Explore the secrets of mangrove roots

Star T Project
Report

The Exploration of the Secrets of Mangrove Roots

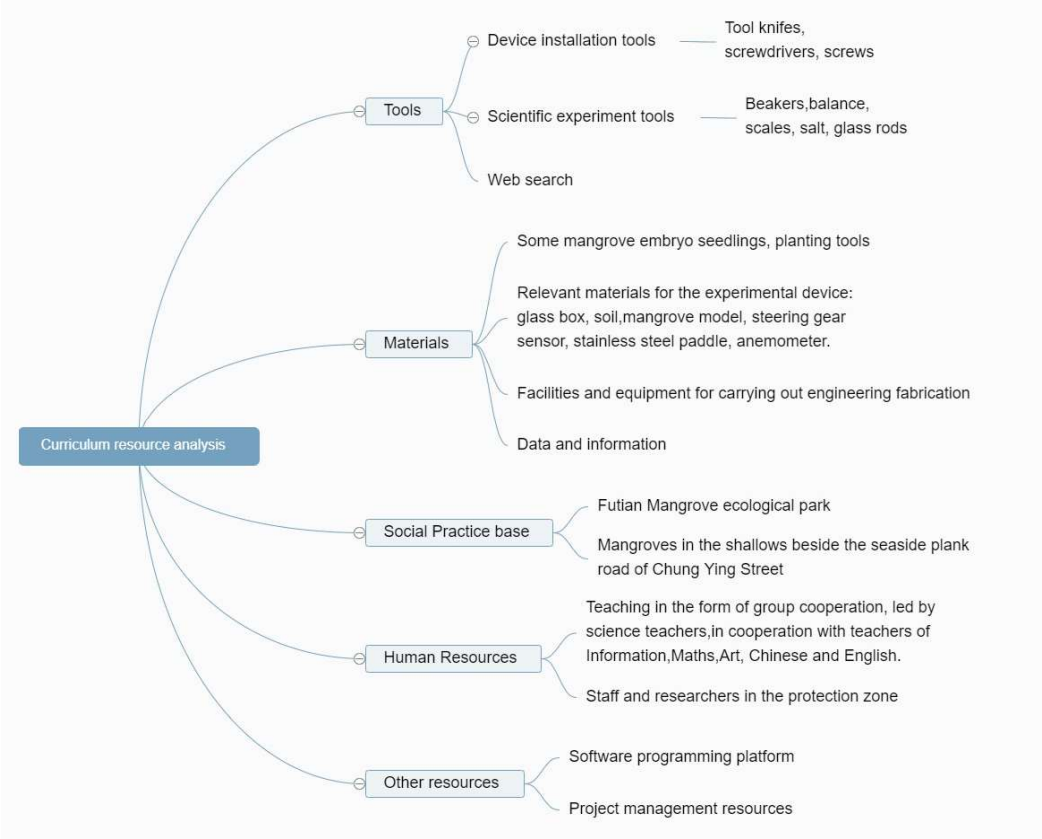
——Exploring the Ecological Value of Mangrove Windbreak and Sand Fixation

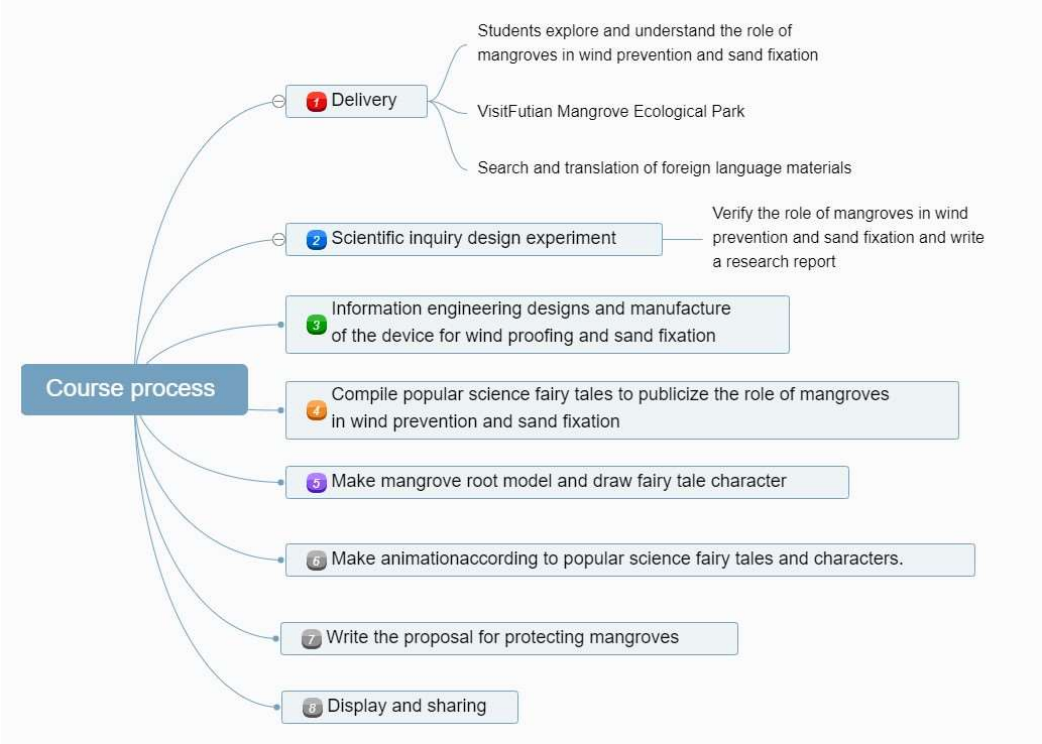
● **The number of the team members (children and teenagers): 171 people**

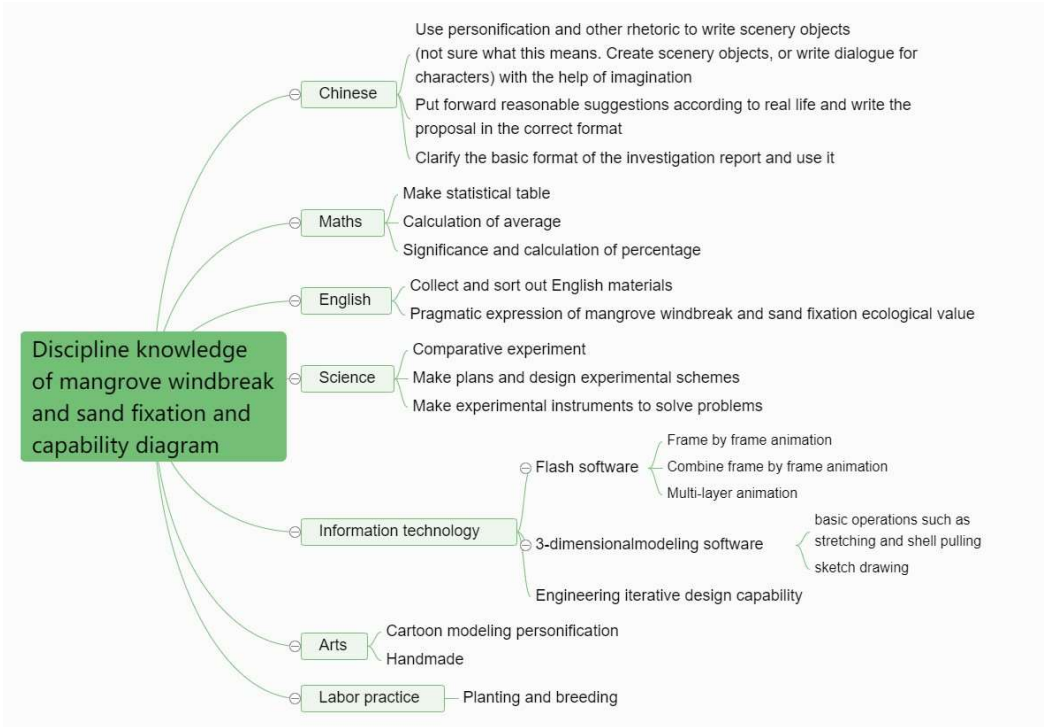
- **Star T topics related to the project:**
  - ○Science
  - ○Comprehensive Practical Course
  - ○ Information Technology and Engineering
  - ○ Maths
  - ○Chinese
  - ○Art
  - ○ English

- A brief description of the team, the project, and how we implemented the project.

The 36 students who participated are members of the project-based learning community from grade 6, and our instructors are teachers of various subjects.




Course process
1 Delivery
Students explore and understand the role of mangroves in wind prevention and sand fixation
VisitFutian Mangrove Ecological Park
Search and translation of foreign language materials
2 Scientific inquiry design experiment
Verify the role of mangroves in wind prevention and sand fixation and write a research report
3 Information engineering designs and manufacture of the device for wind proofing and sand fixation
4 Compile popular science fairy tales to publicize the role of mangroves in wind prevention and sand fixation
5 Make mangrove root model and draw fairy tale character
6 Make animationaccording to popular science fairy tales and characters.
7 Write the proposal for protecting mangroves
8 Display and sharing


Discipline knowledge of mangrove windbreak and sand fixation and capability diagram
Chinese
Use personification and other rhetoric to write scenery objects (not sure what this means. Create scenery objects, or write dialogue for characters) with the help of imagination
Put forward reasonable suggestions according to real life and write the proposal in the correct format
Clarify the basic format of the investigation report and use it
Maths
Make statistical table
Calculation of average
Significance and calculation of percentage
English
Collect and sort out English materials
Pragmatic expression of mangrove windbreak and sand fixation ecological value
Science
Comparative experiment
Make plans and design experimental schemes
Make experimental instruments to solve problems
Information technology
Flash software
Frame by frame animation
Combine frame by frame animation
Multi-layer animation
3-dimensionalmodeling software
basic operations such as stretching and shell pulling
sketch drawing
Engineering iterative design capability
Arts
Cartoon modeling personification
Handmade
Labor practice
Planting and breeding

1. Project research duration: About a year

2. Project research background:

Our school is located next to Dapeng Bay. We found a small forest on the beach near the school, which raised our question: why won't these trees drown when they grow in the sea? Why are these trees planted here? After asking the science teacher and consulting the data, it is determined that this is a mangrove and has the function of wind prevention and sand fixation. This reminds us of the situation when our school was flooded by sea water and the surrounding coastal plank roads were destroyed after Typhoon "Mangosteen" raged in 2018. This aroused our curiosity to explore whether mangroves can really prevent wind and fix sand.

3. Project research process

（1） We saw some mangrove seedlings beside the seaside plank road next to the school. After consulting a large number of Chinese and English materials, we found that mangroves have ecological values such as wind prevention and sand fixation as well as seawater purification and the establishment of blue carbon ecosystem. This naturally reminds us of the huge damage to the coastline of Yantian caused by Typhoon "Mangosteen" in 2018, especially the tilt of the ancient tower near our school and the flooding of Chungying street by sea water. So we really want to know whether mangroves can prevent wind and fix sand or not. This is also the core driving problem for our project-based learning.

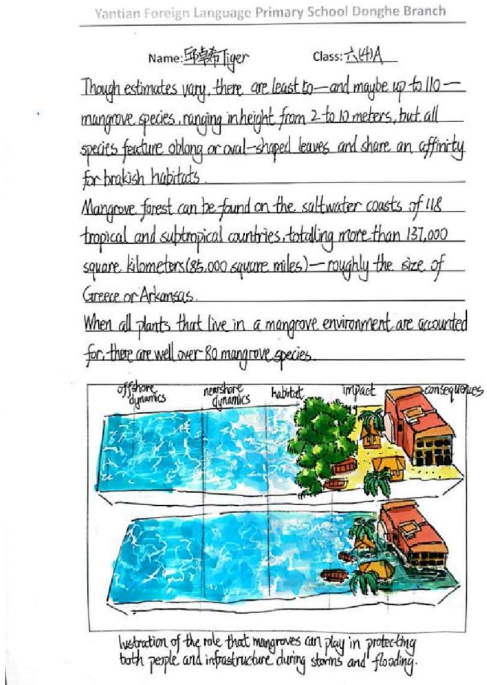
（2） We decided to adopt mangroves and observe the seedlings in the daily maintenance. During this period, our teachers and students visited Futian Mangrove Ecological Park together. Through interviewing the staff of the exhibition hall, as well as rich and direct display and field observation of mangroves in the exhibition hall, we have a clearer understanding that the windbreak and sand fixation effect of mangroves is mainly determined by the distinctive root characteristics of mangroves. When transplanting mangrove seedlings, it was found that its roots were indeed developed. Such an intuitive feeling confirms the knowledge we obtained during our early inspection and interview.

Observation record sheet

Observation Date	Leaves(logarithm,color,shape, etc.)	Plant height (CM)	Others (such as house pests, dead sunflower, etc.)
2021.4.18	two saplings, named No. 1 and No. 2, were brought to the school	13	Null
2021.4.24	after soaking in water for 6 days, one end of the two saplings will grow tender buds.	13+1	Null
2021.5.8	6 tender leaves emerged from both roots, wrapped with new buds, emerald green.	13+2	Null
2021.5.14	No. 1 grew well. The new buds grew about 3cm away. A pair of young leaves symmetrically wrapped the green buds and the surrounding leaflets. The new bud No. 2 grew slowly, surrounded by leaflets, two of which are prominent.	15	Null
2021.5.20	Both of them increased. No. 1, 1 pair of leaves, gradually grow up, like thumb nails. No. 2 leaves with upward wings, very fresh and tender.	15+2	Null
2021.5.27	3 pairs of leaves grew on No. 1, the top pair is smaller, like soybeans, and the other 2 pairs are oval. The trunk of No. 1 is like a radio antenna. A section is pulled up from the original long leaves. It is thin and the plant height is significantly higher than that of No. 2. No. 2 leaves continue to grow, 2 pairs of leaves.	15+4	Null

2021.6.5	there were 3 pairs of leaves on No. 1, the bottom pair remained unchanged, and the middle pair was larger. No. 2, the second pair of leaves continue to grow, 2 pairs of leaves.	20	Null
2021.6.12	No. 1 leaf is green and a little darker.	20+4	Null
	No. 2 leaf is bright green, and the green is lighter. No. 1 began to pull up for the second time and grow the third section.		
2021.6.18	The third section of No. 1 grew higher day by day, and the third pair of leaves also stretched out.	26	Null
2021.6.26	The second pair of leaves of No. 1 appeared reddish brown on the right leaf surface. Check online and remove the suspected bacteria.	28	Erythema, remove
2021.7.3	The second pair of leaves of No. 1 also appeared reddish brown on the left leaf surface, only one was not removed, and there were only 5 leaves left on No. 1.	30	There is erythema, no wilt, no removal
2021.7.9	The plant height of No. 1 and No. 2 was significantly different, and the plant height of No. 1 was half that of No. 2. No. 2, 3 pairs, No. 1, 5 leaves, with new buds. The two roots are developed.	32	Null

Visit and relevant information



Yantian Foreign Language Primary School Donghe Branch

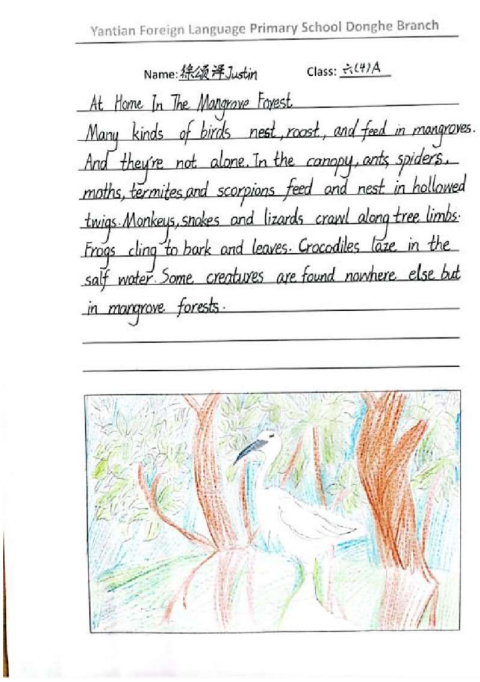
Name: 邱婧涵Tiger Class: 六(4)A

Though estimates vary, there are least 60—and maybe up to 110—mangrove species, ranging in height from 2-to 10 meters, but all species feature oblong or oval-shaped leaves and share an affinity for brakish habitats.

Mangrove forest can be found on the saltwater coasts of 118 tropical and subtropical countries, totalling more than 137,000 square kilometers(88,000 square miles)—roughly the size of Greece or Arkansas.

When all plants that live in a mangrove environment are accounted for, there are well over 80 mangrove species.

Illustration of the role that mangroves can play in protecting both people and infrastructure during storms and flooding.



Yantian Foreign Language Primary School Donghe Branch

Name: 徐俊泽Justin Class: 六(4)A

At Home In The Mangrove Forest

Many kinds of birds nest, roost, and feed in mangroves. And they're not alone. In the canopy, ants spiders, moths, termites and scorpions feed and nest in hollowed twigs. Monkeys, snakes and lizards crawl along tree limbs. Frogs cling to bark and leaves. Crocodiles laze in the salf water. Some creatures are found nowhere else but in mangrove forests.

Refer to the records of common mangrove species, root characteristics and function

Mangrove variety name	typical characteristics of root	root action	remarks
Magnolia	There are spongy lateral roots on which fibrous roots grow.	Support and breathe	
Niangon	plate root	Support and breathe	
Kandelia	Developed geniculate or horseshoe shaped respiratory roots	Support and breathe	
Paulownia tree	The lateral roots were not hypertrophic and had smaller lenticels.	Support and breathe	

Avicennia marina	Erect finger like respiratory roots, numerous	Support and breathe	

（3） In order to prove the role of mangroves in wind prevention and sand fixation, we put forward the idea of comparative experiment. Through discussion, the scheme of wave experiment and wind proof experiment is determined, with plans to continuously improve the scheme in the experiment.

Research activity report of mangrove windbreak and sand fixation ——Experiment 1: Can mangroves reduce the erosion of waves to beach sand?	
Members：Yeran Yang, Yaqing Chen, Zhihang Huang, Jiarao Sun, Yue Xiang, Ziling Li	Instructor： Shulian Chen
Research Questions：Can mangroves reduce the erosion of waves to beach sand?	
Hypothesis： Mangroves can reduce the erosion of waves to the beach sand.	
Factors to consider	The erosion of beach sand and soil caused by wind or tide. Compare and observe the condition of the beach with or without mangroves washed by the waves: the size of the beach, the amount of water in the sea, the size of the waves. The size and other conditions shall be consistent.
Materials	Container, sand, small shovel, water, Mangrove seedling, pen, ruler, stopwatch
Changed conditions	Plant mangroves seedlings or not.
Invariant conditions	The size of the container, the amount of sand, the size of the waves, and the numbers of waves washed.

Experimental method	Comparative experiment： 1. Shovel some sand into the container with a small shovel, and make the sand into a small slope to simulate the coast and beach. Add an appropriate amount of water to simulate seawater. Then, compare the scale mark with an oily pen. 2. Use a hair dryer to make waves to wash the coast, and time it for 30 seconds (or manually stir the water to make waves. Scour the coast, dial 20 times). 3. Observe the condition of the coast after being washed by waves, then measure the change of sand height on the coast with a ruler and make records. 4.After planting mangroves in the container, restore the coast, keep consistent with the original scale line, and repeat steps 2 and 3.
Experimental phenomenon	It was observed that the height of coastal sand without mangroves was lower than the original after being washed by waves. The height is 3mm lower, and the height of coastal sand planted with mangroves is 1mm lower than the original.
Experimental Result	It was found that the beaches with mangroves were less eroded by the waves than those without mangroves.
Existing problems and improvement	**Existing problems:** The effect of making waves with a hair dryer is not good. The waves are too small. Later, waves are made manually, which cannot guarantee the same strength every time, and there may be deviation. **Improvement:** using a larger hair dryer can not only create larger waves, but also ensure the size of waves.

The height of the sand pile mangrove seedlings millimeters lower.

The height of the sand pile without with mangrove seedlings was was three one millimeters lower.

Research Report on mangrove windbreak and sand fixation experiment

——Explore Experiment 1: Can mangroves reduce the erosion of beach sand by waves?

Members: Yeran Yang, Yaqing Chen , Zhihang Huang , Zecheng Guo,Donghua Liu , Ziyan Sun,Qihong Gu

Instructor: Shulian Chen

Research question: Design experiments to verify whether mangroves can reduce the erosion of beach sand by waves.

Hypothesis: Mangroves can reduce the erosion of beach sand by waves

Factors to be considered	The erosion of sea waves on beach sand and soil, and the condition of beaches with or without mangroves washed by sea waves; The size of the beach, the amount of sea water, the size of waves and other conditions shall be guaranteed to agree.
Materials required	Container, sand, small shovel, water, red sapling, oily pen, ruler, blower, stopwatch.
Changed conditions	Whether mangroves seedlings are planted
Invariant condition	The size of the container, the amount of sand, the size of the waves, and the time taken.
Experimental method	Comparative experiment: 1.Shovel some sand into the container with a small shovel, and make the sand into a small slope to simulate the coast and beach. ~~And~~ Add an appropriate amount of water to simulate seawater. And compare the scale mark with an oily pen. 2. Use a blower (the average wind speed measured by ut363 anemometer is 23.6m/s). The waves scoured the coast for 30 seconds 3. Observe the condition of the coast after being washed by the waves, measure the change of sand height on the coast with a ruler and make records. 4. After planting mangroves in the container, restore the coast and keep it consistent with the original scale line, then, repeat step 2 and 3.

	The height of sand decreases		
Planting Basin	the first time	the second time	average

Experimental data	Mangrove seedling is planted （experience group）	8 mm	10mm	9 mm
	No planted mangrove seedling （comparative group）	11 mm	16 mm	13.5 mm
Experimental result	It is found that the beach with mangroves is less eroded by waves than that without mangroves			
Existing problems and improvement	Because of the container, we only planted one mangrove seedling for the experiment, and the experimental effect was not obvious. Improvement: increase the container, plant more seedlings or plant larger mangroves.			
	 No mangrove seedlings were planted, and the sand height was 16 mm lower. lower.  With mangrove seedlings, the sand height was 11 mm			

Research activity report on mangrove windbreak and sand fixation experiment (device version 3.0)

—Explore Experiment 1: Can mangroves reduce the erosion of beach sand by waves?

Members: Yeran Yang, Yaqing Chen , Zhihang Huang , Zecheng Guo, Donghua Liu,Ziyan Sun,Qihong Gu	Instructor: Shulian Chen
Research question: Design experiments to verify whether mangroves can reduce the erosion of beach sand by waves	
Hypothesis: Mangroves can reduce the erosion of beach sand by waves	

Factors to be considered	The erosion of sea waves on beach sand and soil, and the condition of beaches with or without mangroves washed by sea waves; The size of the beach, the amount of sea water, the size of waves and other conditions shall be guaranteed to agree.				
Materials required	Container, sand, small shovel, water, red sapling, oily pen, ruler, wave maker (by Steering gear, push plate and sensor), stopwatch.				
Changed conditions	Whether mangrove seedlings are planted.				
Invariant condition	The size of the container, the amount of sand, the size of the waves, and the time taken.				
Experimental method	Comparative experiment: 1. Shovel some sand into the container with a small shovel, and make the sand into a small slope to simulate the coast and beach; Add an appropriate amount of water to simulate sea water. Compare the scale mark with an oily pen. 2. Use the wave maker to make waves to scour the coast and count 30 times. 3. Observe the condition of the coast after being washed by waves, measure the change of coastal sand height with a ruler and make records. 4. After planting mangroves in the container, restore the coast, keep consistent with the original scale line, and repeat steps 2 and 3.				
Experimental data	Planting Basin	The height of sand decreases			
		the first time	the second time	the third time	average
	There are 3 mangrove seedlings planted (experimental group)	3mm	5mm	4mm	4mm
	No planted mangrove seedlings (comparative group)	8mm	9mm	8mm	8.3mm

Experimental result	It is found that the beach with mangroves is less eroded by waves than that without mangroves.
Existing problems and improvement	Existing problems: the power of the steering gear of the wave maker is too small, and the generated waves are not too large. Suggestions for improvement: use a high-power steering gear.

Investigation activity record of mangrove windbreak and sand fixation experiment (wave)

Recorded by: Yeran Yang Time: 2021.9.1 - 7

Planting Basin	The height of sand decreases				Experimental description
	the first time	the second time	the third time	average	
Mangrove seedlings are planted	1mm	8mm	10mm	9mm	In the first experiment, because the wind force of the blower is too small, the experiment is carried out by making waves by hand, and in the second and third experiments, the blower is used.
No planted mangrove seedlings	3mm	11mm	16mm	13.5mm	
Experimental conclusion	It is found that the beach with mangroves is less eroded by waves than that without mangroves.				

Investigation activity record of mangrove windbreak and sand fixation experiment (device version 3.0)

——Can mangroves reduce the erosion of beach sand by waves?

Recorded by: Peishan Li Time: 2021.10.6

Planting Basin	The height of sand decreases	

	the first time	the second time	the third time	average	Experimental description
Planted mangrove seedlings (3)	3mm	5mm	4mm	4mm	The wave maker is used to make wave s to scour the coast and count 30 times.
No planted mangrove seedlings	8mm	9mm	8mm	8.3mm	
Experimental conclusion	It is found that the beach with mangroves is less eroded by waves than that without mangroves.				

Research Report on mangrove windbreak and sand fixation experiment

——Explore Experiment 2: Can mangroves reduce the erosion of beach sand by strong wind?

Members: Yeran Yang, Yaqing Chen , Zhihang Huang ,Jiarao Sun,Zilin Li,Zechen Guo, Donghua Liu , Ziyan Sun, Qihong Gu,Qihao Wen,Zonghao Li	Instructor: Shulian Chen

Research question: Can mangroves reduce the erosion of beach sand by strong wind?

Hypothesis: Mangroves can reduce the erosion of beach sand by strong wind.

Factors to be considered	The erosion of sand and soil on the beach by strong wind, comparison and observation of the situation of the beach with or without mangrove planting after being blown by strong wind, and measurement of the amount of sand loss; The size of the beach, the size of the wind, the blowing time and the dry humidity of the sand shall be consistent.
Materials required	2 planting pots, sand, small shovel, hair dryer, stopwatch, broom, garbage shovel, cardboard, plastic bag Platform scale, etc
Changed conditions	Whether mangrove seedlings are planted
Invariant condition	The size of the planting basin, the size of the wind, the time of use, and the dry humidity of the sand.

<table>
<tr><td>Experimental method</td><td>1. Shovel sand into two planting pots of the same size with a small shovel, and make the sand in the two planting pots as even or equal as possible. The number of (children) is the same. One planting basin was planted with mangrove seedlings (marked as No. 1 planting basin as the experimental group), and the other planting basin was not planted with any plants (marked as No. 2 planting basin as the comparative group).
2. Use a blower (the average wind speed measured by ut363 anemometer is 23.6m/s) to blow at No. 1 planting basin for 30 seconds, and block the blown sand with cardboard to prevent the sand from being blown away.
3. Stop blowing, clean the blown sand with a broom and garbage shovel, collect it and put it into a plastic bag, weigh it on the platform scale and record the data.
4.Replace No. 1 planting basin with No. 2 planting basin and repeat steps 2 and 3.</td></tr>
<tr><td>Experimental phenomenon</td><td>It can be observed that less sand is blown away in the planting basin with planted mangrove seedlings, while more sand is blown away in the planting basin without planted seedlings.</td></tr>
<tr><td>Experimental data</td><td><table>
<tr><td>Planting Basin</td><td>The weight of the blown sand</td><td>Experimental description</td></tr>
<tr><td>Planted mangrove seedlings</td><td>0.35 kg</td><td>The sand used in the experiment was a little wet.</td></tr>
<tr><td>No planted mangrove seedlings</td><td>1.1 kg</td><td>When the mangrove seedlings were transplanted from the culture basin to the No. 1 planting basin, the sand carried by the roots was removed soon.</td></tr>
</table></td></tr>
<tr><td>Experimental result</td><td>It is found that the beaches with mangroves are less eroded by the wind than those without mangroves.</td></tr>
<tr><td>Existing problems and improvement</td><td>Existing problems and improvement:
Existing problems:
1. The mangrove seedlings planted in the experiment can not solidify with the surrounding sand, which may affect the experimental</td></tr>
</table>

	outcome. 2. During the paperboard sand retaining, some good sand is still blown away and not collected. Although it has little impact on the experimental results, it is not accurate enough. Improvement: Try to experiment with red tree seedlings with sand at the root; Changing the weighing method and using the calculation method makes the experimental data more accurate.

Research activity report on mangrove windbreak and sand fixation experiment ——Explore Experiment 2: Can mangroves reduce the erosion of beach sand by strong wind? (Improvement 1)	
Members: Yeran Yang, Yaqing Chen , Zhihang Huang ,Jiarao Sun,Yue Xiang,Zilin Li,Zechen Guo, Donghua Liu , Ziyan Sun, Qihong Gu,Qihao Wen,Zonghao Li	Instructor: Shulian Chen
Research question: Can mangroves reduce the erosion of beach sand by strong winds?	
Hypothesis: Mangroves can reduce the erosion of beach sand by waves.	
Factors to be considered	The erosion of sand and soil on the beach by strong wind, comparison and observation of the situation of the beach with or without mangrove planting after being blown by strong wind, and measurement of the amount of sand loss. The size of the beach, the size of the wind, the blowing time and the sand, the dry humidity and other conditions of seeds shall be consistent.
Materials required	2 planting pots, sand, small shovel, hair dryer, stopwatch, broom, garbage shovel, cardboard, plastic bag Platform scale, etc
Changed conditions	Whether mangrove seedlings are planted
Invariant condition	The size of the planting basin, the size of the wind, the time of use, and the dry humidity of the sand.

<table>
<tr><td>Experimental method</td><td colspan="5">1.Shovel sand into two planting pots of the same size with a small shovel, so that the amount of sand in the two planting pots is the same as much as possible. One of the planting pots is planted with mangrove seedlings (marked as species 1 Planting basin, as the experimental group), the other planting basin does not have any seedlings planted (marked as species 2 planting basin as comparative group).

2. Weigh the weight of two planting pots respectively with a platform</td></tr>
<tr><td></td><td colspan="5">scale, and make them as equal as possible by increasing or reducing sand. The two pots weigh the same.

3. Align 1 with a blower (the average wind speed measured by ut363 anemometer is 23.6m/s) Blow the No. 1 planting basin for 30 seconds, and block the blown sand with cardboard to prevent the sand blowing away.

4. Stop blowing, weigh the planting basin blown by the wind on the platform scale, and record the data. Clean the sand with a broom and garbage shovel and collect it for reuse.

5.Replace No. 1 planting basin with No. 2 planting basin and repeat steps 3 and 4.</td></tr>
<tr><td>Experimental phenomenon</td><td colspan="5">It can be observed that there is less sand blown away in the planting basin for planting mangrove seedlings, but if there is no planting, a lot of sand is blown away from the planting basin.</td></tr>
<tr><td rowspan="3">Experimental data</td><td>Planting Basin</td><td>Before blowing</td><td>After blowing</td><td>The weight of the blown sand.</td><td>Experimental description</td></tr>
<tr><td>Planted mangrove seedlings</td><td>9.1 kg</td><td>8.9 kg</td><td>0.2 kg</td><td rowspan="2">The sand used in the experiment was relatively dry. When the red tree seedlings were transplanted from the culture basin to the No. 1 planting basin, the sand carried by the root was not removed.</td></tr>
<tr><td>No planted mangrove seedlings</td><td>9.1 kg</td><td>5.65 kg</td><td>3.45 kg</td></tr>
<tr><td>Experimental result</td><td colspan="5">It was found that beaches with mangroves were much less eroded by the wind than beaches without mangroves.</td></tr>
</table>

Existing problems and improvement	Problems： In the experiment, although the planted mangrove seedlings brought their own sand, they still could not communicate with each other. If the surrounding sand is completely solidified, it may affect the experimental outcome. Improvement: Plant the mangrove seedlings in the planting basin for a period of time. After the mangrove seedlings adapt, the roots are closer to the surrounding sand and soil, and then experiment again.

Planted mangrove seedlings (Experimental group):

Before blowing 9.1kg

After blowing 8.9kg

No planted mangrove seedlings (Comparative group):

Before blowing 9.1kg

After blowing 5.65kg

Research activity report on mangrove windbreak and sand fixation experiment

——Explore Experiment 2: Can mangroves reduce the erosion of beach sand by strong wind?

Members: Yeran Yang, Yaqing Chen , Zhihang Huang ,Jiarao Sun,Yue Xiang,Zilin Li,Zechen Guo, Donghua Liu , Ziyan Sun, Qihong Gu,Qihao Wen,Zonghao Li	Instructor: Shulian Chen
Research question: Can mangroves reduce the erosion of beach sand by strong winds?	
Hypothesis: Mangroves can reduce the erosion of beach sand by waves.	

Factors to be considered	The erosion of sand and soil on the beach by strong wind, comparison and observation of the situation of the beach with or without mangrove planting after being blown by strong wind, and measurement of the amount of sand loss; The size of the beach, the size of the wind, the blowing time and the dry humidity of the sand shall be consistent.
Materials required	2 planting pots, sand, small shovel, hair dryer, stopwatch, broom, garbage shovel, cardboard, plastic bag, platform scale
Changed conditions	Whether mangrove seedlings are planted.
Invariant condition	The size of the planting basin, the size of the wind, the time of use, and the dry humidity of the sand.
Experimental method	1. Shovel sand into two planting pots of the same size with a small shovel, so that the amount of sand in the two planting pots is the same as much as possible. One planting basin was planted with mangrove seedlings (marked as No. 1 planting basin as the experimental group), and the other planting basin was not planted with any plants (marked as No. 2 planting basin as the comparative group). 2. Use a blower (the average wind speed measured by ut363 anemometer is 23.6m/s) to blow at No. 1 planting basin for 30 seconds, and block the blown sand with cardboard to prevent the sand from being blown away. 3. Stop blowing, clean the blown sand with a broom and garbage shovel, collect it, put it into a plastic bag, weigh it on a platform scale, and record the data. 4. 4. Replace No. 1 planting basin with No. 2 planting basin and repeat steps 2 and 3.
Experimental phenomenon	It can be observed that less sand is blown away in the planting basin with planted mangrove seedlings, while more sand is blown away in the planting basin without planted seedlings.

Experimental data	Planting Basin	The weight of the blown sand.	Experimental description
	Planted mangrove seedlings	0.35 kg	The sand used in the experiment was a little wet. When the mangrove seedlings were transplanted from the culture basin to the No. 1 planting basin, the sand at the roots was removed.
	No planted mangrove seedlings	1.1 kg	
Experimental result	It was found that beaches with mangroves were much less eroded by the wind than beaches without mangroves.		
Existing problems and improvement	Existing problems: 1 The red tree seedlings planted in the experiment can not solidify with the surrounding sand, which may affect the experimental outcome. During the paperboard sand retaining, some fine sand is still blown away and not collected. Although it has little impact on the experimental results, it is not accurate enough. Improvement: try to experiment with mangrove seedlings with sand at the root. Changing the weighing method and using the calculation method makes the experimental data more accurate.		

Planted mangrove seedlings (Experimental group):

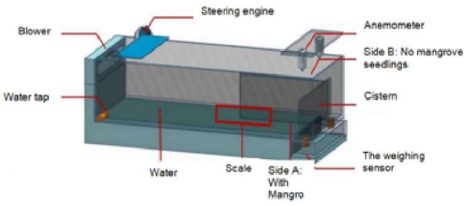
Reduce sand weight 0.35kg

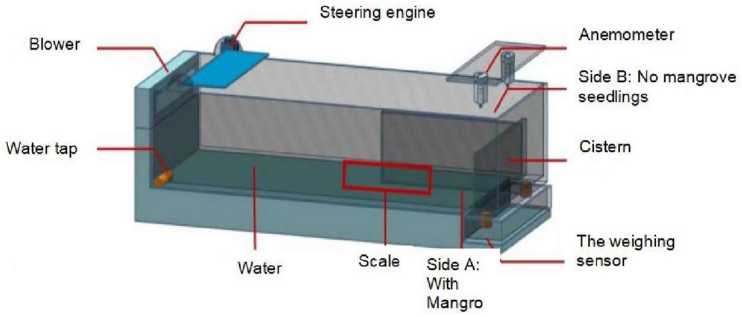
No planted mangrove seedlings (Comparative group):

Reduce sand weight 1.1kg

Investigation activity record of mangrove windbreak and sand fixation experiment (device version 4.0)	
Members: Yeran Yang, Yaqing Chen , Zhihang Huang ,Zechen Guo, Donghua Liu , Ziyan Sun, Qihong Gu, Ziqian Tong	Instructor: Shulian Chen
Research question: Design experiments to verify whether mangroves can prevent wind, fix sand and dissipate waves.	
Hypothesis: Mangroves can prevent wind, fix sand and dissipate waves.	
Factors to be considered	Compare and observe the condition, wind force and sand loss of the beach with or without mangroves after being washed by the waves. The size of the beach, the amount of sand, the amount of sea water, the size of the waves, and the wind force generating the wind shall be consistent.
Materials required	Container, sand, small shovel, water, mangrove model, wave maker (by steering gear, push plate Sensor composition), blower, anemometer, load cell, distance sensor, etc
Changed conditions	With or without planting mangrove model
Invariant condition	The size of the beach, the amount of sand, the amount of sea water, the size of the waves, the wind that produces the wind force magnitude and time taken.

Experimental method	Comparative experiment: 1. Install the device and test whether the device works normally. 2. Pour the same amount of sand into both sides of containers A and B in the device, plant mangrove model on side A, and there is no mangrove model on side B; Add an appropriate amount of water. 3. .Turn on the power supply, adjust the load cell and return the data to zero; Adjust the sand on both sides of A and B. The height of the sand is the same, and the distance sensor data on both sides of A and B are the same; Turn on the anemometer. 4. Turn on the blower and wave maker, observe the changes of each sensor's data and time it for 30 seconds, record the data presented by each sensor.

	Function: ①Wind protection: Use a blower to generate wind, and use an anemometer to detect the difference in wind force on both sides of A and B. ② Wave elimination: Turn off the blower, the steering gear rotates to create waves, the amount of water hitting into the water storage grid on both sides of A and B is different, and use the weighting sensor to measure the difference in the amount of water on both sides. ③Sand fixation: Use the scale to observe the amount of sand and soil loss on both sides of A and B (the amount of sand in the near-shore sea area).								
Experimental data	A. B both sides Data situation	Side A with mangrove model				Side B with no mangrove model			
		1st	2nd	3rd	average	1st	2nd	3rd	average
	Wind force (anemometer)	1.18 m/s	1.17 m/s	1.16 m/s	1.17m/s	1.86 m/s	1.84 m/s	1.85 m/s	1.85 m/s
	Soil erosion (load cell)	1 g	0 g	1 g	0.67 g	121 g	118 g	120 g	119 g
	Sand reduction height (distance sensor)	1 mm	2 mm	1 mm	1.3 mm	5 mm	4 mm	5 mm	4.7 mm
Experimental result	Through simulation experiments, it is proved that mangroves can (prevent wind) , fix sand and dissipate waves.								



Investigation activity record of mangrove windbreak and sand fixation experiment (strong wind)

Recorder: Yaqing Chen Time： 2021.9.1-7

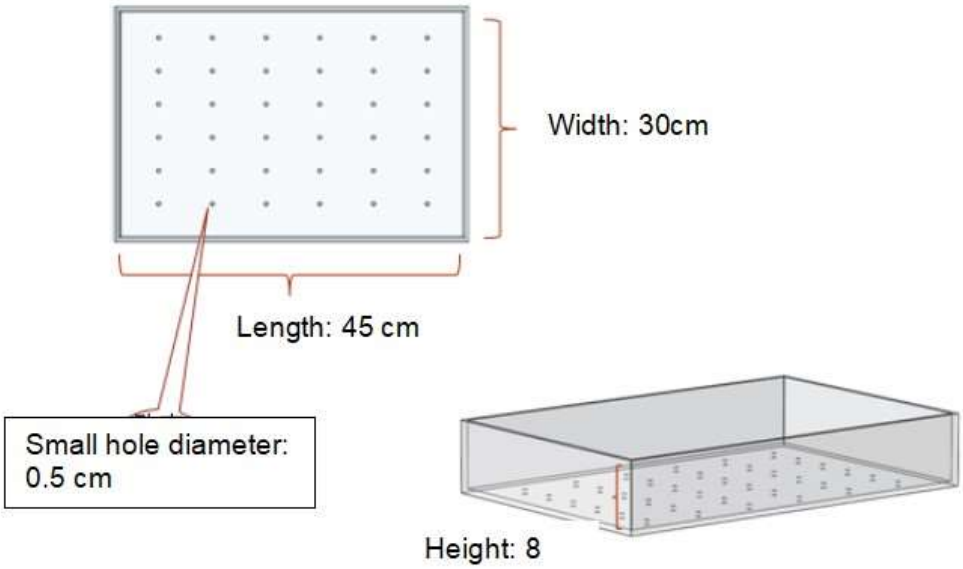
Planting Basin		The flag condition	The weight before blowing	The weight after blowing	The weight of the blown sand	Average
Planted mangrove seedlings	1st	No flags	9.1 kg	8.9 kg	0.2 kg	0.17 kg
	2nd	4 flags on and 1flag is down	14.8 kg	14.6 kg	0.2 kg	
	3rd	4 flags on and all flags are down	13.6 kg	13.5 kg	0.1 kg	
No planted mangrove seedlings	1st	No flags	9.1 kg	5.65 kg	3.45 kg	2.62kg
	2nd	4 flags on and all flags are down	13.6 kg	12.0 kg	1.6 kg	
	3rd	4 flags on and all flags are down	12.3 kg	9.5 kg	2.8 kg	
Experimental result	It was found that beaches with mangroves were much less eroded by the wind than beaches without mangroves. It proves that mangroves have windproofing and sand fixation characteristics.					

During the experiment, we have found many problems with the experimental device. After many improvements, the experimental device can not only synchronously realize the comparative experiment, but also display accurate data to compare the great differences in wind speed and soil erosion on the beach with and without mangroves, so as to prove that mangroves do have the function of wind prevention and sand fixation.

①Device version 1.0

a. The cardboard box is cut with scissors and art knife, and pasted with glue to form a micro device with gathering effect.

b. A simple simulation experiment is carried out by (using the blower instead of the blower) and the structure is improved.



②Device version 2.0



a.Use 3D software to model the actual size (sand collecting device and planting basin) to obtain more accurate data and facilitate the production of finished devices.

b. Through searching information and consulting the professionals of manufacturing companies, we chose the appropriate materials to make the finished products, and finally chose acrylic board.

Materials	Advantages	Disadvantages
cardboard	Easy to make	Very light in weight,will be blown away
Acrylic board	Heavy in weight,convenient for observation and experiment	Complex in manufacture

Stainless steel	Convenient to make	Expensive in price

C.In order to simulate the windbreak and sand fixation effect of trees, we made a tree model.

项目式学习：红树防风沙的生态价值探究

——探究红树根的秘密

小组成员：张--，[illegible]相宁、李亦昊、刘嵘琪、李[illegible]琳　　时间：2021.9.1　　活动内容：计算红树各部分高度所占比例

序号	红树的高度（cm）	红树的株距（cm）及占比（%）		泥土中茎高（cm）及占比（%）		树根的根数	树根的长度（cm） ①	②	③	平均长度（cm）及占比（%）		树根的辐射宽度（cm）及占比（%）		枝干的长度（cm）及占比（%）		枝干的数量
①	15.9			6	31.7%	12	7.7	7.1	4.7	6.7	42.1%	9.5	59.7%	4.6	28.9%	
②	20.5			5	24.4%	18	17.5	2	7	8.8	42.9%	28	136.6%	11.1	54.1%	
③	15.5			4	25.8%	13	14.5	8.8	3.7	8.9	57.4%	25.3	163.2%	15	96.8%	
④	17.6			5.5	31%	11	14.8	1.5	4	6.76	38%	7.3	41%	11.2	63%	
⑤	20.1			6.1	30%	14	9	2	3.9	4.96	24%	7.6	37%	10	49%	
⑥	17			4.2	24%	19	7.7	0.7	4	4.13	24%	8.3	48%	3.5	20%	
平均	17.77	根据株距尺寸变动调整			28.8%	15					38.1%		80.92%		52%	3-5个主干

Project Learning: A Research on the Ecological Value of the Mangroves in sandbreak and Windbreak

——Investigate the Secret of the Mangrove Roots

Group members: (5 pupils) Yiyi Zhang, Xiangning Yi, Donghao Li, Junqi Liu, Taiyan Li

Date: 1ST of September, 2021

Task: To figure out the proportions of each part of the mangroves

Order	Height of the mangrove (cm)	Height of the stem in soil (cm) and its percentage (%)		Amount of the roots	Length of the roots ①	②	③	Average length (cm) and its percentage (%)		Width of the roots' cover area (cm) and its percentage (%)		Length of the branch (cm) and its percentage		Amount of the branches
No.1	15.9	6	37.7 %	12	7.7	7.1	4.7	6.7	42.1 %	9.5	59.7%	4.6	28.9 %	
No.2	20.5	5	24.4 %	18	17.5	2	7	8.8	42.9 %	28	136.6 %	11.1	54.1 %	
No.3	15.5	4	25.8 %	13	14.5	8.5	3.7	8.9	57.4 %	25.3	163.2 %	15	96.8 %	
No.4	17.6	5.5	31%	11	14.8	1.5	4	6.76	38%	7.3	41%	11.2	63%	
No.5	20.1	6.1	30%	14	9	2	3.9	4.96	24%	7.6	37%	10	49%	
No.6	17	4.2	24%	19	7.7	0.7	4	4.13	24%	8.3	48%	3.5	20%	
Average	17.77		28.8 %	15					38.1 %		80.92 %		52%	3~5 branches

项目式学习：红树防风沙的生态价值探究

——探究红树根的秘密

小组成员：张一一，易湘宁，李东昊，刘峻祺，李泰妍　时间：2021.9.1

活动内容：计算红树各部分高度所占比例

小组计算活动记录单

序号	红树的高度（cm）	红树的株距（cm）及占比（%）		泥土中茎高（cm）及占比（%）		树根的根数	树根的长度（cm） ①	②	③	平均长度（cm）及占比（%）		树根的辐射宽度（cm）及占比（%）		枝干的长度（cm）及占比（%）		枝干的数量
①	15.9			6	37.7%	12	7.7	7.1	4.7	6.7	42.1%	9.5	59.7%	4.6	28.9%	
②	20.5			5	24.4%	18	17.5	2	7	8.8	42.9%	28	136.6%	11.1	54.1%	
③	15.5			4	25.8%	13	14.5	8.6	3.7	8.9	57.4%	25.3	163.2%	15	96.8%	
平均	17.3				29.3%	15					47.4%		119.83%		59.9%	

Project Learning: A Research on the Ecological Value of the Mangroves in sandbreak and Windbreak

——Investigate the Secret of the Mangrove Roots

Group members: (5 pupils) Yiyi Zhang, Xiangning Yi, Donghao Li, Junqi Liu, Taiyan Li

Date: 1ST of September, 2021

Task: To figure out the proportions of each part of the mangroves

Order	Height of the mangrove (cm)	Height of the stem in soil (cm) and its percentage (%)		Amount of the roots	Length of the roots ①	②	③	Average length (cm) and its percentage (%)		Width of the roots' cover area (cm) and its percentage (%)		Length of the branch (cm) and its percentage		Amount of the branches
No.1	15.9	6	37.7 %	12	7.7	7.1	4.7	6.7	42.1 %	9.5	59.7%	4.6	28.9 %	
No.2	20.5	5	24.4 %	18	17.5	2	7	8.8	42.9 %	28	136.6 %	11.1	54.1 %	
No.3	15.5	4	25.8 %	13	14.5	8.5	3.7	8.9	57.4 %	25.3	163.2 %	15	96.8 %	
Average	17.3		29.3 %	15					47.4 %		119.83%		59.59 %	

d. After getting the finished product, conduct the wind proof test again. The wave experiment is carried out with a plastic box which is more suitable for the size of the blower, and the wave making by the blower is used instead of manual wave making.

③ Device version 3.0

a. Gear to simulate the motion mode of manual wave making, and finally decide to drive the paddle to rotate a certain angle each time to make waves.

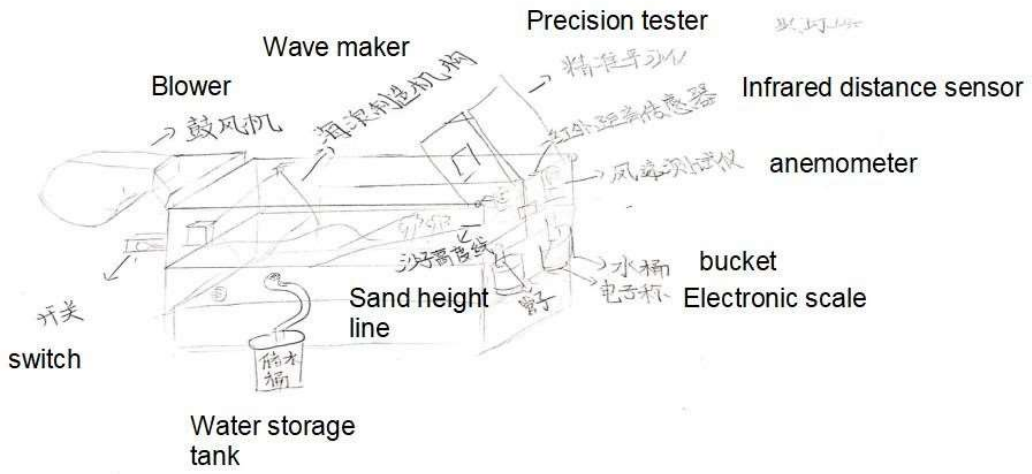
b. Structural design: Try the hole plate and nails of the laser cutting machine to build the paddle and steering gear support, and conduct repeated debugging.

c. Program design: How much angle does the steering gear rotate and how fast can it rotate to make waves? Program and debug the steering gear.

d. Experimental test: What is the water level during the experiment? When is the experimental effect best?

④ Device version 4.0

a.Design the structure of the experimental device.



b.Wave experiment:

The steering gear drives the paddles.

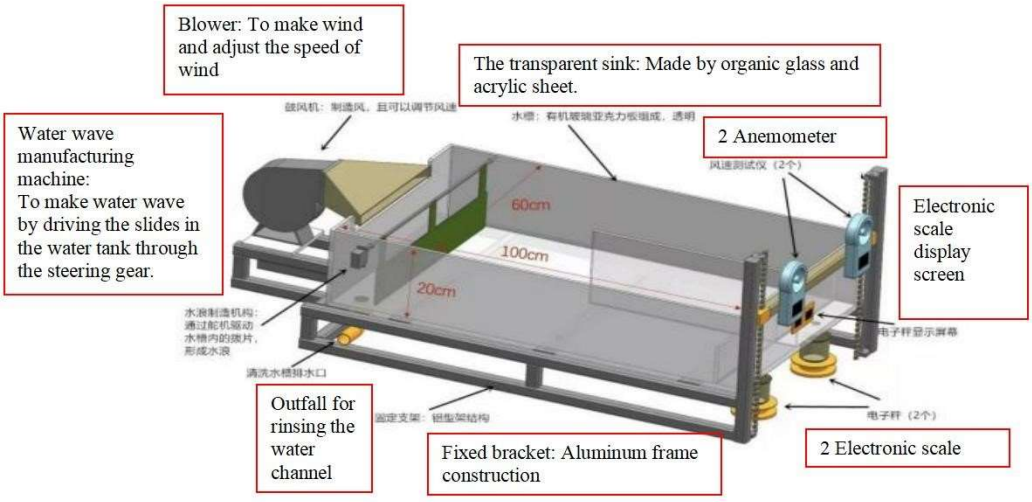
Measure the weight of soil and water waste loss.

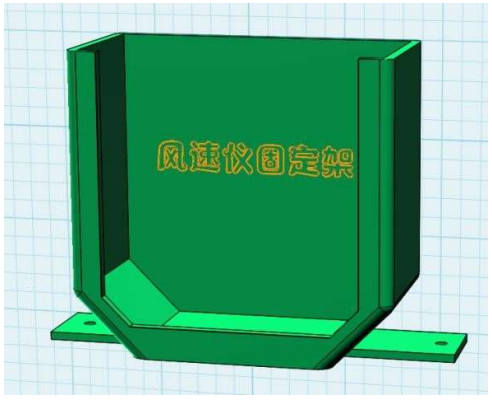
Measure how far the sand has fallen—Ultrasonic transducer.

c. The instructor demonstrates and teaches the principle and programming method of sensors.

d. Form the final design drawings for the manufacturing company to produce the finished product.

e. 3D design experimental support fixed electronic equipment.



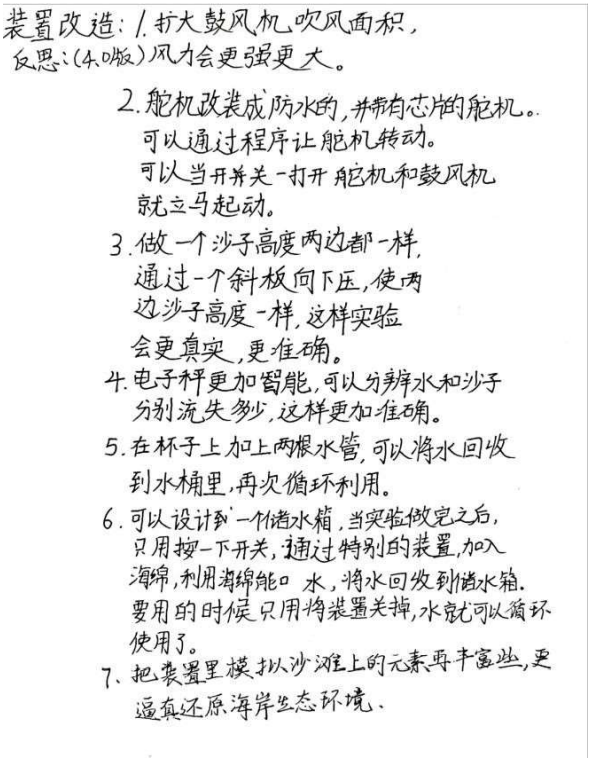


Anemometer mounting frame

f. **After getting the finished product, then add sensors and other electronic components for repeated program debugging.**

At the same time, water, sand and mangroves are added to simulate the real natural environment as much as possible.

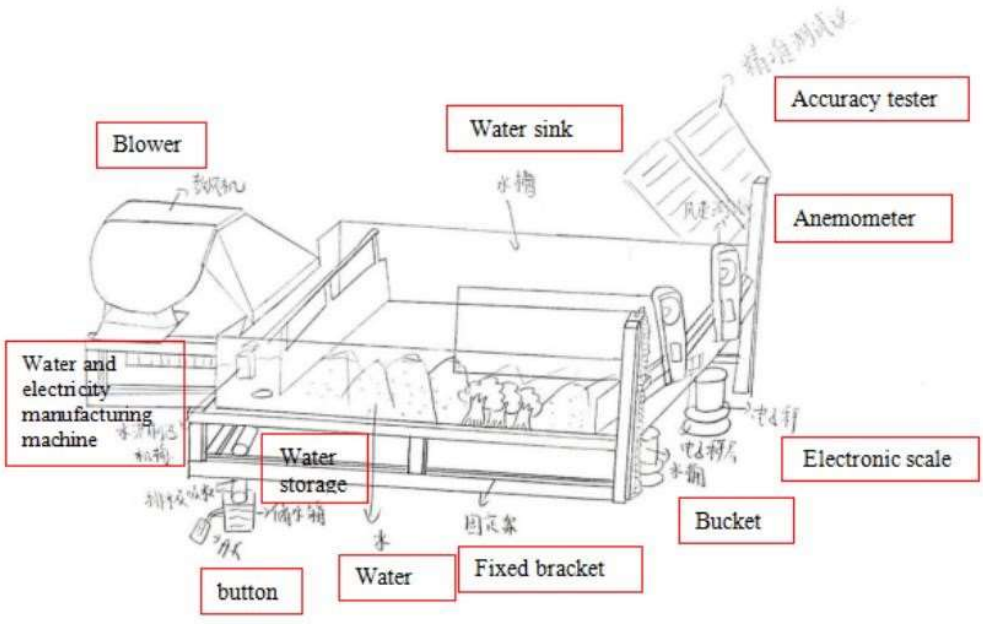
Device modification:



Reflection:(Mode 4.0)

1. The wind power is stronger by expanding the blower area.
2. Make the steering gear into a waterproof version with chip. Make the steering gear rotate by programming. The steering gear and blower works when the button opens.
3. Use an inclined plate to press sand into the same height in order to make the experiment more realistic and exact.
4. Make the electronic scale more intelligent so that it can not only distinguish water and sand but also the water and sand loss. The experiment will be more exact.
5. Add two water pipes above the cup. Recycle the water and pour it into a bucket.
6. Design a water storage box to recycle water. Push a button and use a special device to add sponge to suck out water and recycle the water into the storage box. Water can be reused again by turning off the button.
7. Make the elements on the beach in the installation more abundant and more realistic to resemble the coastal ecological environment.

We also drew reforming design drawings :



We can also optimize our devices. However, considering that this optimization did not directly affect the experimental results and our time of exploration was limited, we did not include the design drawing of these practice upgraded devices.

The experimental results gave us a great shock. We confirmed that the mangrove does have the role of wind prevention and sand fixation, and we have a deeper understanding of the mangrove who is the "Marine guardian". We should ensure that

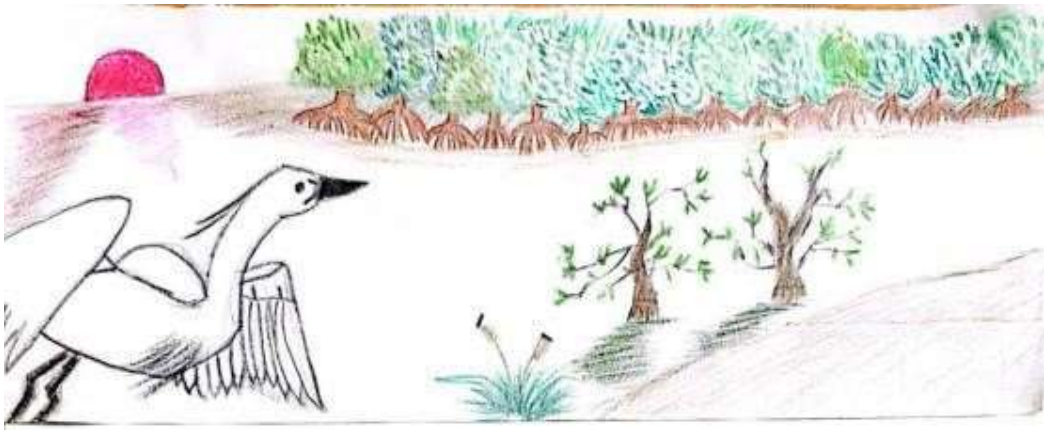
more people understand and protect it. In order to allow more children to join this team, we decided to use the root knowledge of mangroves to write a popular science pantomime, and use information technology to make animation that children like.

Image design achievements

In order to better publicize the concept of mangrove protection, we wrote a proposal, designed different layouts, printed and distributed our self-designed proposal with pictures to tourists and residents of Chung Ying Stree. Our activities have well publicized the role of mangroves in windbreak and sand fixation. We also advocated for people to protect mangroves well.

Mangrove sea guard

Exhibition of students' proposals for mangrove protection



"保护红树林"倡议书

中英街居民、游客朋友们：

海洋是生命的摇篮，我们深圳人民拥有得天独厚的山海资源。我们中英街依山傍水，风景秀丽，在美丽的海边栈道旁有一片红树林，它们虽然栽种不久，但是却是一道独特的风景线。我们学校经过一年的项目式学习探究，证实了红树的确有着很强的防风固沙的作用。我们了解到它们还能净化海水，固碳储碳、维护生物多样性，有"海岸卫士"、"海洋绿肺"等美誉。红树林生态系统是世界上最富多样性、生产力最高的海洋生态系统之一。为了让这一片小树林茁壮成长，并号召更多的人加入到保护红树、种植红树的队伍中来，我们年级的全体师生向大家发出倡议：

1. 多去学习和了解关于红树的相关知识，能科学认识到红树的特性。

2. 不折枝，阻止非法砍伐红树林行为。

3. 每年领养红树苗，并能按时种植红树苗到滩涂上。

4. 积极参加红树林修复工作和后期管护的公益活动。比如给红树林割草，定期捡拾红树根拦截的垃圾。

5. 主动参加相关的宣传活动，积极宣传保护红树、保护海洋环境的理念。

我们承诺从小事做起，从现在开始，珍视红树林，关爱海洋生态，用实际行动带动更多的人关爱海洋，守护我们的蓝色家园！

深圳市盐田区外国语小学东和分校六年级全体师生

2021年12月6日

Written proposal for “Protection of mangroves”

Chung Ying Street residents/ tourists and friends:

The sea is the cradle of life, and we enjoy the unique resources of mountains and seas. Chung Ying Street has beautiful scenery including mountains and rivers. There is a group of mangroves can be called a mangrove forest or a mangrove biome beside the beautiful seaside boardwalk. Although they have not been planted for a long time, they are a unique scenery line. We know that they also can purify water which has the function of carbon sequestration and carbon storage and the maintenance of biological diversity. Mangroves are often called "coast guard", "sea green lung" . The ecosystem of mangroves is one of the world's richest in diversity and one of the most productive marine ecosystems. In order to help the small trees thrive and recruit more people to join the protection of mangrove planting, all the teachers and students of our grade would like to propose to you:

1. Learn and understand more about mangroves so as to scientifically understand the characteristics of mangroves.
2. Do not break branches of mangroves and prevent the action of illegal logging of mangroves.
3. Adopt red saplings every year and plant red saplings on the beach on time.
4. Actively participate in the public welfare activities of mangrove restoration and later management and conservation. For instance,pruning mangroves and regularly picking up litter that mangrove roots trap.
5. Take the initiative to participate in relevant publicity activities and actively publicize the concept of mangrove protection and marine environment protection. We promise to start from small things. From now on, let’s cherish mangroves, care for marine ecology and encourage more people to care for the ocean with practical actions. Let’s protect our blue homeland hand by hand!

All the teachers and students of Grade 6 in Donghe Branch school, Yantian District, Shenzhen.

December 6,2021

After the exploration activities, we also planted the mangroves we maintained on some sea beaches in the salt field, so that the mangroves can return to nature and contribute to the protection of the beautiful mountain and sea homes!

Summary and reflection

In this project-based learning, after much brainstorming, we focused on the problems around us, and put forward questions and willingness to explore. Such project-based learning activities are close to our life. In the process of exploration, we will naturally learn and use a lot of subject knowledge to solve problems. Each link not only reaps surprises, but also improves our comprehension quality. Especially in the iterative process of experimental devices, we use our hands and brains to solve problems and turn ideas into reality. Our experiments are becoming more and more accurate and persuasive. This allows us to truly experience the scientific spirit of seeking truth from facts and continuous exploration. More importantly, during the project-based learning process, we publicized the concept of protecting mangroves with the community residents around the school in the form of a proposal. The activities of raising and planting mangroves have received positive responses from our families and friends. Therefore, they have a deeper understanding of the role of mangroves in wind prevention and sand fixation. They also consciously join our activities to plant and protect mangroves together. This shows that our inquiry activities can also have a positive impact on many people.

We believe that this project-based learning activity is only the beginning of our exploration of mangroves. With the change of our exploration angle and the expansion of our scope, the exploration will continue to deepen. We will start with this project-based learning, make the exploration of mangroves into a school-based curriculum,

and pass on the environmental protection concept of protecting mangroves and establishing a harmonious ecological environment to our students.

Project achievement

（ 1）**Experimental device for verifying the windproof and sand fixation effect of mangrove:** Designed and manufactured by children in the process of continuous exploration and iteration. It is composed of mangrove model, steering gear and transmission device made according to a certain proportion to resemble the natural wave effect as much as possible and present the experimental results of the comparative experiment at the same time.

（2） **Experimental report**

（3）**Popular science fairy tale script**

（4） **Popular science animated film**

（5） **Proposal for protecting mangroves**

In the process of project-based learning, we start with the observation of the phenomena around us, put forward problems, and use interdisciplinary knowledge to solve them. In this process, we include different types of participants and a collaborative community. We focus on the core driving problems, and many sub problems make our exploration step by step. Under the critical thinking, we have made our experimental device more and more sophisticated, and the experimental results more and more accurate. Practice has confirmed that the mangrove has the function of wind prevention and sand fixation, and let the concept of protecting mangroves penetrate into the minds of the children and the community.