**Lesson Overview**

**LA-STEAM Cross Curricular Lesson-Windmills**

Students will:

* Read and study The Fabulous Perpetual Motion Machine
* View videos and images of perpetual motion machines, windmills, windfarms, dams and hydro-electric turbines.
* Work in groups of 3 or 4
* Build a class standard Windmill
* Calculate the Power output of the Windmill
* Make modifications to the blades of the Windmill to create more power
* Create a summary of the process in the form of a comic using and understanding the literary elements of Character/Plot/Rising Action/Climax/Resolution
* Extensions: Create a water turbine and measure the power output. Write a short paragraph comparing and contrasting the machine created by the students in the play and the windmill machine created in the classroom experiment.

**Language Arts:** CLOSE study of Perpetual Motion Machine

**Science:** Understanding the Sun’s energy and it’s effect on the Earth

**Technology:** Study of simple machines

**Engineering:** Building and Modifying a machine

**Art:** Creating a comic or graphic novellete (create with templates from makebeliefs.com or pixtons.com or just by good old fashioned pencil and paper)

**Math:** Calculating and converting relevant units of measurement

**\*Visuals and Diagrams Located in Powerpoint**

**LA+STEAM Windmill Lesson**

**Topic: Energy and Motion (The Fabulous Perpetual Motion Machine)**

**Testable question**: How can the blades of a wind turbine be modified to create more power?

**Lesson question**: How is the sun’s energy transferred to create electrical energy?

or

(How is the Sun’s energy transferred to and used by a windmill?)

**Pages From core text**:

* **The Fabulous Perpetual Motion Machine**
* Power in the Wind

**Common Core Reading and Writing standards**:

RL1,RI2, RI3,W2,W4,W5

RI.5.7 Draw on information from multiple print of digital sources…

SL.5.5 Include multimedia componets and visual displays in presentations when appropriate

**Background Knowledge:**

Students need to know that the sun’s energy is responsible for the uneven heating of the earth which creates wind. Wind energy is created by solar energy.

**NGSS standards:**

3-5-ETS1-2   Engineering Design

3-5-ETS1-1   Engineering Design

5-ESS3-1   Earth and Human Activity

5-PS3-1   Energy (focusing mainly on the crosscutting concept that Energy can be transferred in various ways and between objects).

**Math Skills explored and practiced:**

* Conversions (joules to watts)
* Collecting and recording data
* Graphing
* Multiplying and Dividing

**Writing and Art Assignment**:

Students will create a comic book story of their group’s process of discovery during the windmill project. The comic story must have these elements:

* Setting
* Intro to characters (students)
* Problem
* Rising Action
* Climax
* Resolution

(This activity lends itself to the understanding of the writing convention of dialogue and how it serves as a vehicle for plot advancement).

**Lesson Resources to be used at teacher’s discretion in an order that makes sense.**

* **Instructional Text #1:** **The Fabulous Perpetual Motion Machine** (Pearson**©)**
* **Instructional Text #2:** Windmill Project PDF <http://www.education.com/pdf/engineering_windmill/>
* **Instructional Text #3:** Power in the Wind <http://learn.kidwind.org/learn/wind_basics_power> (this is a huge resource to be explored. Choose what suits your level of involvement in this project)
* **Instructional Text #4:** How to construct a windmill and calculate its power

<http://science.wonderhowto.com/how-to/construct-model-windmill-and-calculate-its-power-259781/>

**Activities**

* CLOSE reading of the play The Perpetual Motion Machine
* Build a windmill
* Calculate Power of windmill
* Modify the Windmill
* Create a comic that represents (in story form) the group’s process and experience during the windmill project. (Students will use a collective and agreed upon story of their experience, however, each student will create their own comic).
* Extension LA lesson: Write a short paragraph comparing and contrasting the machine created by the characters in the play to the windmill machine created by the group.

**Struggling readers and Language learners**

* Groups will be heterogenious and peer buddies will be assigned to struggling readers and language learners.
* Teacher will pull small groups of stuggling readers and language learners for extra support while other students are working independently
* Modify writing assignment by giving a comic template and sentence/dialogue starters.

**Video Support:**

Perpetual motion machines (background music annoying)

<https://www.youtube.com/watch?v=287qd4uI7-E>

<https://www.youtube.com/watch?v=FO566k4nA3g>

Why does the wind blow? <https://www.youtube.com/watch?v=xCLwbqmacck>

A working windmill tour

<https://www.youtube.com/watch?v=t9KI2g-r8rA>

Marine and hydrokinectic energy

<https://www.youtube.com/watch?v=ir4XngHcohM>

Hydropower

<https://www.youtube.com/watch?v=tpigNNTQix8>

Wind turbines

<https://www.youtube.com/watch?v=tsZITSeQFR0>

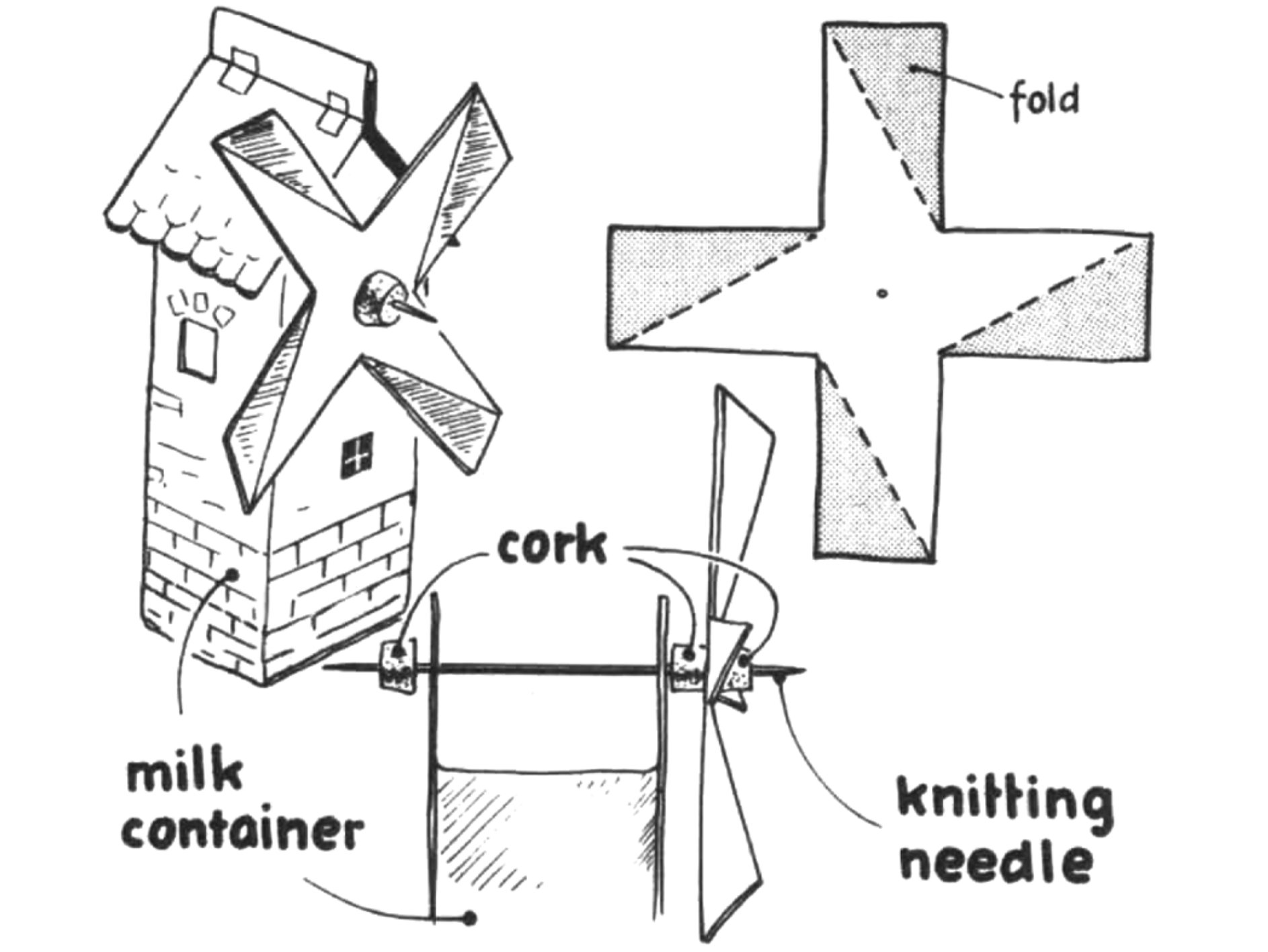
How to construct a windmill and calculate its power

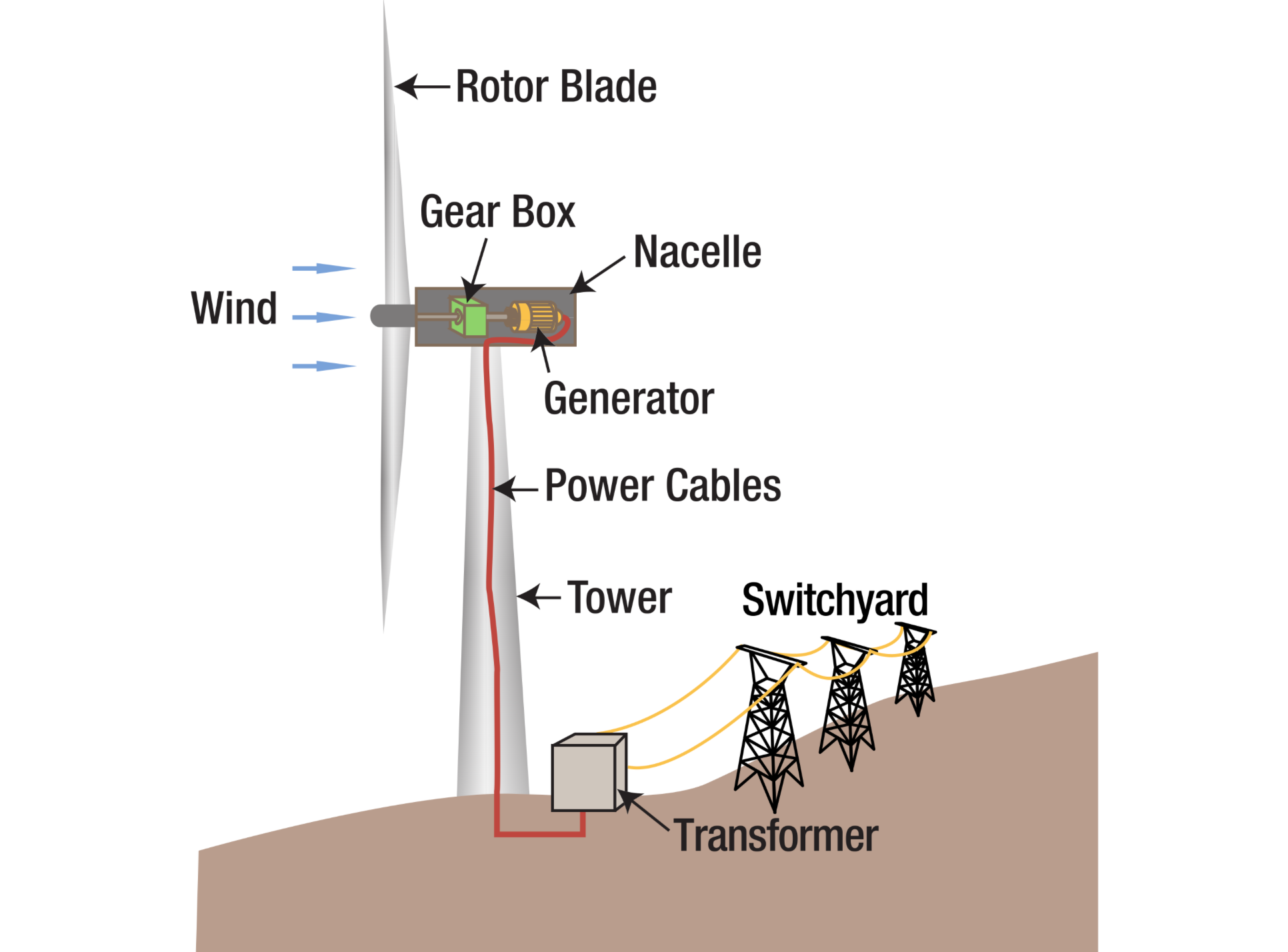
<http://science.wonderhowto.com/how-to/construct-model-windmill-and-calculate-its-power-259781/>

MacGyver Windmill Kit (I wouldn’t buy this kit because of the expense but the ideas of construction are well illustrated and the video of the kids working together is valuable).

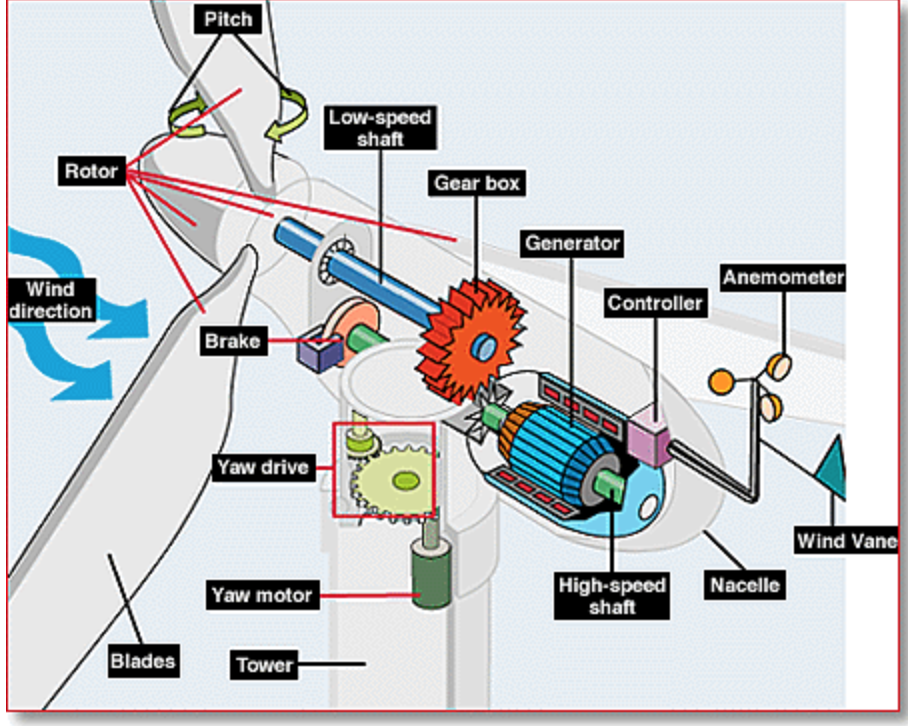
<http://store.kidwind.org/catalog/macgyverwindmill>

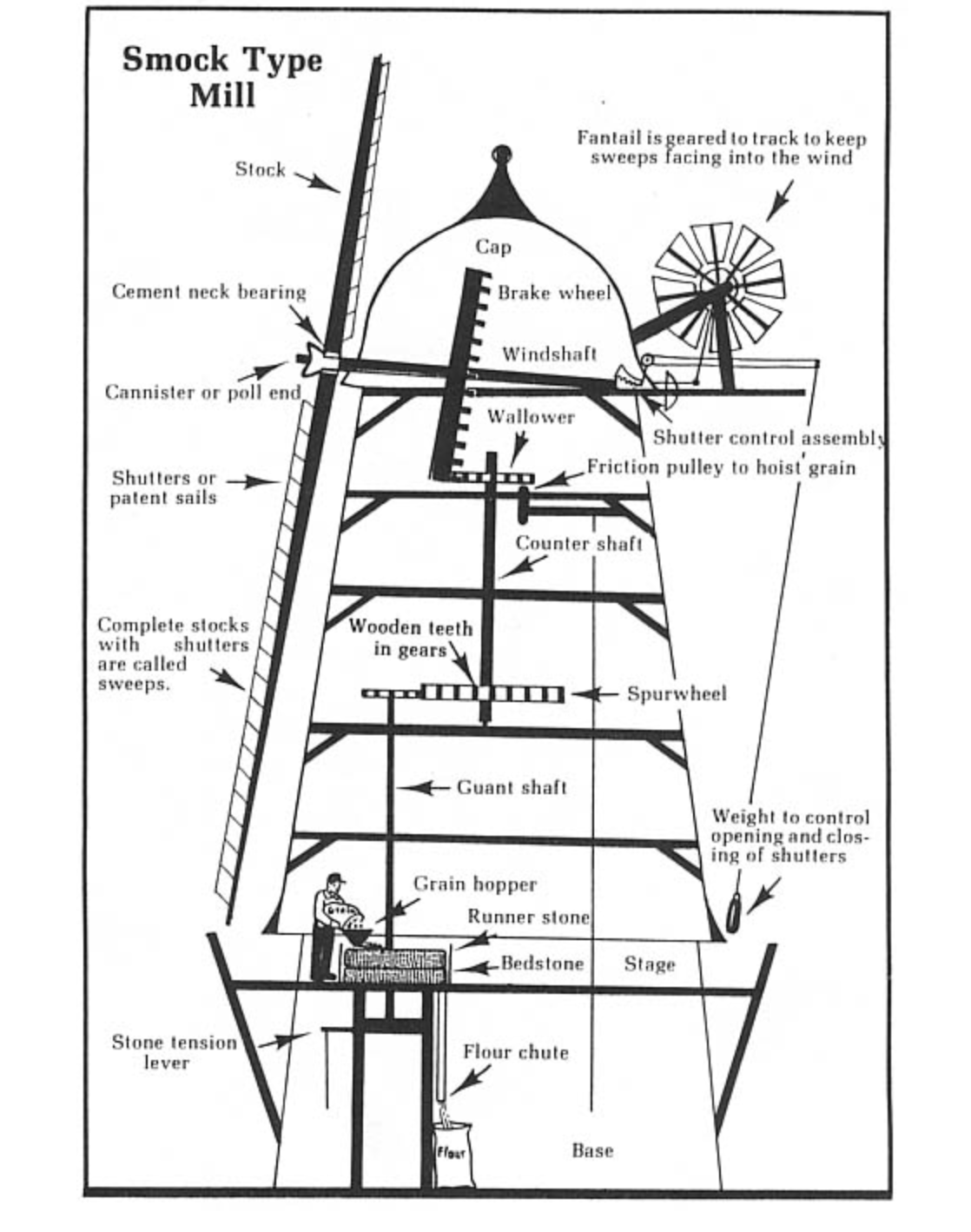
**Core Diagrams (other visuals in ppt):**





**Another Contruction Option!**





**Experiment Work Guide:**

**Exploring Power**

(a review of the windmill video)

How to calculate **Power output** of machines.

**Power** is the measure of the **rate** (time) of which a machine does **work**

The example in the video:

* Load =.9 newtons (the load were some coins or washers in an evelope)
* He weighed the load with a Newton spring scale.
* Work= force (.9 newtons) x distance (2.5m) (He measured the distance the load traveled from the ground to the top of the windmill).
* Work = 2.25 **joules**(units of work) (So the amount of work the windmill is doing is measured as 2.25 joules)

**Power is the rate of which a machine does work**

The **Watt** is the unit of **power**

**1 Watt= 1 Joule per second**

Power = Work/time (Divide the work done by the time it took to do the work).

The windmill completed the work (lifting the load) in 9 seconds

Time = 9 seconds

Important Vocabulary or words to know:

* **Unit**
* **Power**
* **Rate**
* **Work**
* **Newtons**
* **Joules**
* **Watt**

Power = Work/time

So, to find power divide 2.25 Joules (work) by 9 seconds (time)

Power = .25 Watts power output is .25 watts

What will effect the power output?

**A toaster is a 1000 Watt device.**

**It would take 4000 of these windmills to run the toaster!**

**Now, let’s measure the amount power your windmill creates:**

* Measure the **load** with the Newton scale
* Measure the **distance** the load will travel
* Measure the amount of **time** the load takes to travel from the ground to the top of the windmill.
* Finally calculate the **watts**
* **Remember no naked numbers! Label your numbers with units (ex. 4meters or 4m)**

|  |  |
| --- | --- |
| **Load** or **Work** | joules |
| **Distance** |  |
| **Time** |  |
| **Watts** |  |

**Formulas:**

Work Space for Calculations

**Work= Force x Distance**

Work = F\_\_\_\_\_ x D\_\_\_\_\_\_

Work =\_\_\_\_\_\_\_\_\_joules

**Conclusion:**

Our windmill produced\_\_\_\_\_\_\_\_\_watts of power. We would need \_\_\_\_\_\_\_\_\_\_windmills to power a toaster! (hint: divide the toaster’s watts needed by the amount of Power your windmill produces).

**Part2 of this experiment:**

Make a modification to your windmill to create more power!

**Power= work/time**

Power=work\_\_\_\_\_/time\_\_\_\_

Power=\_\_\_\_\_\_\_\_\_watts

**Comic Book Story Collector Template:**

**Record your group’s story as you go:**

Name:

Table Group:

Setting (describe where the action of your story takes place)

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Characters (list and describe the people in your group)

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Problem (What problem needs to be solved)

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Rising Action (What steps are taken to try to solve the problem)

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Climax (Will the problem be solved???)

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Resolution (How was the problem solved, or not!)

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Sketch your Windmill here:

**Comic Templates:**

