WONDERS OF ENERGY

Grades 7-8

STUDENT JOURNAL

This journal belongs to:

THE GOOD AND THE BEAUTIFUL

INSTRUCTIONS

This student journal accompanies *The Good and the Beautiful Wonders of Energy* science unit. It contains all the activity and journal pages that are needed to complete the unit. Each student will need a copy of the science journal.

The lesson extensions are also found here. These extensions are optional for older students (grades 7–8) to complete on their own. Each extension is accompanied by lined paper so the student can keep his or her work in one place.

Have each student spend enough time to create high-quality work as the activities and worksheets are completed. Students may enjoy looking back on their past discoveries after they've finished.

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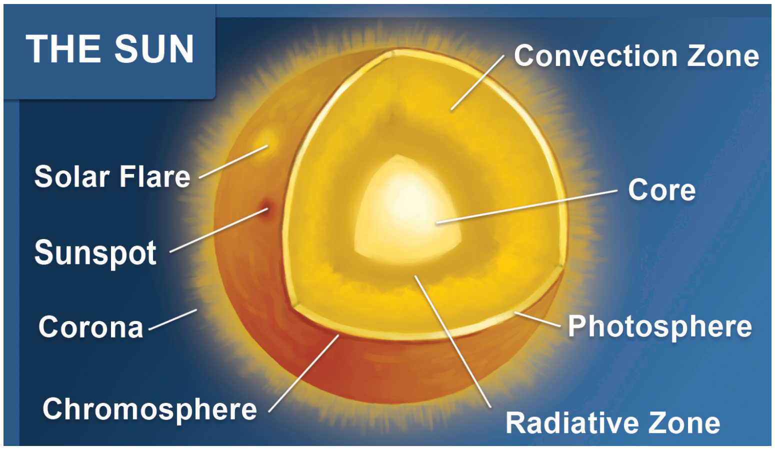
EXTENSION

Instructions:

1. On the blank page, draw an image of the sun like the one below.
2. Read the article and use the information to label the parts of the sun you drew on your journal page. Write one fact about each layer below its label. You may enhance your picture with color and other graphics if you wish.

Earth's Energy-Producing Star



Energy is a part of everything we do each day, and that energy ultimately comes from the sun. Our sun is known as a yellow dwarf star. It is about 1.4 million km (860,000 mi) in diameter. This giant star makes energy on Earth possible.

The sun's energy output begins in the ***core***. The center of the core is about 15 million °C (28 million °F). Energy is released when four hydrogen atoms in the core join to create a helium atom. This is called nuclear fusion.

The released energy then travels to the ***radiative zone***. This layer is made of a dense plasma that causes the radiation to bounce around in a zigzag path for a very long time until it reaches the next layer.

This layer is called the ***convection zone***. Cooler temperatures in the convection zone make the plasma too thick for radiation to pass through; so instead, large bubbles of hot plasma form and move up to the surface of the sun, much like a pot of boiling water.

The visible surface of the sun is called the ***photosphere***, and it's about 5,500 °C (10,000 °F).

Just above the photosphere is the ***chromosphere***, which is part of the atmosphere of the sun. It looks like it glows red in certain light. There is a transition region between the chromosphere and the next layer, the ***corona***, where the temperature drastically increases within a short distance. The corona is made of hot plasma that's even hotter than the surface of the sun at over 1 million °C (1.8 million °F). Scientists are still not sure why this solar atmosphere gets so hot when it is farther from the sun. You can see the corona only during a total solar eclipse or with a special tool called a coronagraph. Past the corona, the sun's electromagnetic waves travel to the earth at light speed—299,792 km (186,282 mi) per second.

SOLAR Fun Facts

- The sun is an almost perfect sphere with only a 10 km (6.2 mi) difference between the diameter at the poles and the equator. It is the closest thing to a perfect sphere that has been found in nature.
- The sun appears white to our eyes because it has all the colors of the visible light spectrum mixed together.
- The distance from the sun to Earth changes throughout the year because Earth travels on an elliptical orbit around the sun. The distance between the two bodies varies from 147 to 152 million km (91 to 94 million mi).
- The sun generates ***solar wind***, which is a flow of extremely fast-moving particles (about 450 km [280 mi] per second) through the solar system.
- The sun has a strong magnetic field, and when its energy is intensified, areas of cooler temperatures, called ***sunspots***, are created, as well as ***solar flares*** that spin like giant tornadoes. Very large solar flares are called coronal mass ejections.

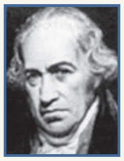
Lesson 3 | Grades 7-8

EXTENSION

Instructions:

1. Read the information below.
2. Write at least one fact about each inventor.
3. Calculate the following, using a calculator if desired. Determine if each temperature is hot or cold. 25 °C = _____ °F   327 K = _____ °C   10 °F = _____ °C

Inventors of the Modern Temperature Scales

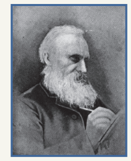


Daniel Gabriel Fahrenheit

Fahrenheit, a German physicist, invented the temperature scale that bears his name in 1724 after designing the first alcohol and mercury thermometers. The scale was based on three fixed temperatures: body temperature; the melting point of ice; and the freezing point of equal parts water, ice, and salt, which he gave the value of 0° F. He thought his scale would make things mathematically simpler, but the numbers had to be tweaked to work out right. He ended up with 32° F as the freezing point of water and 212° F as the boiling point of water. Using a Fahrenheit scale, there are exactly 180 degrees between the freezing temperature and boiling temperature of water.

Anders Celsius

Celsius was a Swedish astronomer who created the Celsius scale in 1742. People first called the scale centigrade (meaning "hundred steps"), but it was renamed to Celsius after being confused with other mathematical measurements, such as centimeters. Celsius wanted a scale that simplified the boiling and melting points of water and avoided using negative numbers or fractions as much as possible. When he first invented his scale, the boiling point of water was set at 0° C, and the freezing point was 100° C. Somewhere along the line, the two measurements were switched, and now we use 0° C as the freezing point of water and 100° C as the boiling point of water.



Lord William Thomson Kelvin

Kelvin was a British scientist who invented his scale in 1848 as a means of measuring the extremes of hot and cold. Zero on the Kelvin scale is called ***absolute zero*** and is equal to -273.15 °C. Scientists believed that the volume of a purely theoretical ideal gas would become zero at this temperature. This is only a theory though, as a gas has never reached absolute zero before becoming a liquid or solid. The Kelvin scale helps scientists make calculations with an absolute zero starting point. Like the Celsius scale, there are 100 kelvins between the temperatures of boiling and freezing water. The symbol for kelvin is K and does not use a degree sign.

Did you know?

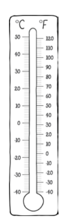
Many English-speaking countries used the Fahrenheit scale until they converted to the metric system, including the Celsius scale, in the 1970s. The United States is one of the few countries that does not use the metric system and still uses the Fahrenheit scale. Scientists mostly use the Kelvin scale because the numbers are always positive, and it is easy to convert to and from Celsius degrees—simply add or subtract 273.15.

Converting Between Scales

Celsius and Fahrenheit

$°C = (°F - 32)/1.8$

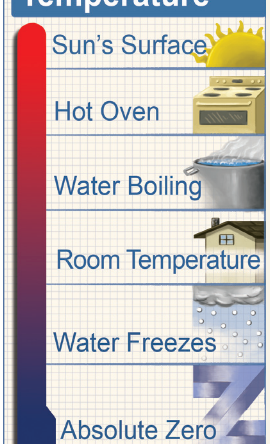
$°F = °C \times 1.8 + 32$



Celsius and Kelvin

$K = °C + 273.15$

$°C = K - 273.15$



Temperature	°C	°F	K
Sun's Surface	5,503	9,937	5,576
Hot Oven	232	450	505
Water Boiling	100	212	373
Room Temperature	22	72	295
Water Freezes	0	32	273
Absolute Zero	–273	–460	0

ART STUDY

"A Raging Waterfall, Laatefossen in Hardanger, Norway"
by Vilhelm Melbye (1824–1882), 1863

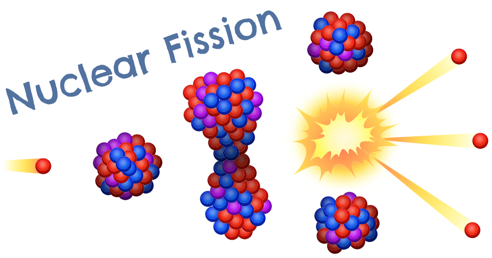
EXTENSION

Instructions:

1. Read the information below.
2. Draw a copy of the nuclear fission diagram, and then explain below your drawing what is happening in it.
3. Write one reason nuclear power is useful and one way it is dangerous.

Nuclear Power

Nuclear energy is a very efficient form of power that generates a large amount of electricity. Power plants produce this energy through a process called nuclear fission. Look at the picture below to see the process.



Often, uranium atoms are split when they are hit by a neutron. The small red ball in the image above is a neutron. The first big ball it hits represents a uranium atom. When the neutron hits the atom, it releases heat and radiation and creates more neutrons that spread out from the original. In nuclear power plants, this process is used to produce heat, which is then combined with water to produce steam. The steam is then used to generate electricity for household and industrial use.

While nuclear power generates electricity that we need, it is not without its challenges. Nuclear power plants produce radioactive waste, which comes mainly from uranium fuel that has been used but no longer produces electricity. This dangerous waste sends out radioactive emissions and must be carefully stored until the emissions stop. Radioactive emissions come from atoms wanting to emit extra energy, and that kind of energy can cause humans to get sick. Normally, the radioactive waste is kept at the nuclear power plant where it was made, but if a nuclear power plant is shut down, the radioactive waste has to be safely disposed of as well. This process can take many years to complete.

Nuclear power plants have many safety systems and security procedures in place that are closely monitored by the Nuclear Regulatory Commission (NRC). A single accident at a nuclear power plant can be devastating. If dangerous radiation levels are released over an area, it can cause widespread damage and contamination to the surrounding people, buildings, food and water supply, and livestock.

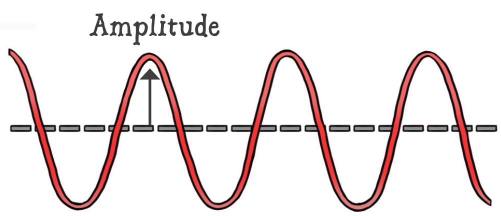
Chernobyl

When: April 1986
Where: Pripyat, Ukraine

Considered the world's worst nuclear disaster, the Chernobyl nuclear disaster occurred on April 26, 1986. Before the accident, the Chernobyl nuclear power plant had scheduled a planned power reduction. By midmorning the power level at the plant had reduced to 50%, at which time one of the power stations in the region unexpectedly lost communication. It was then requested that any further power reduction within the plant be put on hold. However, despite this request, the power reduction and preparations for an accompanying test continued. The accident occurred when one of the nuclear reactors had a sudden power surge that resulted in an explosion and fire. This caused massive amounts of radioactive fallout (fuel and other materials) to be released into the environment, which spread across the western Soviet Union and Europe. It is estimated that 30–50 people died as an immediate result of the Chernobyl nuclear disaster, but it is predicted that up to 4,000 more might eventually die from the long-lasting effects of radiation exposure.

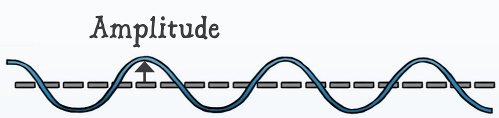
SOUND WAVES

Write at least three examples of each type of sound in real life.



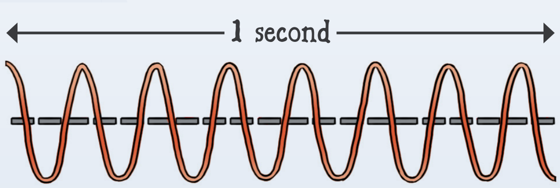
High Amplitude - Loud Sound

1. ____________________
2. ____________________
3. ____________________



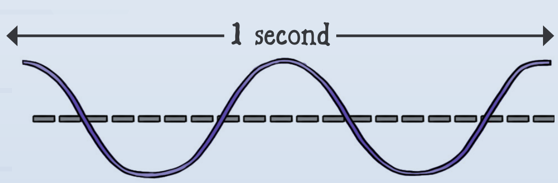
Low Amplitude - Quiet Sound

1. ____________________
2. ____________________
3. ____________________



High Frequency - High Pitch - High Sound

1. ____________________
2. ____________________
3. ____________________



Low Frequency - Low Pitch - Low Sound

1. ____________________
2. ____________________
3. ____________________

EXTENSION

Instructions:

1. Read the information below.
2. Follow the directions to calculate energy usage for 3–4 appliances from the example.
3. If desired, calculate energy usage for 2–3 appliances in your own home, using the directions in the right-hand column of the article.

Electricity Use Case Study

Electricity is really fascinating to learn about, but what does it mean to you directly? During this research assignment, you will see just how many ways you use electricity in your daily life and how much electrical energy you consume. Today you will figure out how much power is used by various appliances in a household by following the directions below.

1. Choose three or four appliances from the samples below.
2. Record the usage in watts (W) or multiply volts times amps (V × A) to get the wattage.
3. Then estimate how many hours you might use the appliance per day in your home (use decimal points if less than an hour).

Refrigerator	500 watts
Hair Dryer	120 volts x 12.5 amps
Washing Machine	2,200 watts
Dishwasher	220 volts x 10 amps
Television	58 watts

Optional: Now, let's figure out how much you pay for having electrical conveniences in your home. Get out your calculator, because science and math go hand in hand.

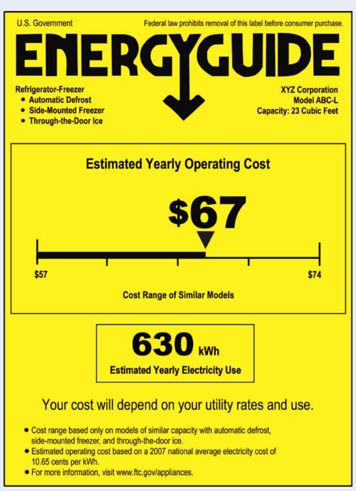
1. Find out how much you would pay per unit of energy by looking at the sample electric bill. This will be in kilowatt-hours (kWh).
2. Using the previously chosen appliances to the left, multiply the appliance's wattage (found during the last section) by the number of hours it is used in a day, and then divide by 1,000. This will give you the total number of kilowatt-hours used in a day.
3. Multiply the kilowatt-hours by your cost per kWh. This is your cost per day for using that appliance.
4. To calculate your cost per month, multiply your cost per day by the number of days that you typically use the appliance in a month.
5. To calculate your cost per year, multiply your monthly cost by 12.

Did you know?

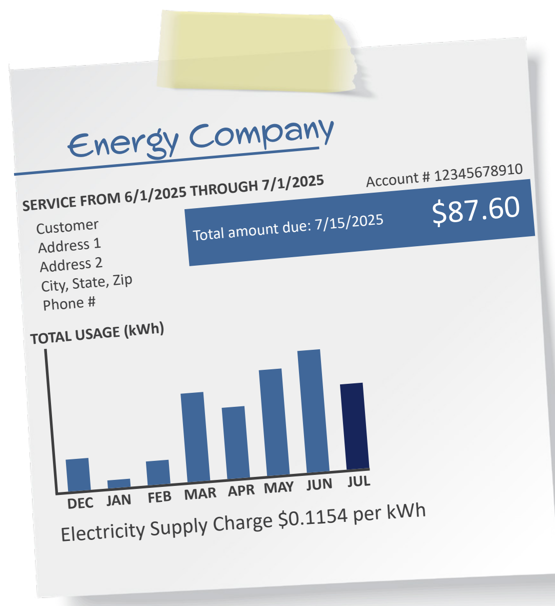
Your refrigerator accounts for an average of 13% of your monthly electric bill.

Did you know?

Appliance stores have yellow EnergyGuide labels because people want to know how much energy an appliance uses, how it compares to similar appliances, and about how much per year it costs to use.



Source: consumer.ftc.gov



Lesson 10 | Grades 7-8

EXTENSION

Instructions:

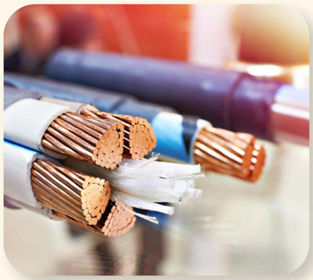
1. Read the information below.
2. Copy the information from the left column and list one example of each.
3. Explain how the discovery of semiconductors has impacted your life.

Conductors

» Materials that heat or electricity can pass through without difficulty

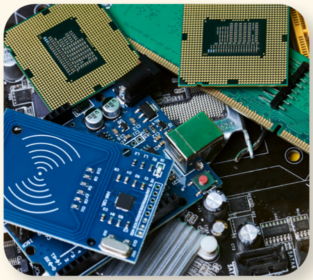
Insulators

» Materials that heat or electricity cannot pass through easily



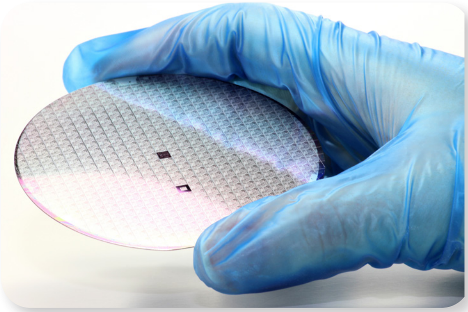
Semiconductors

» Materials that heat or electricity can sometimes pass through easily, but other times cannot



Semiconductors: The Key to Modern Technology

We have learned about conductors and insulators of both heat energy and electricity, but there is actually another category of materials that exists. These materials do not conduct energy as well as metals, though sometimes they can be conductive. Read the section to the left to learn more. Semiconductors are considerably more conductive than insulators, but sometimes they act as insulators as well. These are called ***semiconductive materials***, and they have transformed technology as we know it.



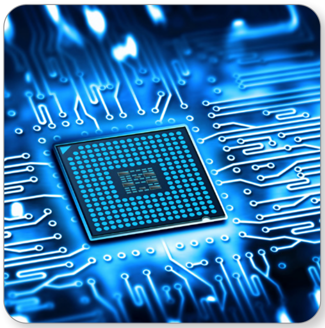
Silicon is the most common semiconductive material and the most important material in creating today's electronics, so we will focus on this element. There are other materials that could work better as semiconductors. However, those materials are expensive, and silicon is inexpensive and abundant, so using it makes electronics more affordable.

You may have heard the term "Silicon Valley," which refers to the area in California, USA, where a lot of technology companies launch their products and have their headquarters. There is a search across the world for even better materials that can be used in electronics.

Semiconductive materials like silicon can be altered to function like a kind of switch that controls the conduction of energy. Through the use of electrical fields, silicon can be switched on to act as a conductor like a metal or switched off to act as an insulator like glass. Semiconductors are able to do this at room temperature, while other materials need temperature extremes, and still others cannot work as a switch at all. With the discovery of the ability to control electrical flow through computer processors with silicon, a new world of information transfer opened and introduced important computer components such as transistors, memory chips, computer processors, and many other electronic components. Silicon is also used in the integrated circuits found in cell phones, computers, scanners, DVD players, and LED lights. Without silicon, communication as we know it would not be possible.

A computer chip is a pure silicon plate with impurities inserted into it at strategic points. Chips are created in super-clean facilities by people wearing full-body suits and gloves to avoid contaminating these chips—even a microscopic flaw like a tiny bit of dust could make the chip malfunction. Added to this silicon plate are transistors and gates that tell electricity where to go and what to do.

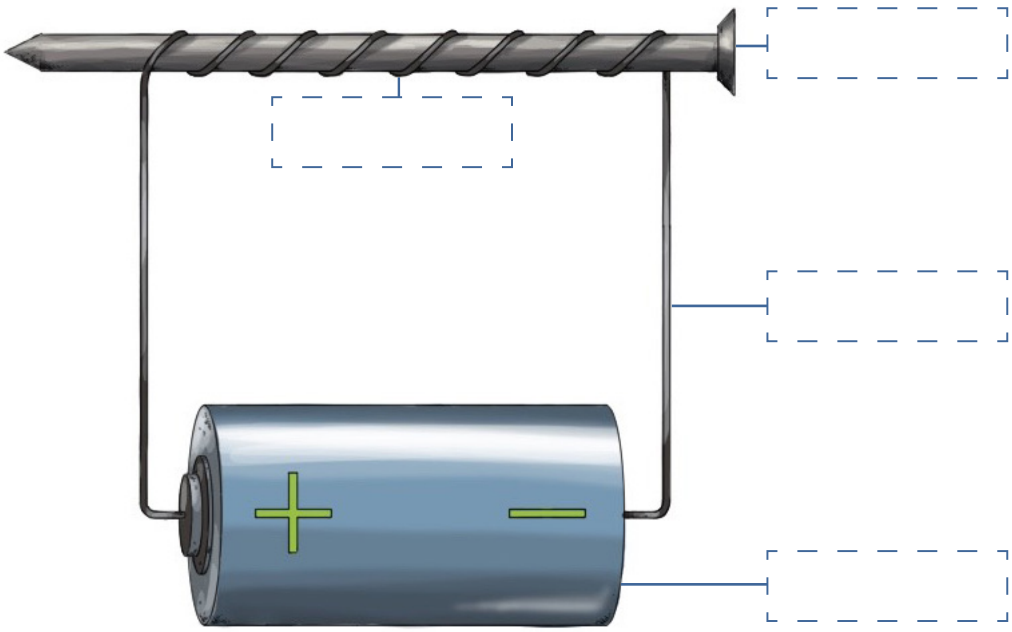
It is an extremely complex process, but it all rests on the ability of silicon to alternate between conducting and insulating. Today's electronics would not exist without semiconductors.



ELECTROMAGNET ACTIVITY

Label the parts of the electromagnet using the word bank to the right.

SIMPLE ELECTROMAGNET



WORD BANK

Coiled wire

Battery

Iron nail

Wire

Reconfigure your electromagnet by changing the number of times you wrap the wire around the nail. Circle the number of wraps around the nail you predict will pick up the most. See how many paper clips or safety pins each configuration will actually pick up. Record your results below.

Coils wrapped around nail	Paper clips or safety pins picked up
30	
5	
45	
10	

How many wraps of the wire picked up the most paper clips or safety pins? Why do you think that happened? Explain why below.

EXTENSION

Instructions:

1. Read the information below.
2. Describe each type of home listed and how it conserves energy.
3. Pick one type of home you would enjoy living in and explain why.

Homes Around the World and Building Off-Grid

Does the type of home we build affect our conservation of energy? Yes. Homes around the world leave different imprints depending on what materials they are made of, how well they insulate heat, and how often they will need repairs. Let's take a tour of homes that have been built around the world and see how homes have been adapted to better conserve energy and suit the local people.

Northern Africa: Ancient cave homes have been carved out of rock to keep their dwellers out of the hot African sun and strong desert winds. These homes are carved into the rock, so they are naturally well insulated, causing them to stay cooler in summer and warmer in winter when the outside temperatures are a stark contrast to what would be comfortable inside. Homes farther south called rondavels are built as round, single-cell huts from local sources of natural material, such as rock and grass. These dwellings are still popular today.

Southwest Asia: Here, you can find whole communities of houses built on stilts. This building technique is due to high rainfall and flooding. It also protects inhabitants from common invaders, such as snakes! Well-slanted rooflines allow heavy rains to run off, which would otherwise cause damage and utilize more resources to repair if not designed with this purpose in mind.

Korea: A *hanok* house is a traditional Korean-built home that was culturally designed with a river in the front and a mountain in the back. Even the seasons were evaluated in the planning of these structures, so the houses use less energy to heat and cool them. As with the other homes listed at left, the building materials were heavily influenced by what was available locally.

Construction has become an ever-expanding industry. New designs that can be quickly replicated have been made to make construction more cost effective, but that doesn't always mean these homes are cheaper in the long run. Using technology to plan both residential and commercial properties, researchers continually examine what types of building materials, as well as sources of energy, can be used to supply our modern need for housing while considering the cost of maintaining our comfort in these homes long term. Individuals also look at how to source their building supplies locally and consider methods of building that pay off in the long run.

One example of energy conservation that can be used on existing or new homes is solar panels. Solar panels can be installed on the roofs of existing homes and even supplement the energy they are already consuming from local energy companies. Even modern homes can be sustained fully off-grid, meaning they don't use any energy outside of what they can collect themselves from sources like the sun, wind, and moving water like a stream or creek. With solar panels and batteries to hold the charge or wind and watermills, these options make excellent sources of renewable energy depending on location and environment. It is exciting to see how this industry continues to grow, making alternate forms of electricity available in the future.

Scripture points us to counting the cost with our resources and plans. Whether we are building a home or executing our school assignments, counting the cost will give us an understanding of what it takes to be efficient in the long run!

Luke 14:28

"For which of you, intending to build a tower, sitteth not down first, and counteth the cost . . ."