INSTRUCTOR INFORMATION

Multiply the Power of simpleGEN

Students will use the wind from a fan to spin a home-made generator and generate electricity. They will investigate the effect of added gears on the voltage generated.

ESTIMATED TIME

We estimate that this activity will take about one class period. It is recommended that students perform the experiments "Generate Power with simpleGEN" and "Spin the simpleGEN with Wind" before starting this experiment. Both of these experiments can be found at www.vernier.com/kw-sgen.

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas	Crosscutting Concepts	Science and Engineering Practices
Middle School PS2.B Types of Interactions (MS-PS2) ETS1.B Developing Possible Solutions **High School** PS2.B Types of Interactions (HS-PS2) PS3.A Definitions of Energy (HS-PS3) PS3.C Relationship Between Energy and Forces (HS-PS3)	Patterns Cause and effect Structure and function	Analyzing and interpreting data Constructing Explanations and Designing Solutions Planning and Carrying Out Investigations (in Extension)

EQUIPMENT TIPS

1. A video showing construction of the simpleGEN is available at www.vernier.com/kw-sgen.
2. This activity requires the KidWind Gear Set with Spool (KW-GEAR) available at www.vernier.com/kw-gear.
3. This activity was designed using a digital multimeter, such as that included in the simpleGEN kit. It is possible to measure the voltage generated in this activity with a Vernier Differential Voltage Probe or a Vernier Energy Sensor with a data-collection interface and software.
4. It is helpful to have already built the generators ahead of time, as it can take a full class period alone to do so. This can be accomplished by completing the experiment "Generate Power with simpleGEN" before doing this experiment.

5. It will be helpful for students to have already constructed turbine blades and turbines. This can be accomplished by completing the experiment “Spin the simpleGEN with Wind” before doing this experiment.

6. If available fans have only two speeds, students can omit filling out the “Fan on medium speed” columns of the tables.

DATA COLLECTION AND ANALYSIS TIPS

1. If students do not get a reading from the digital multimeter, they may need to re-sand the ends of the wire so that there is no enamel on the last 2 cm of each wire end.

2. The digital multimeter must be set to measure alternating voltage, as shown in Figure 2.

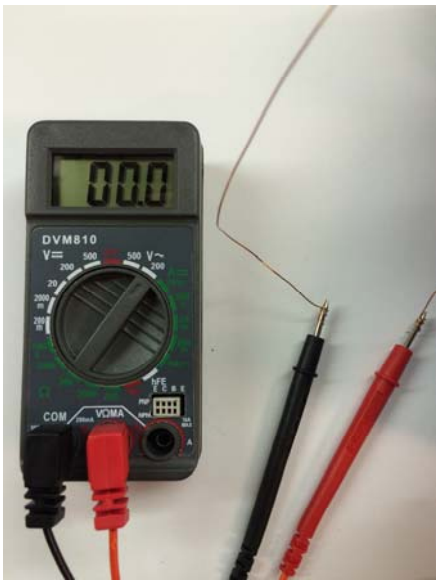

Figure 2

3. If the voltage reading fluctuates, students should watch the values for at least 30 seconds and record the highest value that is repeatedly shown on the multimeter display.

4. The turbine blades may not turn at all when the gears are in use, especially at lower fan settings. This is to be expected and can be used as a teachable moment. A wind turbine has a limit to how low the wind speed can be and have the turbine still spin.

SAMPLE DATA

ANALYSIS

Total number of turns of wire: 150 Number of magnets in holder: 4

Number of blades: 3 Angle of blades: 15°

Length of blades: 18 cm

Part I No Gears

	Fan on low speed	Fan on medium speed	Fan on high speed
Voltage reading (V)	0.7	0.9	1.0

Part II 16-tooth and 32-tooth gears

	Fan on low speed	Fan on medium speed	Fan on high speed
Voltage reading (V)	0.7	1.4	1.9

Part III 16-tooth and 64-tooth gears

	Fan on low speed	Fan on medium speed	Fan on high speed
Voltage reading (V)	Did not turn	2.0	3.1

ANSWERS TO ANALYSIS QUESTIONS

1. Yes, the low and medium fan speeds did not turn the blades. The gears may have made turning the turbine harder to do.
2. More voltage can be generated by combining a gear with more teeth with the 16-tooth gear.
3. The wind speed limits the ability to use gears to increase voltage.
4. The gear ratio in Part II is 2. The gear ratio in Part III is 4. While an increase in gear ratio is correlated with increased voltage generation, there does not seem to be a proportional relationship.