

Agri-raft

Setting the Scene

You will be working as a member of a research team in the department of agriculture. Your team has been asked to improve raft farming. You will carry out some research on 3 areas; growing material, raft design, and how farming affects the environment. Then you will write a report of your findings and submit it to the office of Suphan Buri city hall.

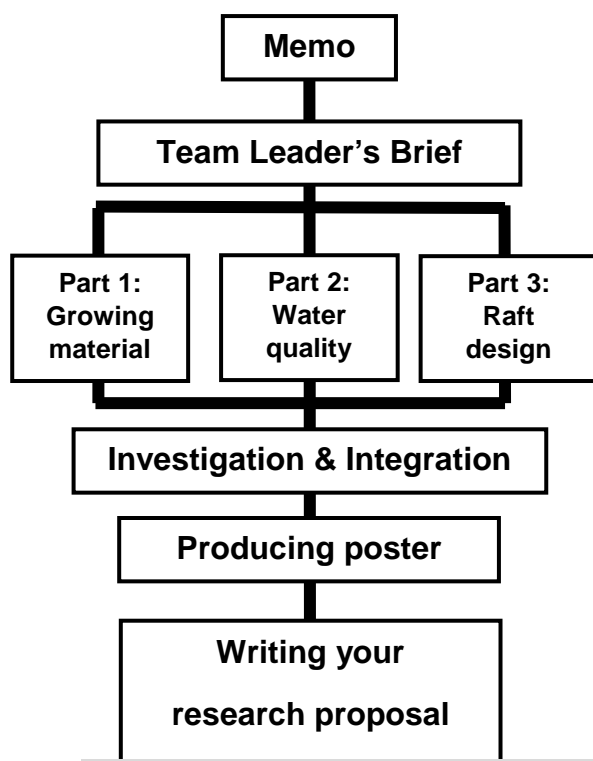
STEM Research Brief

Study Guide

Curriculum Targets

- Buoyancy makes rafts float.
- Area and volume affect raft floating.
- Temperature, light, water, nutrients, and CO₂ are plant growth factors.
- Nitrogen, Phosphorus, and Potassium are essential nutrients for plants.
- Colour, odour, turbidity, etc. are physical indicators of water quality.
- DO and pH are chemical indicators of water quality.
- Aquaponics refers to any system that combines conventional aquaculture (raising aquatic animals such as snails, fish, crayfish or prawns in tanks) with hydroponics (cultivating plants in water) in a symbiotic environment.

Route through the Brief



Outcome Checklist

You will carry out research into one aspect of raft farming design. Investigate to find the growing material which has least effect on the environment and also the best design for your raft (floating ability, area for planting, etc.) Then present a report of your findings to the office of Suphan Buri city hall. You will write a research proposal. You should make sure you produce the following items as you work through the Brief.

Scientific papers

- notes on points raised by handwritten comments

Group discussion

- discuss the 3 topics (growing material, water quality and raft design), then plan the investigation

Investigation

- write report and present the poster

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From: The Department of Agriculture at Suphan Buri province
To: Researchers in The Department of Agriculture
Subject: Raft Farming
Date:

Memo

I am sure you may have noticed recent cases of flooding in Suphan Buri. I have attached a newspaper cutting of one such case to the bottom of this memo.

During the rainy season, much of the farmland in the Bang Plama district is covered by water, making it impossible to grow crops. Even when the floods recede, the land remains waterlogged restricting people's ability to cultivate vegetables to feed themselves and to generate an income. Raft farming is an alternative form of cultivation that could be used to solve this problem.

I have also sent you an article about growing material, water quality, and raft design which describe some of the background science. You will find these useful in planning your research.

I look forward to reading your report



Suphanburi flood Flood situation is still hard. Military provide urgent assistance "Talad-Kao-Hong" (100 years) at Bangplama district was overflowing water from the Tha-Chin River. Sandbag barrier collapse asected by water spilled into the flooded houses affecting more than 300 homes ...

Thairath online, Sep 9th, 2011

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Department of Agriculture

New project: Agri-raft

Team Leader's Brief

At our recent meeting we agreed to seek funding for a research project leading to the development of Agri-rafts. To enable us to submit a research proposal we will have to follow up our previous work with further research. I have allocated a scientific paper to each team, with suggestion for further research tasks.

Expert group 1	study paper 1 "Growing material"
Expert group 2	study paper 2 "Water quality"
Expert group 3	study paper 3 "Raft design"

Research tasks for each team

1. Get into group of 3 as a "home group", then each member from every home group form 3 expert groups as the following:

Expert group 1	study "growing material"
Expert group 2	study "water quality"
Expert group 3	study "raft design"

Investigate on each topic.

2. Members in expert groups go back to form home groups. Discuss and plan further investigations on the 3 areas.
3. Follow your investigation plans.
4. Present your results to the department of agriculture.
5. Produce a research report on your investigations and poster summaris your research. The sections of the report should be:
 - Title
 - Introduction to your research
 - Objective and hypotheses
 - Scientific background and papers
 - Idea to your Agri-raft
 - Research methodology
 - Results (graphs and tables)
 - Research summary
 - Discussion of your results
 - Suggestion for further research

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Floating farms A farming innovation

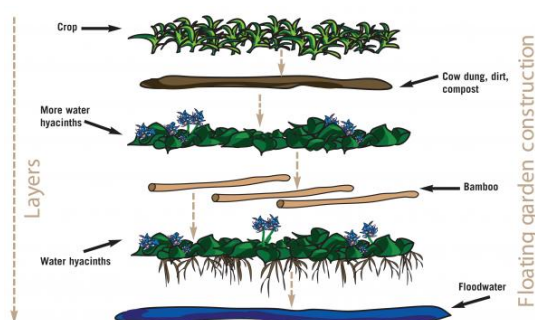
KASET JOURNAL

Farming is a major occupation of Thai people, especially rice farming. In the past, rice was usually farmed in lowland areas since it consumes so much water. Suphan Methasarn, a farmer in Suphan Buri, has come up with a new idea for rice farming. He wondered 'Why don't we grow rice in water so it will always have plenty of water to grow?'. He got his idea after a massive flood damaged his rice crop badly. Flooding caused great suffering for farming families. However, a floating farm can survive flooding.

One type of raft we can use for this type of farming is made from a network of bamboo. Then we put some easy-to-find material to make the base of our raft. Wet material can be used for plants to root in, for example narrow leaf cattail. We put some soil and fertilizer on top to increase nutrients in the growing material. Finally, we put clay on top of the raft for the surface and the raft is ready for farming.

Floating farm can not only avoid major damage from flooding, but also reduce the cost of farming. In Bangladesh, which is one of the world's poorest countries, floating farms are very popular. However, the raft design in Bangladesh is different from the type used in Thailand. In Bangladesh, water hyacinth is used as the structure of the raft.

Then bamboo is put above as a layer and another layer of water hyacinth is put on top of the raft. And the raft is ready for growing material and crop. See the picture below.



The raft works in the same way as in Thailand; i.e., growing material absorbs water for the crop. In the Bangladeshi raft, water hyacinth does this job.

In Thailand, plants that are often farmed on rafts are vegetables. In some provinces located near rivers e.g., Sing Buri, many families farm vegetable for a living. Chinese cabbage, garland, chilli, and coriander are popular for home farming.

What materials is the raft made of?

What jobs do the different layers in the raft do?

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FACTORS AFFECTING PLANT GROWTH

Primary Nutrients

These nutrients are used extensively for plant growth and function.

1. Nitrogen (N)

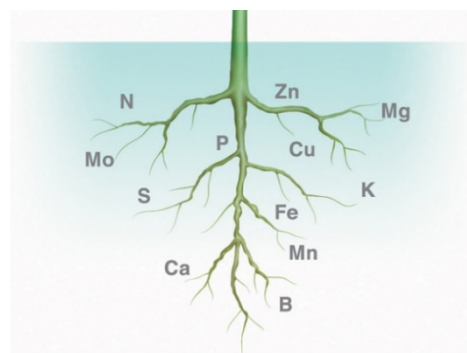
Nitrogen increases the number of seeds and fruits produced by the plant, and it improves the quality of leaves. Most plants get their nitrogen from the decomposition of organic matter in soil or fertilizers.

2. Phosphorus (P)

Phosphorus is needed for blooming and root growth. Plants get the phosphorus from sources such as bone meal, and fertilizer like superphosphate.

3. Potassium (K)

Potassium aids photosynthesis and is part of the protein building process.



Macro Elements	Secondary Elements	Micro Elements
N - Nitrogen	Ca - Calcium	Fe - Iron
P - Phosphorous	Mg - Magnesium	B - Boron
K - Potassium	S - Sulphur	Zn - Zinc
		Cu - Copper
		Mn - Manganese
		Mo - Molybdenum

Which plants can grow on a raft?
And why?



Table 1 : Time to harvest and nutrients required by vegetables

Vegetables	Time to harvest (days)	N-P-K
1. Chinese Kale	30-45	15-15-15/12-8-8
2. Chinese Cabbage	30-45	15-15-15/12-24-12
3. Lettuce	40-50	15-15-15/46-0-0
4. White Radish	40-60	15-15-15
5. Yard Long Bean	45-50	15-15-15
6. Tomato	55	15-15-15
7. Brinjal	60-80	15-15-15
8. Cucumber	30-40	15-15-15

Which nutrients are essential for growing plants?

What do these nutrients do?

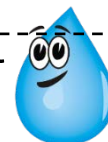




Water Quality

Water quality refers to how suitable a sample of water is for a particular use. Water quality is affected by many environmental factors, including the nature of the terrain, climate, geology, natural vegetation activity of humans and other organisms. Water quality is determined by physical, chemical and microbiological properties of water.

What is water quality?



Physical Characteristics of Water

Some physical characteristics of water (temperature, colour, taste, turbidity etc.) can be determined by senses of touch, sight, smell and taste.

Temperature : The temperature of water affects some of the important physical properties and characteristics of water. The Ministry of Industry does not allow the temperature of the water released into the public water supply to exceed 40° C.

Colour : Reddish or brownish colours can indicate organic pollution while green colour is often due to algae.

Turbidity : Turbidity is a measure of the light-transmitting properties of water and is affected by suspended solids including clay, plankton and other microbes.

What essential nutrients affect water quality



Chemical Characteristics of Water

All of the water we see around us contains dissolved substances. These substances control the chemical properties of the water sample.

pH : pH is a measure of how acidic or basic water is. pH can be used as a proxy of water quality conditions since water pH is easily changed by chemical pollution



Dissolved Oxygen : Dissolved Oxygen (DO). Microorganisms living in water take in oxygen for respiration. This decreases the amount of oxygen dissolved in the water. In clean water dissolved oxygen is approximately 5-8 ppm. However in wastewater the dissolved oxygen can fall below 3ppm. DO is an important value indicating if sufficient oxygen is in the water

Do growing material and fertilizer affect water quality?



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Why do things float?

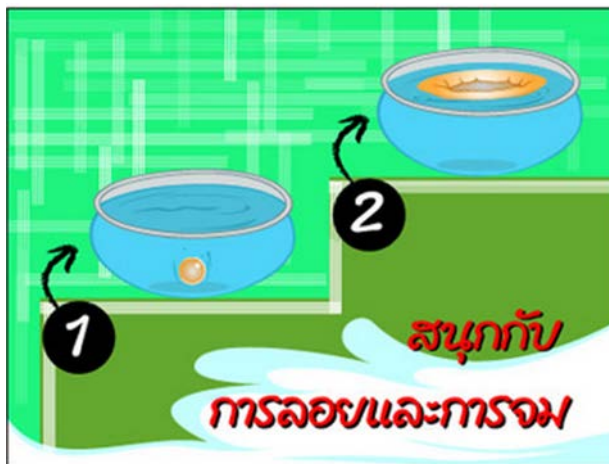
In general, an object floats when the volume of the object is equal to water but has less mass. The ratio of mass to volume in the same unit is called density. Therefore, an object with lower density than water can float. Besides density, other factors affect how an object floats or sinks and can be studied by the following experiment:

Equipments

1. Plastic bowl with water about 3/4 of the bowl
2. Modelling clay

Method

1. Model the clay into spheres and put it in the water as in the picture on the right. Mark the height of water surface. Observe the clay.
2. Pick the clay out from water and made it flat with short edges



The sphere clay sinks, but the same clay floats if it is flat like a ship because water has a force pushing it up. This force is called buoyancy force which is directly proportional to the volume of water replaced by the object. Hence, if the object has more area touching the water, it can replace more water (see the higher water surface level), resulting in higher buoyancy force. For the clay in the experiment, the sphere is small and can replace less water, then it sinks. On the other hand, it will float when it is shaped flat like a ship. This reason confirm how can a big ship can float, even though it has much weight

Which factors affect the floating ability of an object over fluid?



Buoyancy Force

Is an upward force exerted by fluid that opposes the weight of an immersed object. The relationship is

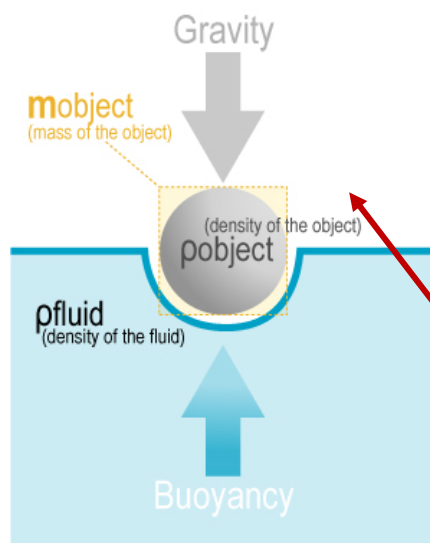
$$F_B = \rho_L g V_L$$

where F_B is buoyancy force

ρ_L is density of fluid

g is earth gravity

V_L is volume of an immersed object



How can the type of fluid, volume of fluid and mass of object affect the buoyancy force?



Building a Raft out of Water Bottles

Archimedes' principle said that "Any object, wholly or partially immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object."

I wanted my raft to support myself. I weigh 80 kg. So, if I wanted to build a raft from water bottles, the average water bottle contains 700 ml. of water. Thanks to scientific measurements, one liter of water supports one kg of weight, such that, each bottle can support 0.7 kg.

Conclusion, I need $\frac{80}{0.7} = 114.2857$ or 115 bottles to made myself float above water.

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