GRID & SILICON

Parent / teacher guide

Gas Turbines: From Hot Gas to Electricity

Word help: gridandsilicon.com/glossary/

Quick answer key

Time: about 30–40 minutes. **Materials:** Pencil, student sheet and explainer; extension materials are listed below.

- I can trace energy through gas turbines.
- I can use the model to explain a new situation.
- I can explain one limit or tradeoff.

NGSS connections: 4-PS3-2: energy transfer by heat and electrical currents (concept connection). 4-PS3-4: devices converting energy between forms (concept connection; lesson alone does not meet the full design expectation). These are partial teaching connections, not certification.

Warm-up: 1. Compressor · 2. Shaft

Multiple choice: 1. C · 2. B · 3. A · 4. C · 5. C · 6. A · 7. A · 8. B · 9. B

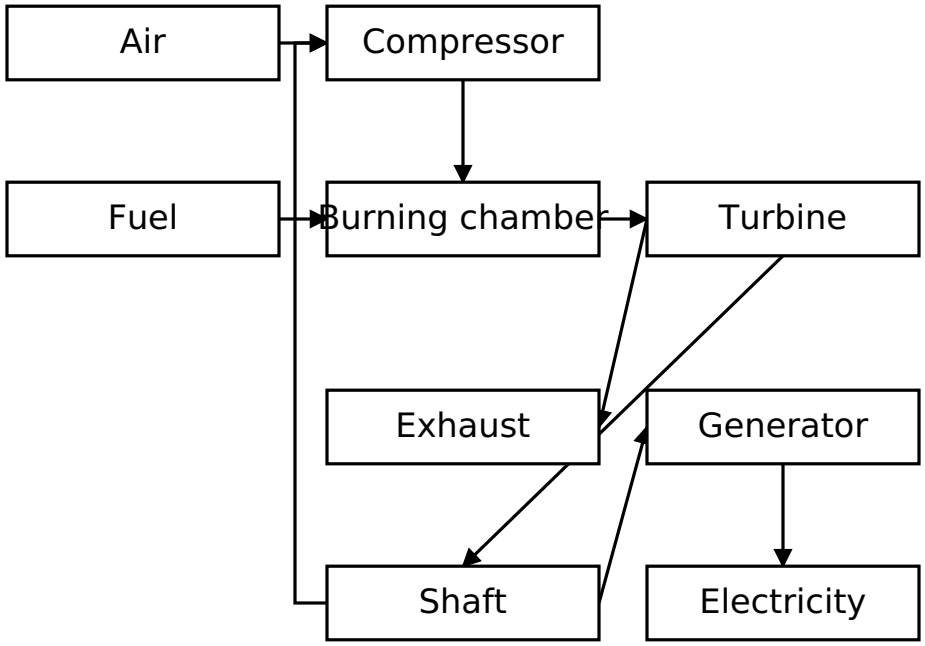
Fill-in: compressor · shaft · generator

Diagram labels, by number: 1. Air · 2. Compressor · 3. Fuel · 4. Burning chamber · 5. Turbine · 6. Generator · 7. Electricity · 8. Exhaust · 9. Shaft

Open responses: accept a clear link between the example and the technology. See the samples below.

The big idea

A gas turbine uses fuel and air to produce a hot gas stream. That gas pushes blades and makes them turn. The movement drives a generator, which changes motion into electrical energy. Some energy leaves as heat, so not all fuel energy becomes useful electricity.



Words to know

compressor: A compressor draws in air and raises its pressure. Like a bicycle pump squeezing air. · shaft: A shaft is a turning rod that connects parts of a machine. Like a rod joining turning parts so movement can pass between them. · generator: A generator changes movement into electrical energy. Like a converter between motion and electrical energy. · exhaust: Hot exhaust, meaning gas leaving the turbine, carries heat away. Like the outgoing stream after a machine has used a flow.

Question guide

1. Which machine uses hot gas to produce rotating motion?

C. Gas turbine. One machine turns blades; another uses a chemical reaction directly.

> **Evidence:** "A gas turbine uses hot, moving gas to turn blades."

Other choices: A: Fuel cells make electricity through chemistry without turbine blades. B: Battery cells deliver stored energy rather than rotating blades.

If stuck: One machine turns blades; another uses a chemical reaction directly.

2. A plant needs air at higher pressure before burning. Which part does that job?

B. Compressor. Follow incoming air before the burning stage.

> **Evidence:** "A compressor draws in air and raises its pressure."

Other choices: A: Exhaust leaves the turbine rather than pressurizing intake air. C: A generator converts motion rather than squeezing air.

If stuck: Follow incoming air before the burning stage.

3. Fuel meets compressed air in which part?

A. Combustion chamber. Find the controlled burning step.

> **Evidence:** "The combustion chamber is the part where fuel mixes with air and burns."

Other choices: B: The generator receives motion, not fuel for burning. C: Exhaust is downstream of the burning chamber.

If stuck: Find the controlled burning step.

4. The hot gas stream weakens. What directly loses its driving push?

C. Turbine blades. Trace the gas to the part it pushes.

> **Evidence:** "The hot gas pushes blades and makes them spin."

Other choices: A: The question concerns blade drive, not intake temperature. B: The gas directly pushes blades, not the fuel supply pressure.

If stuck: Trace the gas to the part it pushes.

5. The compressor and generator turn with the turbine. What transfers that motion?

C. Shaft. Separate a solid mechanical connection from flowing gas.

> **Evidence:** "A shaft is a turning rod that connects parts of a machine."

Other choices: A: An exhaust duct carries gas rather than shaft rotation. B: A fuel pipe carries fuel rather than turning motion.

If stuck: Separate a solid mechanical connection from flowing gas.

6. A spinning shaft must supply a computer with electrical energy. Which part converts the motion?

A. Generator. Match the output needed with each part's job.

> **Evidence:** "A generator changes movement into electrical energy."

Other choices: B: The chamber creates hot gas rather than electrical output. C: The compressor squeezes air rather than generating electricity.

If stuck: Match the output needed with each part's job.

7. Hot gas leaves after pushing the blades. What is that outgoing flow called?

A. Exhaust. Distinguish an output from the two inputs.

> **Evidence:** "Hot exhaust, meaning gas leaving the turbine, carries heat away."

Other choices: B: Intake air enters before the burning stage. C: Fuel enters before burning; exhaust leaves afterward.

If stuck: Distinguish an output from the two inputs.

8. A plant captures heat from its exhaust. Why might that help?

B. Some fuel energy still leaves as heat. The exhaust can carry energy after the blades have turned.

> **Evidence:** "Not all fuel energy becomes useful electricity."

Other choices: A: A generator converts energy rather than creating it. C: Exhaust contains heat after work, not simply fresh fuel.

If stuck: The exhaust can carry energy after the blades have turned.

9. An air inlet is blocked while fuel is available. What happens to normal power production?

B. It cannot continue normally. Both air and fuel support the burning step.

> **Evidence:** "If fuel or air cannot reach the burning stage, normal power production cannot continue."

Other choices: A: Fuel also needs air for normal burning. C: A generator cannot supply replacement oxygen.

If stuck: Both air and fuel support the burning step.

Warm-ups, vocabulary and labels

Which part squeezes air before fuel is burned? Compressor. Which connection turns both the compressor and generator? Shaft.

Use the labeled diagram to check each numbered blank. Arrows show the path; a return arrow brings liquid back, while the shaft carries turning motion.

1. compressor — A compressor raises incoming air pressure.

2. shaft — A shaft transfers turning motion between machine parts.

3. generator — A generator changes movement into electrical energy.

Think about it: sample answers

You blow on a pinwheel. Which part of a gas turbine works in a similar way? Moving air pushes the pinwheel, like moving hot gas pushes turbine blades.

A hair dryer produces warm moving air. Which turbine energy steps does that remind you of, and what extra part makes electricity? The dryer moves and heats air. A turbine also uses hot moving gas, then turns a shaft and generator to make electricity.

Look for a correct connection to the new situation, not a memorized sentence.

Common mix-ups

- A compressor raises incoming air pressure.
- A shaft transfers turning motion between machine parts.
- A generator changes movement into electrical energy.
- Gas turbines use fuel and air, and some energy leaves as exhaust heat.
- A diagram is a simplified model, not a construction plan.

Exit ticket

1. Name one input and one output.
2. Explain what one part does.
3. Predict what changes if a needed input stops.

Check for a valid input/output, the correct job of a named part, and a prediction that follows the energy path.

How to help

Read aloud, pause after one section, and allow a look back at the model. Praise a useful strategy. If frustration grows, take a break and resume with one manageable step.

Safe at-home extension

With an adult, make a paper pinwheel and blow gently on it. Compare the push from moving air with a turbine blade. Keep away from fans, flames and power equipment.