebi

Every process in toebi has a code and all codes work together to make toebi automated.

in our process we have four algorithms.
The cutting machine
Temporary storage
Weight and the bucket.

In **The cutting machine** we used two motors to shred the materials, and two touch sensors to control the opening and closing of the machine.
In the second process we use bluetooth to reach C/N ratio we sync **the temporary storage** with weight to make the process more efficient.
In **the bucket** we have two controller : NXT controller and Arduino controller.
we use NXT controller for weighting the materials and make connections with the controller of temporary storage by Send Bluetooth Function.

```
task sendBTmessage()
{
  while (true)
  {
    sendMessageWithParm(send); //send up to 3 values
    wait1Msec(100);  // Don't send messages too frequently.
  }
```

The main code of weight:

```
task main()
{
 while(true)
 {
  switch(SensorValue[T1])
  {
  case 1:
    send=100;
    startTask(sendBTmessage);
    startTask(recieveBTmessage);
    switch(re)
    {
    case 0:
      if(z==0)
      {
        nMotorEncoder[AZ] = 0; // reset the Motor Encoder of Motor AZ
        while(nMotorEncoder [AZ] > -950) // while the Motor Encoder of Motor AZ
          //has not yet reached -950 counts:
        {
          motor[AZ] = -30; // motor A is given a power level of -30
        }
        motor[AZ] = 0; // motor AZ is given a power level of 0 (stop)
        ClearMessage();
        z++;
      }
      break;
    case 1:
      if(x==0)
      {
```

```
    nMotorEncoder[AZ] = 0; // reset the Motor Encoder of Motor AZ
    while(nMotorEncoder [AZ] < 950) // while the Motor Encoder of Motor AZ
      //has not yet reached 950 counts:
    {
      motor[AZ] = 30; // motor AZ is given a power level of 30

    }
    motor[AZ] = 0; // motor AZ is given a power level of 0 (stop)
    nMotorEncoder[CAA] = 0; // reset the Motor Encoder of Motor CAA
    while(nMotorEncoder [CAA] > -800) // while the Motor Encoder of Motor CAA
      //has not yet reached -800 counts:
    {
      motor[CAA] = -30; // motor CAA is given a power level of -30

    }
    motor[CAA] = 0; // motor CAA is given a power level of 0 (stop)
    displayBigTextLine(3,"2");
    stopTask(recieveBTmessage);
    x++;
  }
  break;
  displayBigTextLine(3,"1");
case 2:
  displayBigTextLine(3,"needing");
ClearMessage();
  break;
case 3:
  if(y==0)
  {
    startTask(recieveBTmessage);
```

```
      nMotorEncoder[CAA] = 0; // reset the Motor Encoder of Motor CAA
      while(nMotorEncoder [CAA] < 800) // while the Motor Encoder of Motor CAA
        //has not yet reached 800 counts:
      {
        motor[CAA] = 30; // motor CAA is given a power level of 30

      }
      motor[CAA] = 0; // motor CAA is given a power level of 0 (stop)
      displayBigTextLine(3,"3");
    ClearMessage(); // clear the message to give room for new ones.
      y++;
    }
    break;
  }
  break;
case 0:
  send=001;
  startTask(sendBTmessage);
  z=0;
  x=0;
  y=0;
  displayBigTextLine(3,"default");
      nMotorEncoder[AZ] = 0;
        nMotorEncoder[CAA] = 0;
        motor[AZ]=0;
        motor[CAA]=0;
          ClearMessage(); // clear the message to give room for new ones.
          if(SensorValue[T2]==1)
        {
```

Now let's move to Arduino controller. we made a lot of things

1-water level

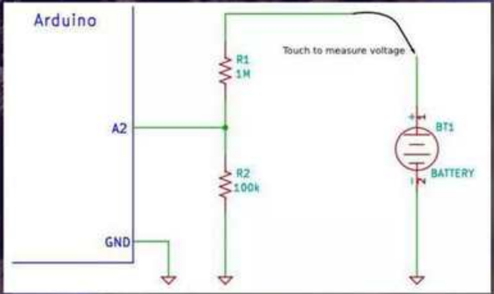
To make water level we use voltage divider concept also, we use water like a changing resistor.

```
int sum = 0;                    // sum of samples taken
unsigned char sample_count = 0; // current sample number
#define NUM_SAMPLES 10
int rd; //result
int fi; // final result
void setup()
{
  lcd.begin(16, 2);
  Serial.begin(9600);

}

void loop()
{
  // Ten analog samples are taken using the following code:
   while (sample_count < NUM_SAMPLES) {
        sum += analogRead(A1);
        sample_count++;
        delay(10);
   }
   // The sum or total of all 10 values added together are stored in sum.
   //The variable sample_count keeps track of the number of samples.
    rd= ((float)sum / (float)NUM_SAMPLES);
    fi = (rd/1024.0)*100; //to make result out of 100
  lcd.clear();
  delay(500);
  Serial.println(fi);
 delay(500);
  sample_count = 0;
    sum = 0;
```

2-Battery level

We use voltage divider concept to Battery level

voltage divider circuit :



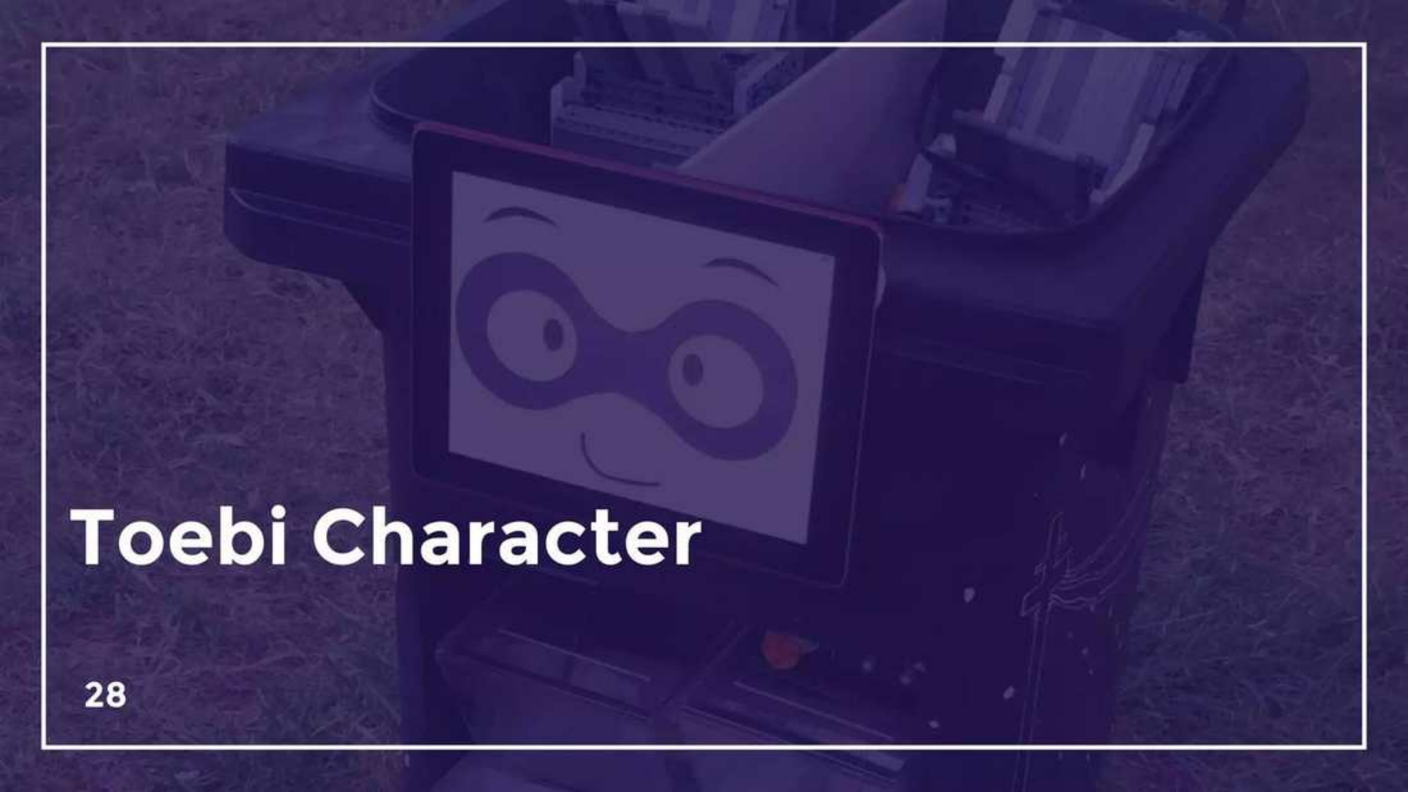
A voltage divider circuit consisting of two resistors in series will divide the input voltage to bring it within the range of the Arduino analog inputs.
The circuit shown below will divide the input voltage by 11 (from the battery as the example input voltage being measured).

The circuit with the particular values shown has an input impedance of 1MΩ + 100kΩ = 1.1MΩ and is suitable for measuring DC voltages up to about 50V.

Finally, Tobie is connected to the cloud that mean Tobie has a mobile phone app to send you all notification included : battery level , water level , humidity and when compost done to make this operation:
first : we used HC-05 Bluetooth module to send data from Arduino to server.
second: an app on server it's made by C# to receive data ,analyze data and convert it to CSV file.

```
int sum = 0;                    // sum of samples taken
unsigned char sample_count = 0; // current sample number
float voltage = 0.0;            // calculated voltage
#define NUM_SAMPLES 10
void setup()
{
    Serial.begin(9600);
}

void loop()
{
    // take a number of analog samples and add them up
    while (sample_count < NUM_SAMPLES) {
        sum += analogRead(A2);
        sample_count++;
        delay(10);
    }
    // calculate the voltage
    // use 5.0 for a 5.0V ADC reference voltage
    // 5.015V is the calibrated reference voltage
    voltage = ((float)sum / (float)NUM_SAMPLES * 5.015) / 1024.0;
    // send voltage for display on Serial Monitor
    // voltage multiplied by 11 when using voltage divider that
    // divides by 11. 11.132 is the calibrated voltage divide
    // value
    Serial.print(voltage * 11.132);
    Serial.println (" V");
    sample_count = 0;
    sum = 0;
}
```

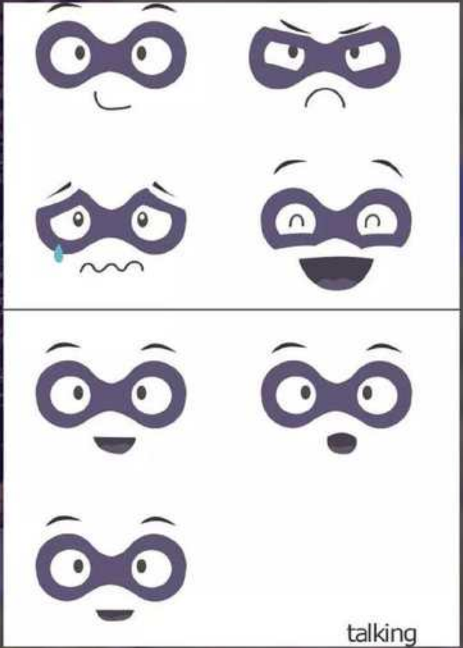
Toebi Character



We made a beautiful Character for our project, so this character or let's say Toebi can talk with people, and make conversations with them. It can talk with anyone through microphone, connected directly to the speaker inside the container.

And in same time we can change and show some reactions with Toebi to make our conversation more real with people.
We work hard to chose the right character for our project, we needed a character with a positive reaction and get a good impression but in same time we need it to be more to a robot character but in very simple way.

We are looking forward to see you talking with Toebi in India.




Ideas

Compost Machine Application

WHAT MAKES OUR SOLUTION BETTER THAN TYPICAL ONES:

- It is all automatic and needs no human hands. The process will be done by time as soon as you put your waste in it.
- You get all the info's you should know as notifications by our app (anything about the batteries, the washer, the moisture continent and the end time of your compost).
- The practical size is appropriate to personal uses on your home or your building. Plus, it can be applied for larger areas with the same mechanism just bigger size.

- It works every time with no need for any repairing operation.
- A user guide comes up with the container for the materials you can use and the materials you can't.
- Low operating cost.
- Takes less time than bigger composting system (almost 14-25 days).

This machine was done after the studies and researches to find a better solution for making compost so easy to made and fun at the same time. That way we save the world from over waste and learn how to recycle.

Everyday we have trash to get rid of, and for that our machine is supposed to be in every house or in every building. It can be sized to whatever is the use of it like the one for the house will be smaller than that for a restaurant.

The bucket can be changeable and you can get how much you need and put it in the bottom of the machine.

This would reduce the amount of waste including food waste, papers and cartons, woods, and yard trimmings.

This project will be applied in smart cities where the container is near every building, home, restaurant, park, etc…

As this containers can walk, and because they have an app it will send to the trash cars if it's full so they won't go to the street until they know which containers they need to empty. This will reduce energy usage and won't need anyone to get down and push it up to the trash care because now it can walk by itself.

Plus, if it spreads and become an ordinary container in the streets it will help to reduce the amount of waste and make people realize the importance of this issue to make them more responsible and think twice about the things they throw away. Because nothing just go away it sure will end up somewhere.

Food waste from economic view?

Water, food, and energy are the future biggest needs, so by reducing food waste we save food, water and energy.

The businesses have a lot to work with. As much as 40 percent of the American food supply goes in the trash. Most of the waste comes from consumers and retailers, the government estimates, and in recent years, the issue has resonated, particularly with younger consumers.

Due to economic development, industrialization and increasing population, problems related to the expanded consumption and depletion of resources, and the increased output of wide-ranging types of waste are becoming more serious than ever.

There is a word in Japan: Mottainai. It encompasses the practice of treasuring and using all things as long as possible.

While economies continue to grow, this spirit of Mottainai restrained the generation of waste and motivated the development of technology for reuse, recycling and effective use through heat recovery. As Japan's landmass is limited and finding landfill disposal sites is difficult, we have developed a system to collect and transport waste, process it through intermediary treatment by incineration and other methods, and then dispose it in landfills in a sanitary manner, in order to prevent environmental pollution in the areas surrounding densely populated cities.

How to make compost?

Recently, a new method has been developed which corrects some of the problems associated with the old type of composting. With this process, compost can be made in 2 to 3 weeks.

To make compost we need 4 essential inputs:

1- nitrogen rich materials: which are vegetable and fruit peels, green leaves and animals manure.

2- carbon rich materials: which are straw, dry leaves, grayed papers and cartons.

3- air: by mixing the compost to make sure there's enough oxygen for the aerobic bacteria

4- water: because humidity is important for the decomposition. The compost should be wet but not floating in water.

Plus, we should shred all the materials to small pieces and make sure that the C:N (carbon to nitrogen) ratio is balanced, 50% nitrogen and 50% carbon.

Did you know that all organic matter has a ratio of Carbon to Nitrogen (C:N) in their tissues? For microorganisms, carbon is the basic building block of life and is a source of energy, but nitrogen is also necessary for such things as proteins, genetic material, and cell structure.

In compost lingo, this balance is referred to as the Carbon-Nitrogen ratio, and shown as C:N.

Generally, you can get C:N ratios of 30:1 to 50:1 by adding two parts of a GREEN material to one part of a BROWN material to your bin. A "part" can be defined as a certain quantity of the material, such as two 5-gallon buckets of GREEN and 1 packed bucket of BROWN.

but experience has shown that mixing equal volumes of green plant material with equal volumes of naturally dry plant material will give approximately a 30/1 carbon to nitrogen (C/N) ratio. Green material can be grass clippings, old flowers, green prunings, weeds, fresh garbage and fruit and vegetable wastes. Dried material can be dead, fallen leaves, dried grass, straw and somewhat woody materials from prunings. Such materials are easy to find in fall and early spring but are more difficult to find in the growing season.

Generally about two-thirds of carbon is respired as CO_2, while the other third is combined with nitrogen in the living cells. However, if the excess of carbon over nitrogen (C:N ratio) in organic materials being decomposed is too great, biological activity diminishes. Several cycles of organisms are then required to burn most of the carbon.

some other researches showed different ratios, (this isn't a perfect world!) to find your own style. The C:N ratio does not need to be exact. Values are calculated on a dry-weight basis. It is difficult to determine an exact C:N ratio without knowing the moisture content of the materials being used.

(Note: Dry materials are generally in the range of 40 to 50 percent carbon, and sloppy, wet materials are generally 10 to 20 percent carbon. Therefore, the most important factor in estimating the carbon-to-nitrogen ratio of plant or food waste is how much water is present).

Don't Make This Mistake: This ratio describes the chemical composition of a material and does not mean that you need a volume of brown materials that is thirty times greater than the amount of green matter! Don't make this mistake!

(the values are written below)

Once a pile is started, do not add anything. The reason is that it takes a certain length of time for the material to break down and anything added has to start at the beginning, thus lengthening the decomposition time for the whole pile. Excess material should be as dry as possible during storage until a new pile is started. Moist stored materials will start to decompose and if this occurs, they will not do a good job in the compost pile.

If done correctly, a pile will heat to high temperatures within 24 to 48 hours. If it doesn't, the pile is too wet or too dry or there is not enough green material (or nitrogen) present.

If too wet, the material should be spread out to dry.

If too dry, add moisture. If neither of these, then the nitrogen is low (a high C/N ratio) and this can be corrected by adding materials high in nitrogen (such as ammonium sulfate, grass clippings, fresh chicken manure or urine diluted I to 5).

As composting nears completion the temperature drops and, finally, little or no heat is produced. The compost is then ready to use. If in the preparation of the compost, the material was not chopped in small pieces, screening the material through 1-inch-mesh chicken wire will hold back such pieces. These can be added to the next pile and eventually they will decompose.

Green (Nitrogen)	Brown (Carbon)
Aged chicken Manure 7:1	Leaves 60-80:1
Food Scraps 17:1 Vegetable Scraps 25:1	Straw, Hay 90:1
Coffee Grounds 25:1	Sawdust 500:1
Grass Clippings - Fresh 17:1	Woody Chips & Twigs 700:1

Fresh Weeds 20:1	Shredded Newspaper 175:1
Fruit Wastes 25-40:1	Nut Shells 35:1
Rotted Manure 20:1	Pine Needles 80:1
Humus (soil) 10:1	Corn Stalks 60:1
Seaweed 19:1	Peat Moss 58:1
General Garden Waste 30:1	

Note: The C:N Ratios given in this chart are average and may slightly vary according to source, researcher or scientist!

Name	Source	%w/w*	Moisture	Class†	Major constituents††
Paper fibre	Card/paper board, office paper, newsprint, magazines, corrugated paper	35–45	Low	Brown	Cellulose
Yard waste	Green plant matter—domestic and municipal garden and park grass, tree, shrubbery trimmings, roadside leaf litter	8–12	Low or Medium	Green	Lignin, cellulose, sugars—nitrogen, phosphorus, and mineral rich
Food waste	Domestic food waste, commercial food wastes	5–15	High	Green	Sugar, proteins, and fat, some minerals
Forest waste, Lumber‡	Construction, saw-mill dust, wood chips, bark, wood and fiber board industry waste	15‡	Low	Brown	Lignin, cellulose (potentially contaminated with toxic organic compounds and heavy metal from preservatives, paints and fillers)
Sewage sludge (Biosolids)	Municipal sewage and waste water processing sludge/solids	–	Variable	Green	Nitrogen and phosphorus and mineral rich, potentially pathogenic (raw sludge solids), may contain toxic heavy metals
Animal manure	Livestock (mixture of animal fecal matter and bedding materials like straw)	–	Medium or High	Green	Lignin, cellulose, hemicellulose—acidic, nitrogen, phosphorus, and mineral rich, may contain antibiotics
Plant manure	Nitrogenous crops like legumes, seaweeds, brewing industry (spent hops, barley), meat operations (rumen contents)	–	Medium	Green	Lignin, cellulose, hemicellulose, proteins—nitrogen and phosphorus rich
Farm waste (Non-manure)	Hay, straws, chaff	–	Variable, usually Low	Green	Usually high C/N ratio, mineral rich

Optimum Parameters

The commonly quoted optimum parameters for aerobic commonly quoted optimum parameters for aerobic decomposition are:

- C:N ratio, 25-30 to 1.
- Moisture content, 40-60%.
- Oxygen concentrations, greater than 10%.
- Average wet bulk density, 200-300 kg/m3 (this increases to 800- 900 over the decomposition process).
- pH, 6.5-8.
- Temperature, 45-65˚C for optimum thermophilic microbial action, including a period of 4 days at greater than 55˚C

Water in which compost has been soaked (often called compost tea) is said to be beneficial to plants.

oxygen

So, how much oxygen is sufficient to maintain aerobic conditions? Although the atmosphere is 21% oxygen, aerobic microbes can survive at concentrations as low as 5%. Oxygen concentrations greater than 10% are considered optimal for maintaining aerobic composting. Some compost systems are able to maintain adequate oxygen passively, through natural diffusion and convection. Other systems require active aeration, provided by blowers or through turning or mixing the compost ingredients.

water

Too much moisture will make a soggy mass, and decomposition will be slow and will smell. if the organic material is too dry, decomposition will be very slow or will not occur at all.

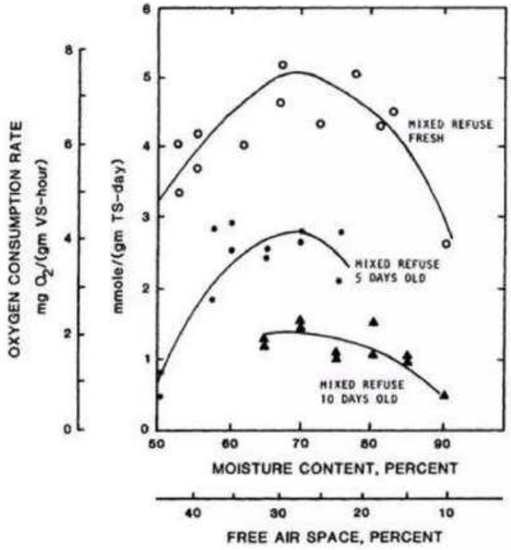


Figure 6.6. Effects of moisture and FAS on oxygen consumption rates of mixed refuse samples. Data were developed from Warburg respirometer runs. Incubation temperatures were not specified. From Jeris and Regan.[5]

PH

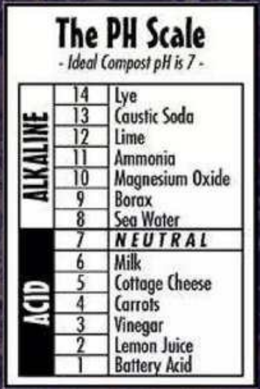
pH is the measure of the acidity or alkalinity of soil, with 7 considered "neutral" and numbers below acidic and above alkaline. Composting feedstocks have a pH, which will fluctuate during the composting process.

A pH between 5.5 and 8.5 is optimal for compost microorganisms. As bacteria and fungi digest organic matter, they release organic acids. In the early stages of composting, these acids often accumulate. The resulting drop in pH encourages the growth of fungi and the breakdown of lignin and cellulose. Usually the organic acids become further broken down during the composting process. If the system becomes anaerobic, however, acid accumulation can lower the pH to 4.5, severely limiting microbial activity. In such cases, aeration usually is sufficient to return the compost pH to acceptable ranges.

The control of the pH in composting is seldom a problem requiring attention if the material is kept aerobic, but large amounts of organic acids are often produced during anaerobic decomposition on a batch basis.

However, since composting is necessarily a batch-process operation, minor changes in the pH are normal.

Knowing the PH can tell you about the type of the decompos-ition you have.



Heat

Which is very important in rapid composting, is supplied by the respiration of the microorganisms as they break down the organic materials. To prevent heat loss and to build up the amount of heat necessary, a minimum volume of material is essential: a pile at least 36" x 36" x 36" is recommended. If less than 32" The rapid process will not occur. Heat retention is better in bins than in open piles, so rapid composting is more effective if bins are used. In addition, the use of bins is much neater. High temperatures favor the microorganisms which are the most rapid decomposers; these microorganisms function at about 1600 F (710C) and a good pile will maintain itself at about that temperature.

A thermometer to measure temperatures inside the pile is helpful although not necessary.

The heat will occur when you have a big space (pile).

Temperature Curve

Compost heat is produced as a by-product of the microbial breakdown of organic material. The heat production depends on the size of the pile, its moisture content, aeration, and C/N ratio. Additionally, ambient (indoor or outdoor) temperature affects compost temperatures.

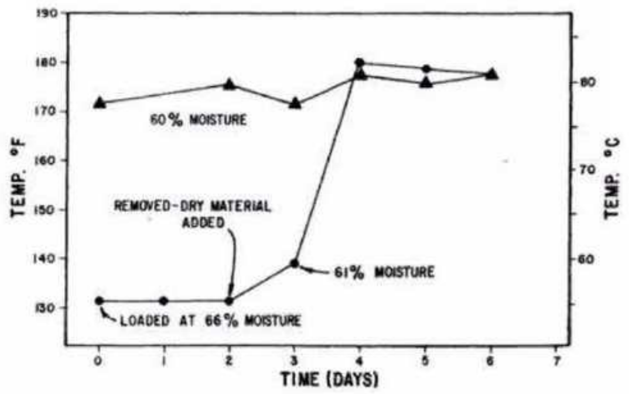


Figure 6.1. Effect of initial moisture content on temperatures developed during composting of dairy manure in deep bins. From Senn.[3]

Particle Size

Microbial activity generally occurs on the surface of the organic particles. Therefore, decreasing particle size, through its effect of increasing surface area, will encourage microbial activity and increase the rate of decomposition. On the other hand, when particles are too small and compact, air circulation through the pile is inhibited. This decreases O2 available to microorganisms within the pile and ultimately decreases the rate of microbial activity.

Particle size also affects the availability of carbon and nitrogen. Large wood chips, for example, provide a good bulking agent that helps to ensure aeration through the pile, but they provide less available carbon per mass than they would in the form of wood shavings or sawdust.

The compost pile needs to be turned to prevent the pile from getting too hot. if it gets much above 160o F, the microorganisms will be killed, the pile will cool, and the whole process will have to start from the beginning. By turning the pile it will not overheat, and it will be aerated also, both of which are necessary to keep the most active decomposers functioning.

If the material in the pile is turned every day, it will take 2 weeks or a Little longer to compost. If turned every other day, it will take about 3 weeks. The longer the interval between turning the longer it will take for the composting to finish.

* this will happen in case of big areas are used not in small sizes like in our projects.

Damascus University of Agriculture

Compost from a SCIENCE view

The Phases of Composting

In the process of composting, microorganisms break down organic matter and produce carbon dioxide, water, heat, and humus, the relatively stable organic end product. Under optimal conditions, composting proceeds through three phases:
1) the mesophilic, or moderate-temperature phase, which lasts for a couple of days,
2) the thermophilic, or high-temperature phase, which can last from a few days to several months, and finally,
3) a several-month cooling and maturation phase.

Different communities of microorganisms predominate during the various composting phases. Initial decomposition is carried out by mesophilic microorganisms, which rapidly break down the organics.

The heat the readily degradable compounds produce causes the compost temperature to rapidly rise. As the temperature rises above about 40˚C, the mesophilic microorganisms become less competitive and are replaced by others that are thermophilic, or heat-loving.

At temperatures of 55˚C and above, many microorganisms that are human or plant pathogens are destroyed. Because temperatures over about 65˚C kill many forms of microbes and limit the rate of decomposition, compost managers use aeration and mixing to keep the temperature below this point.

During the thermophilic phase, high temperatures accelerate the breakdown of proteins, fats, and complex carbohydrates like cellulose and hemicellulose, the major structural molecules in plants. As the supply of these high-energy compounds becomes exhausted, the compost temperature gradually decreases and mesophilic microorganisms once again take over for the final phase of "curing" or maturation of the remaining organic matter.

Microorganisms such as bacteria, fungi, and actinomycetes account for most of the decomposition that takes place in a pile. They are considered chemical decomposers, because they change the chemistry of organic wastes. Aerobic bacteria are the most important decomposers. They are the most nutritionally diverse of all organisms and can eat nearly anything.

Bacteria utilize carbon as a source of energy (to keep on eating) and nitrogen to build protein in their bodies (so they can grow and reproduce). They obtain energy by oxidizing organic material, especially the carbon fraction. This oxidation process heats up the compost pile from ambient air temperature. If proper conditions are present, the pile will heat up fairly rapidly (within days) due to bacteria consuming readily decomposable materials.

Bacteria requiring oxygen to function (aerobic bacteria) and fungi manage the chemical process by converting the inputs into heat, carbon dioxide and ammonium. The ammonium (NH_4) is the form of nitrogen used by plants. When available ammonium is not used by plants it is further converted by bacteria into nitrates (NO_3) through the process of nitrification.

The compost itself is beneficial for the land in many ways, including as a soil conditioner, a fertilizer, addition of vital humus or humic acids, and as a natural pesticide for soil. In ecosystems, compost is useful for erosion control, land and stream reclamation, wetland construction, and as landfill cover.

aerobic bacteria need oxygen levels greater than five percent.

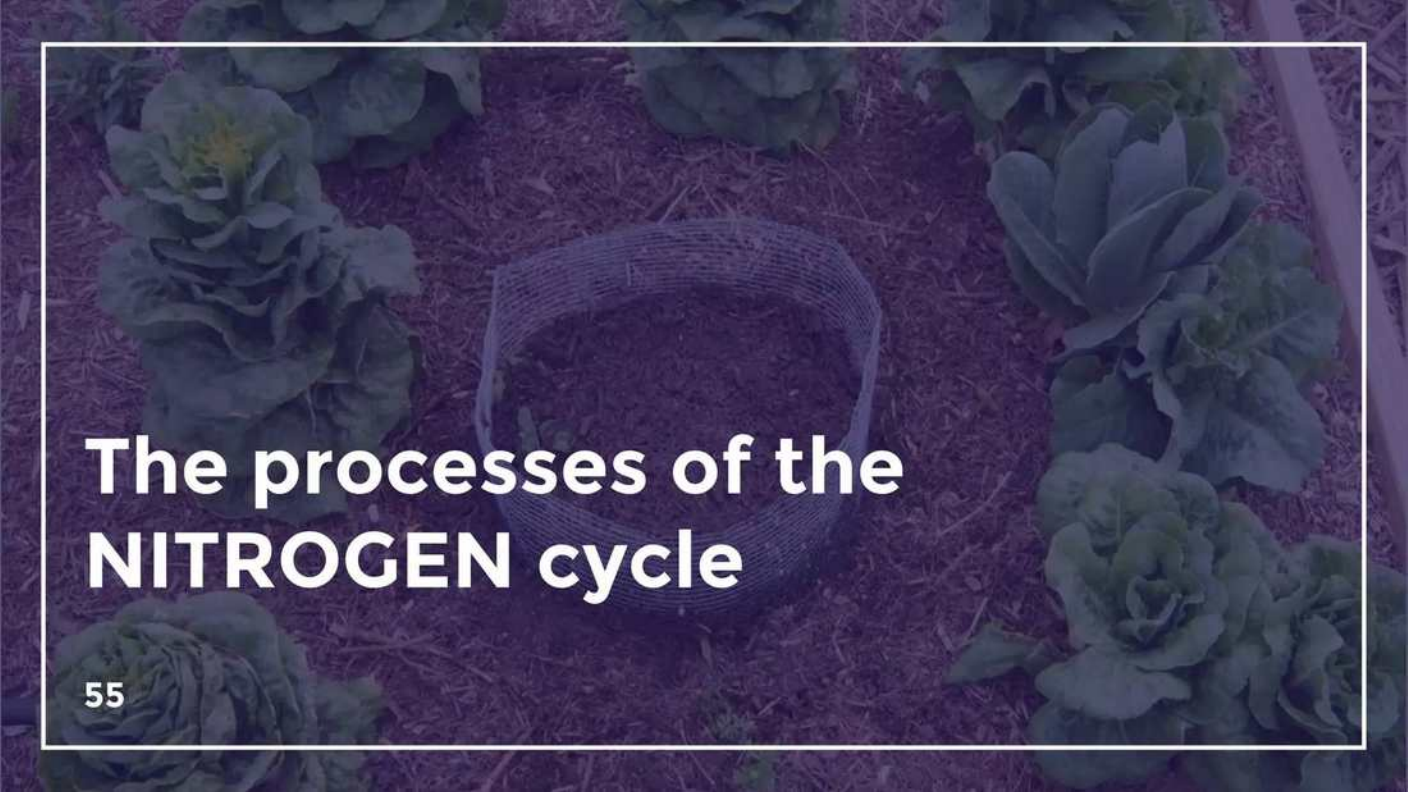
When oxygen levels fall below five percent, the aerobes die and decomposition slows by as much as 90 percent. Anaerobic microorganisms take over and, in the process, produce a lot of useless organic acids and amines (ammonia-like substances) which are smelly, contain unavailable nitrogen and, in some cases, are toxic to plants.

The drop in compost pile temperature is not a sign that composting is complete, but rather an indication that the compost pile is entering another phase of the composting process

Biological activity diminishes if the compost mix contains too much carbon in relation to nitrogen. Several cycles of organisms are required to burn excess carbon. This is a complex chemical process. When organisms die, their stored nitrogen and carbon become available to other organisms.

These new organisms form new cells which again need nitrogen to burn excess carbon and produce CO_2. Thus, the amount of carbon is reduced and the limited amount of nitrogen is recycled. Finally, when the ratio of available carbon to available nitrogen is low enough, nitrogen is released as ammonia.

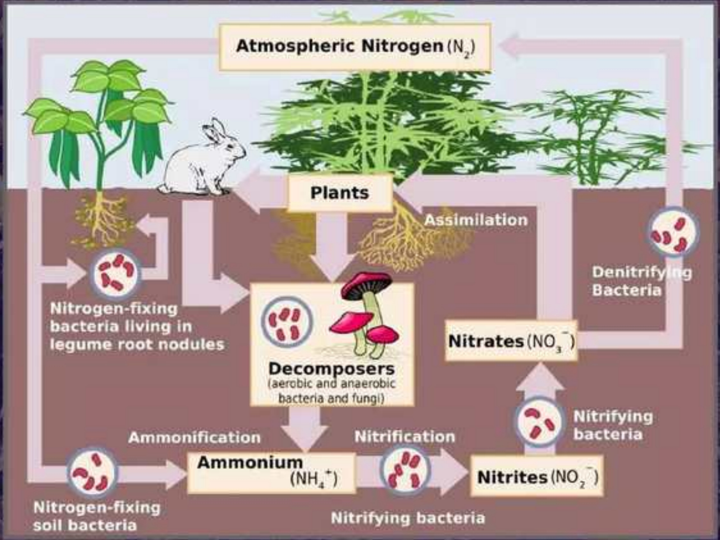
Oxidation of Carbon: $C + O_2 \rightarrow CO_2$



The processes of the NITROGEN cycle

Nitrogen is present in the environment in a wide variety of chemical forms including organic nitrogen, ammonium (NH_4^+),nitrite (NO_2^-), nitrate (NO_3^-), nitrous oxide (N_2O), nitric oxide (NO) or inorganic nitrogen gas (N_2). Organic nitrogen may be in the form of a living organism, humus or in the intermediate products of organic matter decomposition.

The processes of the nitrogen cycle transform nitrogen from one form to another. Many of those processes are carried out by microbes, either in their effort to harvest energy or to accumulate nitrogen in a form needed for their growth. The diagram above shows how these processes fit together to form the nitrogen cycle.



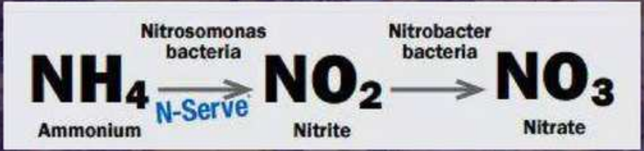
Nitrification

The conversion of ammonia to nitrate is performed primarily by soil-living bacteria and other nitrifying bacteria. In the primary stage of nitrification, the oxidation of ammonium (NH_4^+) is performed by bacteria such as the Nitrosomonas species, which converts ammonia to nitrites (NO_2^-). Other bacterial species such as Nitrobacter, are responsible for the oxidation of the nitrites into nitrates (NO_3^-).[5] It is important for the ammonia to be converted to nitrates or nitrites because ammonia gas is toxic to plants.

Nitrous oxide (N_2O) has risen in the atmosphere as a result of agricultural fertilization

Nitrous oxide is also a greenhouse gas and is currently the third largest contributor to global warming, after carbon dioxide and methane.

During composting a great deal of energy is released in the form of heat in the oxidation of the carbon to CO_2. For example, if a gram-molecule of glucose is dissimilated under aerobic conditions, 484 to 674 kilogram calories (kcal) of heat may be released. If the organic material is in a pile or is otherwise arranged to provide some insulation, the temperature of the material during decomposition will rise to over 170˚F. If the temperature exceeds 162˚F to 172˚F, however, the bacterial activity is decreased and stabilization is slowed down.



Key Factors Affecting The Composting Process

There are certain key environmental factors which affect the speed of composting. The organisms that make compost need food (carbon and nitrogen), air, and water. When provided with a favorable balance, they will produce compost quickly. Other organism factors affecting the speed of composting include surface area/particle size, volume, and temperature.

For the practical size, if aeration is adequate small particles will degrade more quickly.

Too much nitrogen can cause a rise in the pH level which is toxic to some microorganisms.

Natural aeration occurs when air warmed by the composting process rises through the pile, bringing in fresh air from the surroundings.

Water in which compost has been soaked (often called compost tea) is said to be beneficial to plants.

Reweigh the sample, subtract the weight of the container, and determine the moisture content using the following equation: $Mn = ((Ww-Wd)/Ww) \times 100$

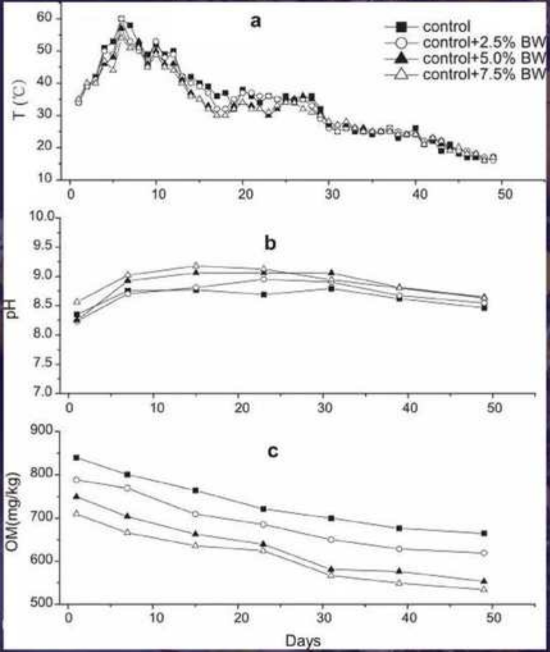
in which:

Mn = moisture content (%) of material n

WW = wet weight of the sample,

and Wd = weight of the sample after drying.

a moisture content of 50%-60% by weight is optimal for composting conditions.



The next step is to calculate the relative amounts of materials you should combine to achieve your moisture goal. The general formula for percent moisture is:

Moisture Content in which: Qn = mass of material n ("as is", or "wet weight") G = moisture goal (%) Mn = moisture content (%) of material n

Carbon Nitrogen Ratio (C/N) =Carbon Content /Nitrogen Content

C:N Ratio =Wt. of "C" in Material A + "C" in B + "C" in Material C / Wt. of "N" in Material A + "N" in B + "N" in C

Table 7.1. General Chemical Compositions for the Organic Fraction of Various Organic Materials

Waste Component	Typical Chemical Composition	Reference
Carbohydrate	$(C_6H_{10}O_5)x$	
Protein	$C_{16}H_{24}O_5N_4$	
Fat and Oil	$C_{50}H_{90}O_6$	
Sludge		
Primary	$C_{22}H_{39}O_{10}N$	
Combined	$C_{10}H_{19}O_3N$	McCarty[1]
Refuse (total organic fraction)	$C_{64}H_{104}O_{37}N$	Haug et al.[2]
	$C_{99}H_{148}O_{59}N$	Corey[3]
Wood	$C_{295}H_{420}O_{186}N$	Corey[3]
Grass	$C_{23}H_{38}O_{17}N$	Corey[3]
Garbage	$C_{16}H_{27}O_8N$	Corey[3]
Food wastes	$C_{18}H_{26}O_{10}N$	Kayhanian and Tchobanoglous[4]
Mixed paper	$C_{266}H_{434}O_{210}N$	Kayhanian and Tchobanoglous[4]
Yard wastes	$C_{27}H_{38}O_{16}N$	Kayhanian and Tchobanoglous[4]
Bacteria	$C_5H_7O_2N$	
Fungi	$C_{10}H_{17}O_6N$	

Nutrient Balance

Adequate phosphorus, potassium, and trace minerals (calcium, iron, boron, copper, etc.) are essential to microbial metabolism. Normally these nutrients are not limiting because they are present in ample concentration in the compost source materials.

C/N Ratio Of the many elements required for microbial decomposition, carbon and nitrogen are the most important. Carbon provides both an energy source and and the basic building block making up about 50 percent of the mass of microbial cells. Nitrogen is a crucial component of the proteins, nucleic acids, amino acids, enzymes and co-enzymes necessary for cell growth and function.

To understand this ratio, consider a microbe using a starch or cellulosic substrate as an energy source. Glucose is the base monomer of both starch and cellulose, and the energy reaction can be written as:

$$x\left[C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy}\right]$$

$$x(180)$$

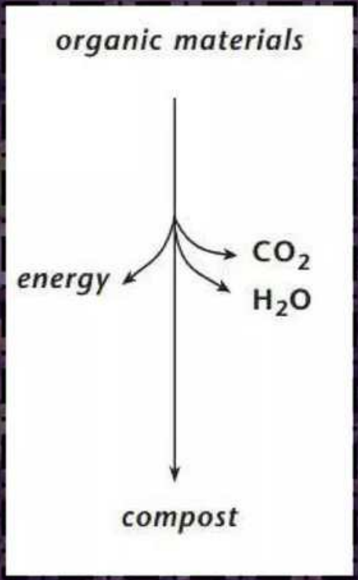
This shows us that cellulose and other materials can decompose, but for sure it needs more time than other materials.

This reaction yields free energy that the cell can apply to drive the synthesis of new microbial mass. Assuming an average cell formulation of $C_5H_7O_2N$ and ammonia as the source of cell N, the synthesis reaction is:

$$5CO_2 + 2H_2O + NH_3 + \text{energy} \rightarrow C_5H_7O_2N$$

Multiplying the energy reaction by 6 and adding to the synthesis reaction gives the net metabolic reaction:

$$6C_6H_{12}O_6 + 31O_2 + NH_3 \rightarrow C_5H_7O_2N + 31CO_2 + 34H_2O$$



Oxidation of the organics and neutralization by the produced CO_2 can be represented as

$$\overset{y}{C_{10}H_{19}O_3N} + 12.5O_2 = \overset{x}{10CO_2} + NH_3 + 8H_2O$$

Oxidation of organics and neutralization by produced NH_3 can be represented as

$$\overset{y}{C_{10}H_{19}O_3N} + 12.5O_2 = 10CO_2 + \overset{x}{NH_3} + 8H_2O$$

$$\overset{x}{3NH_3} + 3H^+ + 3Cl^- = 3NH_4^+ + 3Cl^-$$

Reaction formula

A Lot of equations can be a sample for the decomposition because there are unlimited materials in the compost. The equations before showed how materials like cellulose can be decomposed, and how NH4 is released. So these are examples for some decomposition reactions.

The generalized reaction for chemical decomposition is:

$$AB \rightarrow A + B$$

Carbonates will decompose when heated, a notable exception being that of carbonic acid, H_2CO_3. Carbonic acid, the "fizz" in sodas, pop cans and other carbonated beverages, will decompose over time (spontaneously) into carbon dioxide and water

$$H_2CO_3 \rightarrow H_2O + CO_2$$

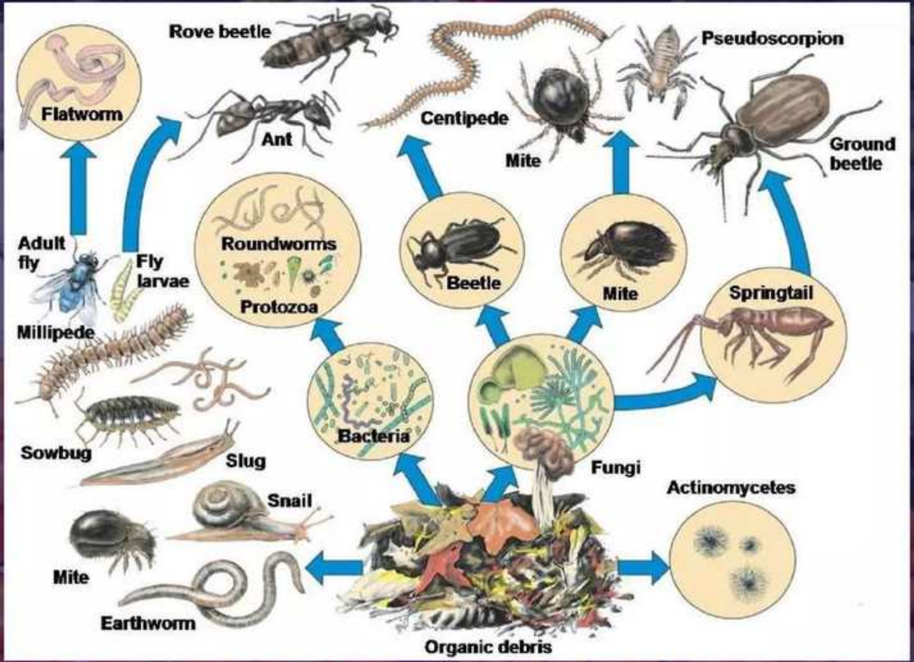
A specific example of this involving calcium carbonate:

$$CaCO_3 \rightarrow CaO + CO_2$$

A common decomposition of a chlorate to evolve oxygen utilizes potassium chlorate as follows:

$$2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$$

Microorganisms


Rove beetle
Pseudoscorpion
Flatworm
Ant
Centipede
Mite
Ground beetle
Adult fly
Fly larvae
Roundworms
Protozoa
Beetle
Mite
Springtail
Millipede
Bacteria
Fungi
Sowbug
Slug
Snail
Actinomycetes
Mite
Earthworm
Organic debris

Bacteria

Bacteria are the smallest living organisms and the most numerous in compost; they make up 80 to 90% of the billions of microorganisms typically found in a gram of compost.

Bacteria are responsible for most of the decomposition and heat generation in compost. They are the most nutritionally diverse group of compost organisms, using a broad range of enzymes to chemically break down a variety of organic materials.

Bacteria are single-celled and structured as either rod-shaped bacilli, sphere-shaped cocci or spiral-shaped spirilla. Many are motile, meaning that they have the ability to move under their own power. At the beginning of the composting process (0-40˚C), mesophilic bacteria predominate. Most of these are forms that can also be found in topsoil. As the compost heats up above 40˚C, thermophilic bacteria take over. The microbial populations during this phase are dominated by members of the genus Bacillus.

The diversity of bacilli species is fairly high at temperatures from 50-55˚C but decreases dramatically at 60˚C or above. When conditions become unfavorable, bacilli survive by forming endospores, thick-walled spores that are highly resistant to heat, cold, dryness, or lack of food.

They are ubiquitous in nature and become active whenever environmental conditions are favorable. At the highest compost temperatures, bacteria of the genus Thermus have been isolated. Composters sometimes wonder how microorganisms evolved in nature that can withstand the high temperatures found in active compost.

Thermus bacteria were first found in hot springs in Yellowstone National Park and may have evolved there. Other places where thermophilic conditions exist in nature include deep sea thermal vents, manure droppings, and accumulations of decomposing vegetation that have the right conditions to heat up just as they would in a compost pile.

Once the compost cools down, mesophilic bacteria again predominate. The numbers and types of mesophilic microbes that recolonize compost as it matures depend on what spores and organisms are present in the compost as well as in the immediate environment. In general, the longer the curing or maturation phase, the more diverse the microbial community it supports.

Fungi

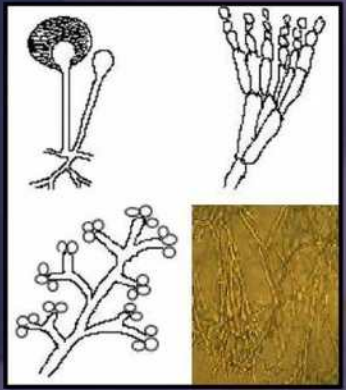
Fungi include molds and yeasts,and collectively they are responsible for the decomposition of many complex plant polymers in soil and compost. In compost, fungi are important because they break down tough debris, enabling bacteria to continue the decomposition process once most of the cellulose has been exhausted.

They spread and grow vigorously by producing many cells and filaments, and they can attack organic residues that are too dry, acidic, or low in nitrogen for bacterial decomposition.

Most fungi are classified as saprophytes because they live on dead or dying material and obtain energy by breaking down organic matter in dead plants and animals.

Fungal species are numerous during both mesophilic and thermophilic phases of composting. Most fungi live in the outer layer of compost when temperatures are high.

Compost molds are strict aerobes that grow both as unseen filaments and as gray or white fuzzy colonies on the compost surface. Compost Microorganisms



Macroorganisms

As mentioned earlier, larger organisms are involved in physically transforming organic material into compost.

In addition to mixing materials, they break it into smaller pieces, and transform it into more digestible forms for microorganisms. Their excrement is also digested by bacteria, causing more nutrients to be released.

Micro- and macroorganisms are part of a complex food chain. This food chain consists of organisms classified as either first-, second-, or third-level consumers. The categories are based on what they eat and who eats them.

First level consumers become the food for second level consumers, which in turn, are eaten by third level consumers. Soil ecologist Dr. Daniel L. Dindal gives an example of how the food chain works in Ecology of Compost:

"Mites and springtails eat fungi. Tiny feather-winged beetles feed on fungal spores. Nematodes ingest bacteria. Protozoa and rotifers present in water films feed on bacteria and plant particles. Predaceous mites and pseudoscorpions prey upon nematodes, fly larvae, other mites and collembolans. Free-living flatworms ingest gastropods, earthworms, nematodes and rotifers. Third-level consumers such as centipedes, rove beetles, ground beetles, and ants prey on second-level consumers."

The following is an overview of some of the larger macroorganisms you are likely to find in a compost pile:

Ants - Ants feed on a variety of materials including fungi, seeds, sweets and other insects. They help the composting process by bringing fungi and other organisms into their nests. Ants can make compost richer in phosphorus and potassium by moving minerals around as they work.

Flies – Flies are two-wing insects that feed on almost any kind of organic material. They also act as airborne carriers of bacteria, depositing it wherever they land. Although flies are not often a problem associated with compost piles, you can control their numbers by keeping a layer of dry leaves or grass clippings on top of the pile. Also, bury food scraps at least eight to twelve inches deep into the pile. Thermophilic temperatures kill fly larvae. Mites help to keep fly larvae reduced in numbers.

Organic or Chemical Fertilizer?

Organic Fertilizer

The words "organic" or "natural" in this case simply means that the product is only minimally processed, and the nutrients remain bound up in their natural forms, rather than being extracted and refined. In the case of fertilizer, "organic" does NOT refer to the standards of processing associated with food.

Advantages of Organic Fertilizer:

- In addition to releasing nutrients, as organic fertilizers break down, they improve the structure of the soil and increase its ability to hold water and nutrients. Over time, organic fertilizers will make your soil–and plants–healthy and strong.

- Since they are the ultimate slow-release fertilizers, it's very difficult to over fertilize (and harm) your plants.

- There's little to no risk of toxic buildups of chemicals and salts that can be deadly to plants.

- Organic fertilizers are renewable, biodegradable, sustainable, and environmentally friendly.

- Although rather expensive in packages, you can make your own organic fertilizer by composting or find inexpensive sources—such as local dairy farms—that may sell composted manure. so an application of organic fertilizer provides a complete package of nutrients for your soil.

Disadvantages of Organic Fertilizer:

- Organic fertilizers break down according to nature's rules, so they may not release nutrients as soon as you need them. You have to be patient – you won't see improvement overnight. In fact, you may actually see a deficiency in your plants during the first couple of months until the first application breaks down. Hang in there! You'll most definitely be rewarded.

Chemical Fertilizers

Chemical fertilizers (also called inorganic, synthetic, artificial, or manufactured) have been refined to extract nutrients and bind them in specific ratios with other chemical fillers.
These products may be made from petroleum products, rocks, or even organic sources. Some of the chemicals may be naturally occurring, but the difference is that the nutrients in chemical fertilizers are refined to their pure stateand stripped of substances that control their availability and breakdown, which rarely occurs in nature.

Advantages of Chemical Fertilizer:

- Since nutrients are available to the plants immediately, improvement occurs in days.
- They are highly analyzed to produce the exact ratio of nutrients desired.
- Standardized labeling makes ratios and chemical sources easy to understand.

Disadvantages of Chemical Fertilizer:

- Chemical fertilizers are primarily made from nonrenewable sources, including fossil fuels.
- They grow plants but do nothing to sustain the soil. The fillers do not promote life or soil health, and even packages labeled "complete" do not include the decaying matter necessary to improve soil structure.

In fact, chemical fertilizers don't replace many trace elements that are gradually depleted by repeated crop plantings, resulting in long-term damage to the soil.

- Because the nutrients are readily available, there is a danger of over fertilization. This not only can kill plants but upset the entire ecosystem.
- Chemical fertilizers tend to leach, or filter away from the plants, requiring additional applications.
- Repeated applications may result in a toxic buildup of chemicals such as arsenic, cadmium, and uranium in the soil. These toxic chemicals can eventually make their way into your fruits and vegetables.
- Long-term use of chemical fertilizer can change the soil pH, upset beneficial microbial ecosystems, increase pests, and even contribute to the release of greenhouse gases.

Making a Choice

If you wish to live in harmony with nature and make a lasting improvement in your own patch of earth for generations to come, organic fertilizers outweigh chemicals by leaps and bounds.

the continuous use of chemical fertilization leads to deterioration of soil characteristics and fertility, and may lead to the accumulation of heavy metals in plant tissues which compromises fruit nutrition value and edible quality.

Chemical fertilizer also reduces the protein content of crops, and the carbohydrate quality of such crops also gets degraded.

Rebuilding SYRIA

Syria was the world's fifth largest olive exporter in the world prior to 2011, and the crop covered 65% of area planted by fruit trees. Despite an image as a desert country, with around 0.22 hectares of arable land per person, and it's 25% of arable landmass,

Syria is more fecund on both indicators than countries such as the United Kingdom, China, or Colombia. The latest estimates (pre-2011) showed that 36% of Syria's land is arable.

"Foodindependence is impossible for a country like Syria to achieve. With 22-million population Syria requires about 22 billion m3 of water annually to grow its food needs. Syria can provide only 15 billion m3 from irrigation and rain combined. The difference is being imported 1/din the form of foodstuffs quietly without fanfare. The gap will get bigger as Syria's population grows."

Over 36% of syrian lands were farm lands. 17% of the earning depends on agriculture but during the war all these percentages diminished. That's why reducing waste is important, and making compost to serve the arable lands and improve agriculture is essential during the rebuilding of our country.

Plus, most of the time the electricity is off and that makes people have to throw the food they have in their refrigerator. This is how food is wasted in our country.

Rethink about it when you throw anything away cause it might lead to global issues...

Definitions

Aerobic

In the presence of, or requiring oxygen.

Anaerobic

In the absence of oxygen, or not requiring oxygen. Composting systems subject to anaerobic conditions often produce odorous compounds and other metabolites that are partly responsible for the temporary phytotoxic properties of compost. Anaerobic conditions are important for anaerobic digestion systems.

Ammonia (NH_3)

A gaseous compound comprised of nitrogen and hydrogen. Ammonia, which has a (sharp) pungent odour, is commonly formed from organic nitrogen compounds during composting.

Maturation

Final stage of composting where temperatures remain steady below 45°C, and the compost becomes safe to use with plants due to the absence of toxins.

Bacteria

A group of microorganisms having single celled or noncellular bodies. Bacteria usually appear as spheroid, rod-like, or curved entities but occasionally appear as sheets, chains, or branched filaments. Bacteria mostly break down organic materials in composting systems. It is bacteria that generate the heat associated with thermophilic composting systems. Bacteria have different temperature optima and are grouped accordingly: psychrophiles ($<20^\circ$C); mesophiles (20-45°C), and thermophiles ($>45^\circ$C)

Enzymes Any of numerous complex proteins produced by living cells to catalyse specific biochemical reactions.

Moisture Content

The fraction or percentage of a substrate comprised of water.

Maturation

Final stage of composting where temperatures remain steady below 45°C, and the compost becomes safe to use with plants due to the absence of toxins.

Carbon to Nitrogen (C:N) Ratio

The ratio of the weight of organic carbon (C) to that of total nitrogen (N) in an organic material.

Manure

The fecal and urinary excretion of livestock and poultry. Sometimes referred to as livestock waste. This material may also contain bedding, spilled feed, water or soil.

Fungi Singular - fungus.

A group of simple microorganisms that lack a photosynthetic pigment. The individual cells have a nucleus surrounded by a membrane, and they may be linked together in long filaments called hyphae. The individual hyphae can grow together to form a visible body. See also bacteria.

Food Organics

Food Organics includes organics generated by any one of the following activities: the manufacturing, preparation or consumption of food (including beverages); the processing of meat, poultry or fish, and the manufacturing of edible grocery products. Such materials may be derived from domestic or commercial and industrial sources. The definition does not include grease trap waste. Food organics is one of the primary components of the compostable organics stream.

Resources

- Cornell Waste Management Institute - Cornell University
- local government association - the potential of food waste disposal units to reduce costs
- The Practical Handbook of Compost Engineering - By Roger Tim Haug
- Managing Food Waste in NM Restaurants
- The Rapid Composting Method - Robert D. Raabe, Professor of Plant Pathology, Berkeley - University of California
- Compost Fundamentals - Washington State University Whatcom County Extension
- Faculty of Agriculture - Damascus University
- Syria's Agricultural Development. Current realities and historical roots - Ella Wind and Omar Dahi
- Toolkit Reducing the Food Wastage Footprint - FAO
- Reducing Wasted Food & Packaging: A Guide for Food Services and Restaurants - United States Environmental Protection Agency - EPA
- Wikipedia
- The Dow Chemical Company ("Dow") or an affiliated company of Dow
- International Composting Awareness Week website which can be found at:**http://www.compostweek.com.au/** and do your bit for the environment.
- New York times report
- Clean Up Australia
- penn libraries university of pennsylvania
- university of florida
- The New York times
- somerset waste partnership - Love Food Hate Waste
- Fertilizer New Zealand - Micro Organism Interaction in the Soil
- Northeastern University - On-Site Systems for Processing Food Waste
- Horticulture/Forest Science Building | The Texas A&M University System | College Station.
- Compost facility- Ohio University, Athens.
- TED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Future
"Keep
Calm
and
Recycle"
THE END