Know your Rice!

(Teacher Version)

This Learning Unit engages students in closely observing different variants of rice available at their home, their neighborhood and at the local grocery shops. They learn that there are several kinds of rice which differ in size, shape, taste, texture, price, and place of origin and record these observations. The students then compare the varieties they see today with what their grandparents' generation ate when they were growing up (i.e. 60-70 years back) by conducting semi-structured informal interviews with their grandparents or any elderly person in their neighbourhood. The essence of this exercise is to record the change in food choices, availability, over two generations by means of recording oral history.

Why is it important to know about diversity in rice?

The food we eat and how we obtain it has evolved over time. Humans were hunter-gatherers who collected fruits, grains and meat from their surroundings. Over the centuries, we changed our methods of acquiring food and have shifted almost fully to cultivating our food crops through agriculture. Modern agriculture has evolved into the anthropological practice of intensively growing a few crops in carefully managed land. Maximizing yield and price for the crop are the biggest goals.

To meet these needs, the agricultural systems have become highly standardized and consequently, industrialized and dependent on the demand and supply of market economics. Monocultures of crops have taken over the agriculture today with only a few varieties of each crop species being grown by our farmers. To sustain the growth of the same crops repeatedly in the soil and avoid large pest attacks, excess of fertilizers and pesticides are used.

This is harmful to the soil, the farmer, the environment and the native flora and fauna of the region. This has also resulted in consumers having limited availability of food varieties and nutrients in their diets, leading to a variety of diseases. Moreover, processing of food for improving its appearance, shelf life, and for better marketing has led to losing on benefits of the local/native foods. This specially is the case with rice where increasingly polished rice is being consumed for its visual appeal and convenience of cooking even though it is nutritionally inferior to unpolished and par-boiled rice. Moreover, the varieties of rice consumed by people have changed over the years and decreased in number.

The objectives of this exercise are: a) to introduce students to the concept of diversity in their food, b) to learn how food consumption has changed over the last 60-70 years, c) to interact with their senior members in their family and/ or society, and d) to realize that rice can be a source of other nutrients besides starch.

Expected Learning Outcomes

- The students learn that several species of a common staple food crop such as rice exist, and are cultivated in India. This links with ideas of bio-diversity in agriculture and in our diet.
- The students explore the morphological differences in length, thickness, texture, and color of the different rice varieties, thus learning that there are often visible differences among species.

- While exploring the prices of different variants of rice and the place where they are grown, students learn about factors such as production cost, transportation, storage etc. that affects the price of rice.
- While interviewing a senior member of their family/ neighborhood, students can contrast about changes in food availability, continuity in food types, consumer choices over a period of 60 to 70 years.

Overarching Learning Goals:

- Developing skills such as collection of field data, observation skills, recording and documentation (integral skills of the scientific process).
- Developing communication skills and the ability to engage with one's community.
- Learning to translate, express and record a narrative into a structured document and interpret the collected data.

Novelty of the Unit:

Oral history is a valuable research tool, one that students can use to expand their understanding about their surroundings and also develop important social skills. Students communicate with individuals from a different generation to understand the changes over the years in the food they eat. The exercise builds in activities that enhance science process skills in a context which is relatable to each student in a unique manner.

How is this Learning Unit connected to the science curriculum?

The science curriculum for grades 6-9 has several chapters related to nutrition, food and its content, crop production, natural resources etc. These chapters are listed below:

Grade 6	**Grade 8**	**Grade 9**
Chapter 1: Food, where does it come from?	Chapter 1: Crop management and Production.	Chapter 14: Natural Resources
Chapter 2: Components of food		Chapter 15: Improvement in food resources

As the students collect information about the different rice varieties, different agricultural production and food processing practices for rice will come into picture. This will bring relevance of the process for the students in their lives. During interviews, students are likely to understand that diversity in rice varieties is related to

- Kind of natural resources- soil quality, rainwater and groundwater availability, kind of insects and pests in a certain region and the climate.
- Different agricultural practices of cultivation.
- Different properties of these rice in terms of their harvest yield, production needs and cooking properties.

- Price of these varieties and awareness among people about their properties and their choices as consumers.

Introducing the Tasks to the students:

The teacher may invoke curiosity in students in the first session by using the following questions:
- Have you ever noticed the different types of rice in your house or when your family purchases rice at the grocery store?
- How are they different? (Some kids may have noticed the different types, a discussion should be encouraged for observing the differences)
- Are there different uses for different types of rice?
- What all dishes you know are made of rice?
- Are there any other uses of rice? (*Rice flour is used for making rangoli and rice glue*)
- Did your parents/grandparents eat similar food as you do today?
- What all types of rice are available in the market? (*Introduce the market survey part*)
- Were the same types of rice available when your grandparents were of your age?
- Are there any other kinds of grains that are available commonly at the stores today? Did your grandparents eat any other types of grains?

Let us find out...

Task A: Observing types of rice in their kitchen

1. Students observe different types of rice available in their house and record observations in the activity sheet.
2. If not more than one type is available at their own home, then the students may choose to compare the type of rice in his/her house with the neighbour's household.

Task B: Visiting a Local Grocer

1. Students visit a local grocery shop/any other grain source in their neighbourhood and ask for all the different types of rice available in the store. They list names (sometimes written on the packet or labeled by the Grocer) and collect sample of each if possible. They collect information from the grocer about the source of the rice sample (State of Origin) and price/Kg for each variety.
2. This task and task C can be done in groups of 3-4 students, which may make enhance the data collection process for students.
3. Students record their observations: Colour, shape, texture, *Size-(length, thickness).*

Note for the Teacher:
The teacher should explain the activity to the students and give a permission note to students which may be required for the data collection from grocery store. Students living in the same area may be allowed to carry out field data collection in groups. Students may be advised to carry out their survey in

a responsible manner: they should not touch anything in the Grocer's shop without permission. They should collect the sample only if the Grocer permits.

Task C: Interviewing an Elderly person (60-80 years of age)

Students interview their grandparents or any other elderly person in their neighbourhood and record the responses in the provided activity sheet. The students may be encouraged to interview in their native language or whichever communication mode is suitable to both interviewer and interviewee. The students may audio record the data, if possible. The interview should be approximately 30 min long.

Task D: Recording and Discussing data

Once the data have been collected from task B and responses from task C, students have to compare collected information to analyze it. The students need to write a summary of their experience and try to find reasons for difference (if any) in the food choices, availability and prices.

Once all students collate their data, a discussion should be carried out in class (this may be done in groups). The instructor needs to discuss the diversity of the rice grains which the students may have collected (you may refer to resource sheet). It could be a board activity where students may be asked to write the names of the types of rice they found and the properties of each type in front of them. Then a discussion on following topics can be done:-

- Why differences are seen among the members of the same *species (rice) and why diversity is important?*
- Differences between polished, unpolished, par-boiled rice focusing on their nutritional content.
- Can all types of rice (brown rice, par boiled rice, etc) be stored for long time or do some types of rice start going bad after some time of storage?
- Are different types of rice suitable for different recipes such as pilav, idli, modak, khichdi?
- What happens if we store rice grains (brown rice, par boiled rice, etc) for long time period?

The students may also be asked to stick a few grains of each rice variety they collected on a large chart paper, so everyone can see all the types of rice available in that area. The class may be divided into groups and students may be encouraged to discuss the oral history data among themselves first and then present in front of the class.

Rice: From Farm to Kitchen

Rice (*Oryza sativa*) is believed to oldest grains cultivated by humans for more than 7000 years. Today, it is a staple food for more than half of the world's population, particularly in southern and eastern Asia. India is the second highest producer of rice in the world, second only to China.

A diagram of a rice grain obtained from the rice plant is given in Figure 1. The grain is covered is a hard outer covering called husk, which cannot be eaten. Inside husk, there is light brown layer called bran, which contain a large fraction of vitamins and minerals. Inside the bran layer, lies the endosperm and germ. Endosperm is largely made of starch with small amount of protein. The germ contains some vitamins, minerals, and several other nutrients.

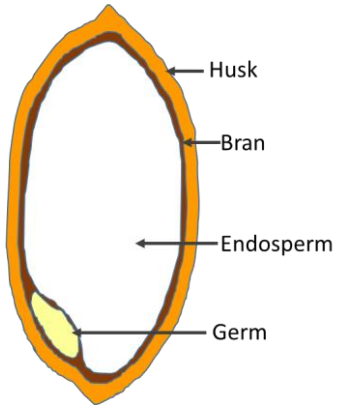

Figure 1: Structure of a Whole Rice Grain obtained from the plant. Bran protects the seed and contains B vitamins and trace minerals, Germ stores nutrients (Vitamin E, B vitamins, and minerals) for the seed whereas endosperm stores energy.

The maturity period of rice crop after sowing varies with variety, ranging from less than 80 days (~2.5 month) to 280 days (~9 months). In India, Rice is largely a *Kharif* crop, sown just before monsoons and harvested in autumn, but in many states, some rice varieties are grown in *Rabi* season with sowing in February and harvesting by June. At the harvest time, farmers cut the stalks which is followed by several processes before we get the final grain which is eatable.

Threshing: Threshing is the process of loosening the edible part of grain from the husk covering and straw to which it is attached. It is done either manually or by using "sheller" machines that remove the husk.

Figure 2: Separating grains from the grass (Source:www.123rf.com/photo_68766750_chiang-rai-thailand-november-23-unidentified-thai-farmer-threshing-by-beating-rice-to-separate-seed)

Figure 3: Rice seed with husk (Inedible) (Source:https://en.wikipedia.org/wiki/Chaff.jpg)

Winnowing: Winnowing is a method for separating grain from husk. The seed-husk mixture obtained from threshing is thrown in the air manually or using machines. As it fall, the lighter chaff is blown away to a farther distance by wind and the heavier grains falls down in a heap.

Figure 4: Rice seed with husk/ hull

Figure 5: Separating rice seed from husk (Source: www.pinterest.com)

Different processing of grains: Broadly, rice processing is done in three ways depicted in Figure 6. In one way known as parboiling, rough rice is soaked, steamed under pressure and dried. Parboiling treatments increase the vitamin content of the polished rice by transferring some vitamins from the bran of the seed to the endosperm. Then the rice is milled to remove the remaining husk, germ and the bran.

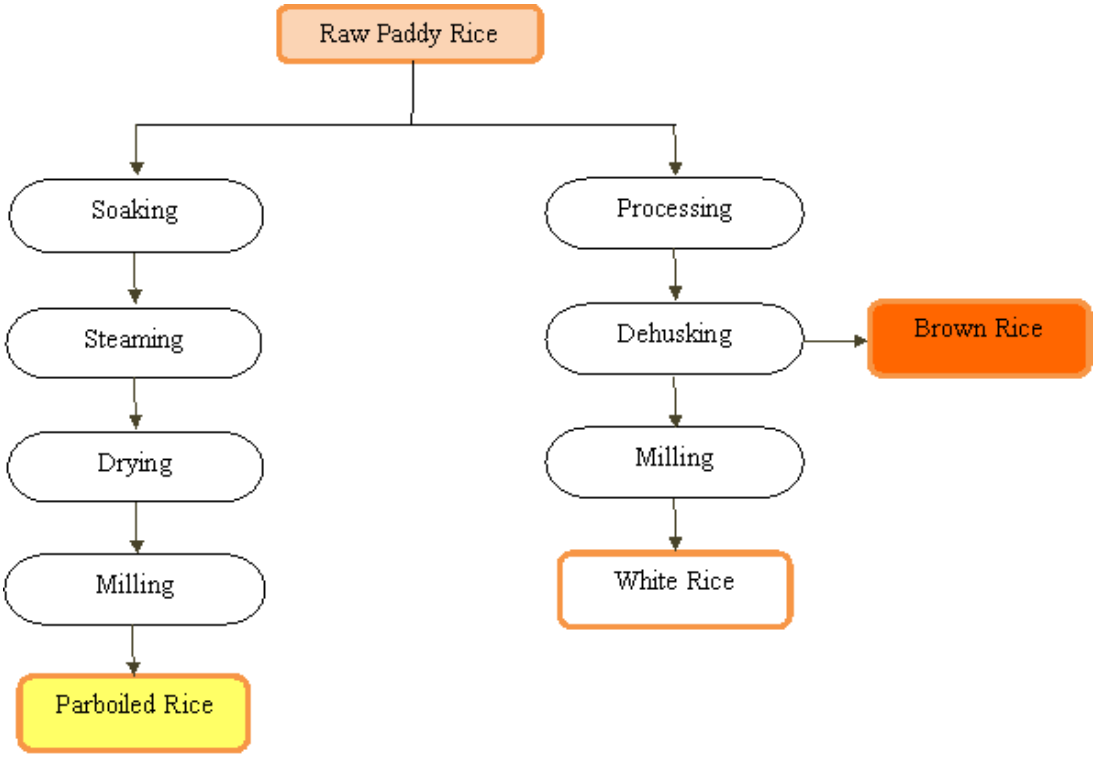

Figure 6: Processing of rice

In second method, the rough rice is passed through Sheller to remove the husk. What remains is brown rice, with the bran layers still surrounding the grain kernel.

In third method, the grains of brown rice are further milled by machines that rub the grains together under pressure. This abrasion removes the bran layer and the germ, revealing white or "polished" rice. Due to removal of germ, the white rice has an indented shape at one end.
Parboiled rice is liked by those who desire rice to be an extra separate, firmer grain when cooked. Final forms of rice are shown in Figure 7.

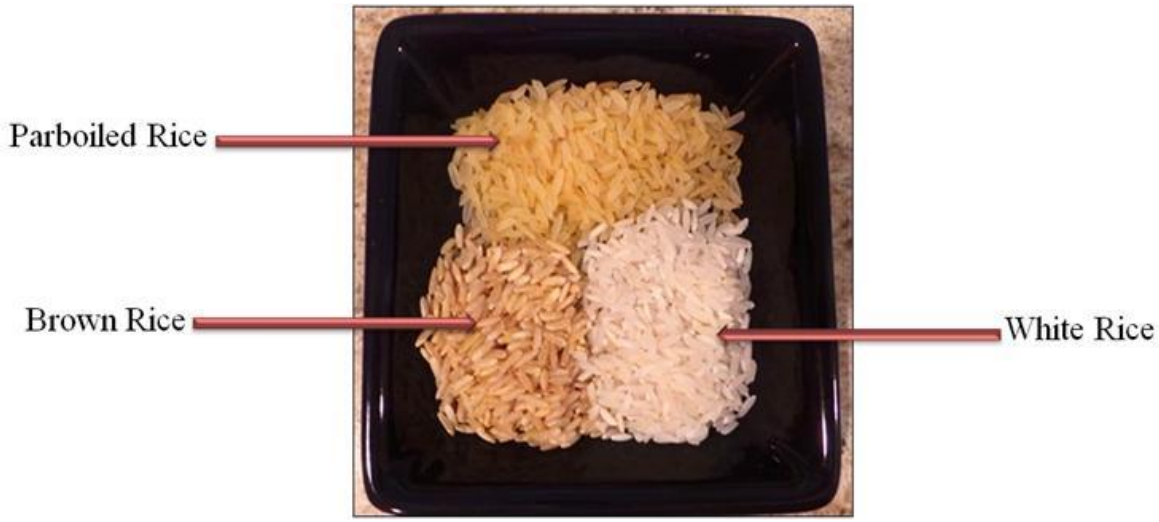

Figure 7: Different types of processed rice: Edible (Source: https://warosu.org/ck/thread/5514754)

Nutritional facts about Rice

Rice grain are largely made of carbohydrates. In brown rice, carbohydrate content varies from 70-80% of the mass, whereas in white rice, ~90% of the mass is carbohydrates. In addition, brown have about 8-10% protein and about 1% of fats concentrated in bran which get lost during process to obtain white rice. Vitamins and minerals are also concentrated in the bran and germ part of the grain which again are very low in white rice but are regained to some extent in par-boiled rice.

Carbohydrates

Starch is the most common form of carbohydrates in rice. Rice starch consists of two types of long chains of glucose known as amylose & amylopectin (typically constituting ~15% and 85% of the total starch, respectively). Rice variety that is high in amylose, such as long grain varieties like jasmine and basmati rice, do not stick together after cooking. Amylose undergoes digestion very slowly and is often knowns as a kind of resistant starch. Resistant starch reaches large intestine without breaking down and hence serves as roughage and helps feed the beneficial bacteria in the gut, stimulating their growth. Amylopectin, which gives stickiness to the rice, is very easy to digest and leads to rapid increase in glucose level in blood after eating.

Fiber

Brown rice contains a fair amount of fiber (1.8%), while white rice is very low in fiber (0.3%). The fiber is concentrated in the bran, which has been stripped from white rice.

Vitamins

However, ***considerable amounts may be concentrated in the bran of brown rice which are components of brown rice, but not white rice.***

• Thiamin: Also known as vitamin B1, thiamin is essential for metabolism and the function of the heart, muscles, and nervous system.

• Niacin: Also known as vitamin B3, niacin in rice is mostly in the form of nicotinic acid. Soaking rice in water before cooking may increase its absorption.

Par boiling increases the vitamin content in the processed rice seeds. In parboiling, the thiamine content is increased from 0.4 to 0.8 mg/kg (for unprocessed polished rice) to 1.5 to 3.1 mg/kg for processed rice. Riboflavin content is increased from 0.15 to 0.32 mg/kg to about 0.29 to 0.52 mg/kg. Niacin content is increased from 15 to 24 mg/kg to about 31 to 60 mg/kg.

Minerals

• Manganese: A trace mineral found in most foods, especially whole grains. It is essential for metabolism, growth, development, and the body's antioxidant system.

• Selenium: A mineral that is a component of selenoproteins, which have various important functions in the body.

• Magnesium: Found in brown rice, magnesium is an important dietary mineral. It has been suggested that low magnesium levels may contribute to a number of chronic diseases.

• Copper: Often found in whole grains, poor copper status may have adverse effects on heart health.

As an example, some common rice varieties available in Maharashtra:

Sr. No.	Rice Variety	Size Of Grain
1	Bhogawati	Long Slender
2	Parag	Long Slender
3	Pawana	Long Slender
4	Indrayani	Long Slender
5	Jaya	Medium Slender
6	Karjat–3	Short Bold
7	Karjat-184	Medium Slender
8	Karjat-5	Long Bold
9	Karjat-7	Long Slender
10	Mahsuri	Medium Slender
11	Ratnagiri 1	Long Bold
12	Ratnagiri 24	Short Slender
13	Panvel 1	Short Bold
14	Palghar 1	Medium Slender
15	Sahyadri – 2	Long Slender
16	Sahyadri – 3	Long Slender
17	Sahyadri-4	Long Slender
18	Pkv Ganesh	Medium Slender
19	Ratna	Long Slender

20	Ratnagiri -73 (1)	Short Bold
21	Terana	Long Slender
22	Rupali	Medium Slender
23	Sahyadri	Long Slender
24	Suruchi	Medium Slender
25	Swarna	Long Slender
26	Sye 1	Short Bold
27	Vidharbha SKL 6	Long Slender
28	Western Amb-157	Medium Slender

References:

1. The following documents summarize information on farming needs and practices for rice in India and in Maharashtra, respectively.

- Lohiya S, Malik D. P, and Diwakar M. C.et al (2014) Rice in India: A status paper; Directorate of Rice developement.
  Weblnk: www.nfsm.gov.in/Publicity/2014-15/Books/Status%20Paper%20Rice_Inner%20Pages_New.pdf
- B. L. Thaware *, R. L. Kunkerkar and H. A. Shivade (2014) Status Paper on Rice in Maharashtra; Regional Agricultural Research Station, Karjat, Maharashtra, India. Available at: www.rkmp.co.in/sites/default/files/ris/rice-state-wise/status%20paper%20on%20rice%20in%20maharashtra.pdf

2. The following two website include a diversity of information about rice production and its varies internationally:

- http://ricepedia.org
- http://knowledgebank.irri.org/