

Water Wheel Building Instructions

Items included:

Quantity	Item	Item Label	Included Yes/No
1	Frame w/ Horizontal Bar	A	
2	Frame	B	
1	Frame w/ Vertical Bar	C	
5	Large Gear Wheel	D	
2	Small Gear Wheel	E	
2	Long Axle	F	
1	Short Axle	G	
2	H Frame	H	
3	Axle Lock	I	
6	Washer	J	
1	Water Wheel	K	
12	Anchor Pin	L	
1	Motor	M	
2	3-hole Bar	N	
1	5-hole Bar	O	

Procedure:

Use Figure 1 for steps 1 and 2.

1. Align pins at bottom of frame A with the fifth hole from the top on frame B. Press firmly to secure into place.
2. Skipping two holes, place frame C next to frame A. Press firmly to secure into place.



Figure 1: Base Assembly

Use Figure 2 for steps 3-7.

3. Slide gear D onto the smooth end of the long axel.
4. Secure gear into place by placing an axle lock and washer onto the long axle.
5. Slide axle through the third hole located towards the bottom of the vertical bar.
6. Secure axle into place by placing gear E at the very edge of the axle.
7. Slide axle lock and washer towards gear E leaving enough room for the washer to spin freely. (The lock should be close enough to prevent

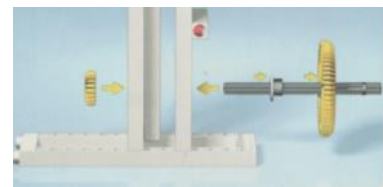


Figure 2: First Gear Assembly

- axle from moving but loose enough to allow the axle to spin easily.)
8. Set assembled base aside.

Use Figure 3 for steps 9 and 10

9. Slide smooth end of long axle through the center hole of H frame. (Red hole)
10. Secure axle with washer and axle lock leaving enough room for the washer to spin freely.

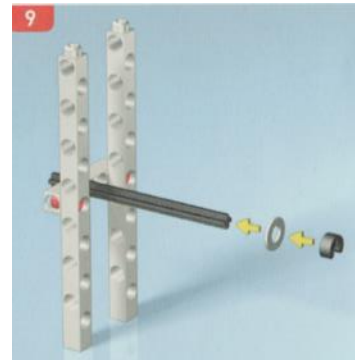


Figure 3: Axle Assembly

Use Figure 4 for steps 11-13.

11. Slide gear D onto the axle, pushing the gear all the way through.
12. Carefully slide the water wheel onto the axle. Pay close attention to the direction of the paddles!
13. Slide 2 D gears onto the end of the axle to secure the water wheel. Leave enough room for the water wheel to spin freely.

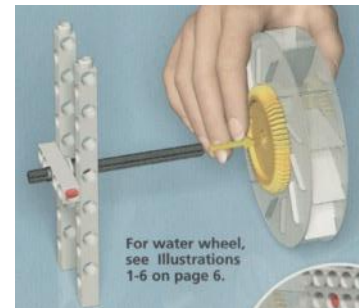


Figure 4: Water Wheel Assembly

Use Figure 5 for steps 14-17.

14. Place anchor pins on the colored corners of the assembled base.
15. Place washer on the red anchor pins of the base.
16. Align bottom of the assembled water wheel with the anchor pins on the left side of the base. The axle should go through the third hole from the top of the vertical bar.
17. Press down firmly to secure water wheel in place and set aside.

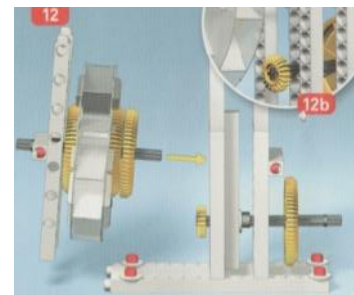


Figure 5: Water Wheel Assembly Cont.

Use Figure 6 for steps 18-22.

18. Place anchor pin on the second holes at the bottom of the H frame.
19. Align bar O with the pins and press firmly.
20. Slide smooth end of short axle through the center hole of H frame. (Top Bar).
21. Secure axle lock, leaving enough room for the axle to spin freely.
22. Slide gear D followed by gear E onto the short axle.

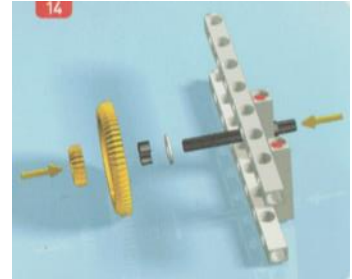


Figure 6: Second Gear Assembly

Use Figure 7 for steps 22-25.

23. Carefully align assembled H frame with the anchor pins on the assembled water wheel.
24. The bottom axle on the base should line up with the center hole at the bottom of the previously assembled frame.
25. The short axle on the assembled frame should align with the middle hole on the horizontal bar of the base.

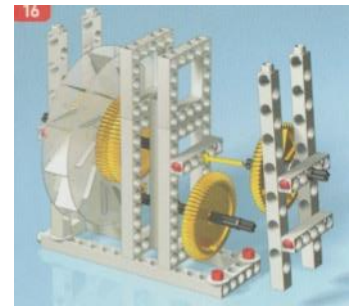


Figure 7: Third Gear Assembly

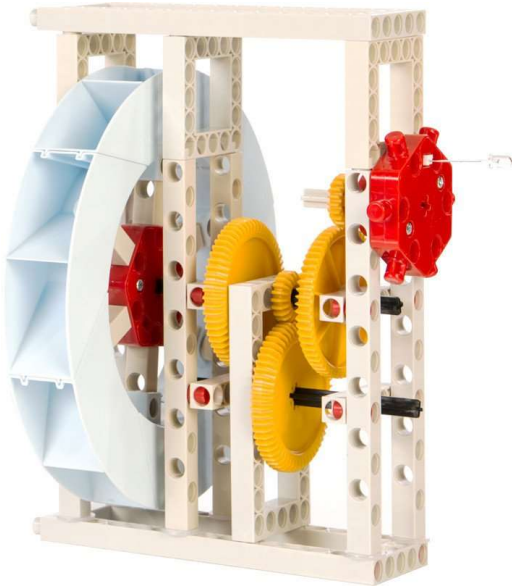
Use Figure 8 for steps 25-29.

26. Place anchor pins at the top of the middle frames and the top holes of the right side frame of the assembled water wheel.
27. Align frame B with the pins at the top of the water wheel and push firmly into place.
28. Align top hole of bar N with red anchor pin and press firmly. Do so for both bars.
29. Align motor pins with the bottom hole of bar N and press firmly to secure motor.



Figure 8: Motor Assembly

Hydrowheel Exercise



Follow the steps and think about the questions below, they are meant to guide you through the process. Remember to answer all the questions.

As a team, you will use your knowledge and understanding on Hydropower and learn how to apply it in order to calculate the energy into the system and the power output. You will learn about the importance of efficiency.

- ❖ Does the Hydrowheel work? Spin the wheel both ways, the LED should light up when you spin it in one direction.

- ❖ What type of energy goes into the system if the water source is 0.7 meters above the water wheel? Calculate the energy into the system and show your work. Assume the mass of water into the wheel is 0.15 kg/s and gravitational constant is 9.81 m/s^2 :

❖ Find the current and voltage using the voltmeter. What is the power output that the system produces? Remember $\text{Power} = \text{Voltage} \times \text{Current}$

❖ Find the efficiency of the Hydrowheel using the power in and power out (power out/power in):

Formula Sheet

KINETIC ENERGY:

$$KE = \frac{1}{2} \dot{m} v^2$$

POTENTIAL ENERGY:

$$PE = \dot{m} g z$$

EFFICIENCY:

$$n = \frac{\text{Energy Output}}{\text{Energy Input}}$$

POWER:

$$P = I * V$$

$$P = A_s * P_{sun}$$

WORK:

$$W = F * d$$

FORCE:

$$F = m * a$$

ACCELERATION:

$$a = \frac{v}{t}$$

VELOCITY:

$$v = \frac{d}{t}$$

COMPONENTS

v = velocity

\dot{m} = mass flow rate

g = gravity

z = height

n =efficiency

I = current

V = voltage

A_s = solar panel area

P_{sun} = power produced by the sun

ρ = density

\dot{V} = volumetric flow rate

A_c = crosssectional area

d = distance

a = acceleration

m = mass