Kinetic City

Mission to Vearth

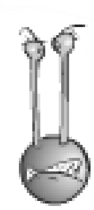
LEADER GUIDE

PHI PACK

warper

terrora

fragg



voltra

Kinetic City Leader Guide Information Sheet

Club Name: ______________________________

	Codename	Password

Crew 1 Name: ______________________________

	Codename	Password
1:		
2:		
3:		
4:		
5:		

Crew 2 Name: ______________________________

	Codename	Password
1:		
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Crew 3 Name: ______________________________

	Codename	Password
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Crew 4 Name: ______________________________

	Codename	Password
1:		
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Crew 5 Name: ______________________________

	Codename	Password
1:		
2:		
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4:		
5:		

Dear *Kinetic City* Leader:

It's not every day that you and your after school program get to save a Universe. But that's what you and other *Kinetic City* clubs around the world will be doing with ***Kinetic City: Mission to Vearth***.

Is this an awesome responsibility? Well, sure. But it's also lots of fun.

In each two-week mission, you and your kids will perform five exciting activities focused on a single area of science. Then, using what they've learned, your kids will play an on-line *Mission to Vearth* game to earn ***Kinetic City Power Points*** for your Club.

These *Kinetic City Power Points* help protect Planet Vearth from the nasty Deep Delete virus. They will also appear on your Club Web Site, showing the world what you've accomplished.

Please don't worry if you are not a computer whiz, or a science whiz. The activities in this box should be fun and easy for you and your kids to do. Most of them can be done away from the computer.

In this Leader Guide, you will find instructions on how to get started with *Kinetic City*, including how to register your Club and set up your Club Web Site. There are also overviews of the four missions in this box, including copies of the five activities that correspond to each mission. If you need more copies of these activity pages, you can photocopy them or print them out from the website.

If for some reason your Club is unable to go to the *Kinetic City* website, simply use the paper copies of the activities in this Leader Guide. Again, most *Kinetic City* activities do not require a computer.

Thank you so much for participating in ***Kinetic City: Mission to Vearth***. We hope you and your children enjoy following the adventures of the Super Crew, and helping them defeat Deep Delete.

Who would've thought that saving a Universe could be so much fun?

Sincerely,

Bob Hirshon
Executive Producer
Kinetic City: Mission to Vearth

Getting Started with Kinetic City: Mission to Vearth

The following steps are recommended to help your kids get the most they can out of ***Kinetic City: Mission to Vearth.***

As always, we encourage and look forward to your comments and suggestions!

Getting Started

The very first thing to do is introduce your kids to Kinetic City. Explain to them that they are about to play a new kind of interactive story-game on the Internet called ***Kinetic City: Mission to Vearth.*** In this game, there is a virtual world named Vearth that desperately needs their help to survive.

After this brief explanation, give each student a copy of the Urgent Letter from the Super Crew. The letter describes the situation the Super Crew are in, and why they need "Actual" kids to help them. You may also wish to read the letter aloud. Emphasize to the kids that the future of Vearth depends on their heroic efforts!

Next, give each child a copy of the Letter to Parents and consent forms. This letter will let the children's parents know that their kids will be participating in a new science program; that the children will be working on the Internet; and, most importantly, that they may be posting work to their own Kinetic City Club website. It is up to the Club to decide if their website will include a team picture or other photographs of the children. While the children are completely anonymous on the site, and while parents rarely object to having their kids' picture in their town newspaper (which is often also posted online), they still may be uncomfortable with this idea. Please do not include photos if parents object or do not return the form at all.

The next step is to pass out the Kinetic City backpack tags and ID cards. Once your Club has a name, and the children log on and register, the kids can write their code names on their cards and keep them in their backpack tags. Of course, these tags can be put on anything, from a book bag to a notebook, if they don't wish to have them on backpacks.

Now, pass out the Kinetic City Case Journals and let the kids know they'll be sent on a new mission every two weeks. They should know that they will play an important role in the ***Kinetic City: Mission to Vearth*** story.

Names and Passwords

Fill in all your names and passwords on the form on the inside front cover of this Leader Guide.

Your first job is to name your official Kinetic City Club, and divide it up into five groups called "Crews." Have the kids spend some time coming up with a fun name for their Club. Pick something that does not identify exactly where you are (in other words, you can call yourselves the New York Brainiacs, but not the New York P.S. 138 Brainiacs). Once your entire Kinetic City Club has a name, have the children break up into five groups of roughly equal members to form the Crews. Have the Crews spend a few minutes coming up with a good name for their group. Let them know that this name will appear on their Crew's home page on the Web, and will be the name by which other players from all over the world will know them.

Finally, the children will have to make up names and passwords for themselves. They should not use their own names, or other personally identifiable information. Animal names are fine (tiger, eagle, froggie), or inanimate objects (scooter, puppet, cookie), or famous characters (merlin, ariel, batman, anastasia) or even words they make up (freegle, blotz, morpholog). Their passwords should be hard to guess but easy for them to remember.

The reason they have codenames and passwords is that they will be playing games on the computer, and we need to keep track of their scores. That way, they can log on from any computer in the world and play to improve their score or look at new challenges. We don't know any of the children's identities – just the made-up names and passwords.

When they log in, the children have the opportunity to enter an email address. The only reason we give them this option is so that we can remind them of their password if they forget it. Otherwise, they'd have to start over with a new name and password, and they'd lose their points. Again, we don't use these emails for any marketing purposes, nor allow anyone else to use them. And they do not have to supply this information to play.

Going Online

To participate in Kinetic City online, you will need an Internet-connected computer with a browser (preferably **Internet Explorer**) and a free plug-in called **Flash.** (To download Flash, go to **http:// www.macromedia.com/downloads** and click on "Macromedia Flash Player")

A fast Internet connection will make the wait times shorter. If you have a slower connection (for example, one that dials over a phone line), it would be a good idea to open each Kinetic City page once before the children arrive. After your computer opens a page once, it will probably save it to its memory, and it will open faster when the kids go back to it.

Once all of the kids are in Crews and the Club name is set, go online to **http://www.kineticcity.com** and have the kids register individually at the Join page. Each child will be asked to choose a code name and password. They should pick a name other than their own so no one will know who they are. It can be funny or silly, but it can't be suggestive or obscene. Once they have a code name, they should create a password that is easy for them to remember, but not easy enough for everyone else to guess. If the kids are worried about forgetting their code names and passwords, they can write them in their Case Journals. Again, if they supply their email address, we will email them their password if they forget it.

Getting Familiar With the Site

Once the kids are at the site they can learn a little more about the Super Crew characters. Have them explore the Home Page and the Control Car especially. If you like, any of the pages on the site can be printed out and copied for the children.

Once your children are familiar with ***Kinetic City***, you're ready to get started!

Making your Club web site

Please go to **http://www.kineticcity.com/club-admin** for instructions on how to make your own club website!

Now you're ready to take your Club on its first mission!

Evaluation and Assessment

Kinetic City: Mission To Vearth is, to the best of our knowledge, the only after school program based entirely on national science learning benchmarks, and developed specifically with each of those benchmarks in mind. We are confident that children performing our activities will gain a new understanding of these benchmarks, and be more motivated, confident learners.

Research by independent evaluators backs up this confidence. The full text of this evaluation is available at our www.kcmtv.com website. We will continue to perform these evaluations on randomized groups of *Kinetic City* users, and to post the results on our website.

We also include tools that allow you to assess individual child performance, built into the program. For example, all children record their activity data and results in their *Kinetic City Case Journals*, providing leaders with detailed information on how each child is progressing through the material.

Each Mission in the *Case Journals* begins with topic questions that ask children to think about the topic before they have explored it. This provides a baseline for each mission for each child.

Examining the work sheet for each activity allows leaders to check for participation and assess the conclusions children have drawn from their data. Leaders can look for progress by comparing the children's pre-mission ideas and theories with the conclusions they present after each activity. Leaders can even pose the pre-mission questions again at the conclusion of the mission, and have children discuss what they learned.

In addition, each team is encouraged to report on their activities on their *Kinetic City* Web Page, giving leaders more information on their progress.

Of course, every child plays the *Mission To Vearth* game, which poses ten multiple-choice questions for each mission. By earning *Kinetic City Power Points*, children demonstrate basic understanding of some of the key learning goals in the mission.

By building these assessments into the *Kinetic City* game itself, children record data, draw conclusions, take quizes, etc., without thinking of any of them as "tests." They are all just part of the fun of participating in *Kinetic City*.

In addition, an independent evaluator will be creating and administering more detailed assessments for a subset of several hundred children, the results of which will help us plan and develop the *Kinetic City* program. In addition to the results of this study, we will also make available on our website the same assessment tools used by the evaluator, for Club Leaders who wish to use them.

As an after school program, *Kinetic City* will never replace a well-designed, rigorous, in-school, teacher-led curriculum. That is not our intent.

However, our assessments have shown that children who participate in ***Kinetic City: Mission to Vearth*** quickly out-perform other children on knowledge of standards-based content information, conceptual information and in overall motivation toward science learning.

Overall, we feel that ***Kinetic City: Mission To Vearth*** has been shown to be effective by independent experts more than any other after school program. This is part of an ambitious and rigorous evaluation that will continue and, we hope, expand as we continue to improve and refine *Kinetic City*.

HEEEEELLLLLLPPPPP!!!

Site isn't loading? Game piece missing? Fly in your coffee? Whenever disaster strikes, check www.kcmtv.com to see if your problem is addressed there. Or use our email center to contact us. When all else fails, call our toll-free sales and service line, 1-888-438-5272.

Mission Pack: Phi

In this set of four missions, children will learn about Forces that Shape the Earth, The Earth, Systems and Harnessing Power.

For **Warper** ("Forces the Shape the Earth"), the main idea is that the earth is constantly changing, sometimes quickly, and sometimes so slowly that you can't even see it. *Kinetic City* activities let children play with these forces and predict their effects. The Move Crew is a card game that will familiarize them with the processes involved in an erupting volcano. We also have them write about the "lives" of geological phenomena, like mountains. These exercises help the kids understand that even rocks, canyons and mountains change over time.

In **Terrora** ("The Earth"), children expand their knowledge of our planet to include natural forces like gravity and air pressure, and cycles like day and night. The important concept in the Fab Lab is that air has substance. It's not just a lot of "nothing." With cups, water, newspaper and rulers, kids discover for themselves the properties of air. In the Move Crew, they'll learn how the rotating earth causes day and night. The Smart Art and Write Away both deal with the water cycle. And the Mind Game gives kids a feel for gravity.

In **Fragg** ("Systems"), children expand what they learned about earth's cycles into a greater understanding of systems. What does it mean to say that something is a "system?" What happens when one part of a system is lost or broken? Those are the themes of this mission. Children will build a virtual system in the Mind Game, and then start removing pieces. In the Fab Lab, they learn about a different kind of system: the hand. How do the parts of the hand work together as a system? Finally, the Move Crew asks the question, can a team be a system?

Finally, in **Voltra** ("Harnessing Power") we look at an abstract concept: power. What is a machine and how does it use power? How can one sort of power be changed to another sort? And how did the ability to harness power change the world?

While this concept is generally taught to older kids (grades 6 through 8), we let younger children play with it to get an intuitive feel, even before they learn the actual physics involved in later grades.

The actiivities for Voltra include a card game that shows children how the ability to harness and redirect power has changed society, and a computer simulation that lets them take a power source and try to accomplish a task with it. In the Write Away, they write about an imaginary city that has just one source of power, and how the people living there manage.

Overall, these four missions help children with some important and profound scientific concepts. By the end of Mission Pack: Phi, we hope all children participating will have at least a basic grasp of these concepts and feel interested and confident enough in their knowledge to want to learn more.

Mission Overview: Warper

This two-week Mission is about processes that shape the Earth: from cataclysmic events like earthquakes and volcanic eruptions, to slower processes like erosion and continental drift. The main lesson of this unit is that the Earth's surface is constantly changing, and that even structures that we think of as permanent (like mountains and rivers) change drastically over very long periods of time.

The activities for this mission include: **Shape It Up!,** an online time-lapse erosion game; **Reunite Pangaea,** an activity about continental drift; **Volcano Baseball,** a game modeled after the stages of a volcanic eruption; **Mountain Mash,** in which students use clay to model mountain formation; and **When I Was Your Age,** a writing exercise that encourages students to think of inanimate geological features as constantly changing.

The Project 2061 Benchmarks for Science Literacy

4C. The Physical Setting, Processes that Shape the Earth

By the end of 5th grade, students should know that:

1. Waves, wind, water, and ice shape and reshape the earth's land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers.

2. Rock is composed of different combinations of minerals. Smaller rocks come from the breakage and weathering of bedrock and larger rocks. Soil is made partly from weathered rock, partly from plant remains and also contains many living organisms.

To learn more, consult these resources:

Books:

Mountains and Our Moving Earth (Geography for Fun)
Robson, Pam. CopperBeech Books: 2001. 32pp. $22.95. ISBN 0761321667.

Shaping the Earth: Erosion
Downs,Sandra. Twenty-First Century Books, 115 West 18th Street, New York, NY 10011: 2000. 64pp. $23.40. 99-045541. ISBN 0761314148.

Dance of the Continents
Gallant,Roy A. Benchmark Books, 99 White Plains Road, Tarrytown, NY 10591-9001: 2000. 80pp. $19.95. 98-28046. ISBN 0-7614-0962-9.

Soil (Simply Science)
Flanagan, Alice K. Compass Point Books: 2000. 32pp. $14.95. 00-008559. ISBN 0756500354.

Web Links:

This Franklin Institute site explores the forces that shape the earth:

http://www.fi.edu/earth/earth.html

A great site that discuss plate tectonics and how they cause earth quakes and volcanoes:

http://www.eduplace.com/kids/sla/6/volcanoes.html

The Web's "Premier Source of Volcano Info". Learn about current eruptions, types of volcanoes and more. A very comprehensive and well done site:

http://volcano.und.nodak.edu/

An informative site created by NASA which explores continental drift and its effect on the globe:

http://kids.earth.nasa.gov/archive/pangaea/index.html

Activity Notes for Leaders: Warper

Mind Game: SHAPE IT UP!

In this game, students are given a picture of a geological formation they need to "make," and then are given various "tools" to make it with. These tools are different forces of nature that help to shape things like canyons, mountains, and so on. Emphasize to the students that time is speeded up incredibly fast in this activity. Normally, the processes they're using would take hundreds of thousands of years to make a big difference!

Fab Lab: REUNITE PANGAEA

This game introduces students to the concept of **continental drift:** the theory that all the continents on Earth were once one giant land mass, which broke apart and gradually drifted over time. Students should notice that the edges of the present-day continents fit together like pieces in a puzzle (indeed, this is how the original theory came about). Students should also be made aware that the continents are still moving today, which can prompt a discussion about where they might end up.

Move Crew: VOLCANO BASEBALL

In this game, students draw and trade cards in order to round four bases and reach an "eruption." The game mirrors the process of a volcanic eruption, which occurs in stages that must build to a certain threshold in order to reach the next stage. The building up of points at each base represents the building up of pressure or other forces at each stage of the eruption process. Rely on the base cards to remind students of the science behind the game.

Smart Art: MOUNTAIN MASH

This is an activity in which students replicate one kind of mountain formation: when two continental plates collide with each other, crumpling the crust of the Earth into jagged mountain shapes. Again, students should understand that this process normally occurs over hundreds of thousands of years. It may be difficult for them to imagine that an impact could have such dramatic effects at such a slow speed, but remind them how massive the plates of the Earth are. The clay is rolled into layers so that students can observe how this process can force deeper layers of crust closer to the surface.

Write Away: WHEN I WAS YOUR AGE...

In this activity, students write about their "youth" from the point of view of some prominent geological formation. Your students will probably have to do some research to write their story. We have provided online links, but library research is also a good tool.

Mountain Mash

Briefing

Ever wonder how mountains are made? Usually, it takes millions of years, so it's not much fun to watch! But in this Smart Art, you'll see how it's done in just a few minutes!

Activity

Most big mountain ranges, including the Himalayas in Asia, the Andes in South America, and the Alps in Europe, are made up of **fold mountains**. Fold mountains are mountains that were formed when the giant plates that make up the Earth smashed together and crumpled up. This happens in super-slow motion over millions of years, but you can speed it up by following these steps!

What You'll Need:
Three colors of modeling clay
Wax paper
A plastic knife

What to Do:
Roll the clay out in rectangular flat sheets on the wax paper, one sheet for each color. Each sheet should be about 10 centimeters wide, 24 centimeters long, and one centimeter thick.

Stack the sheets of clay on top of one another, like you're making lasagna. These layers of clay represent different layers of the Earth's crust. The bottom layer is the oldest rock; the top layer is the newest rock.

Cut the clay in half with the plastic knife. These two stacks of clay represent two continental plates.

Set the two halves down on another sheet of wax paper, so their edges face one another.

SLOWLY push the "continents" together until they collide.

When they crumple together, draw a picture of what you see. Then separate them a little bit and push them together again.

What happened this time? Draw another picture of what you see. Mash them together a few more times until you've got some serious mountains going!

Debriefing

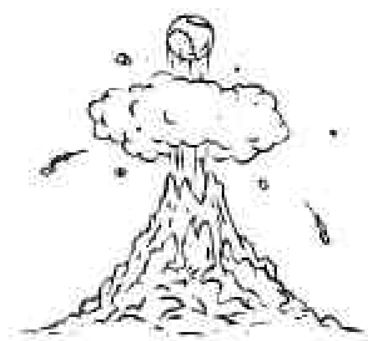
What happened to the edges of the clay when you pushed them together? Did it look like a mountain right away, or did you have to do it over and over again?

What happened to the layers of rock on the edges that smashed into each other? If you found a very old piece of rock on the top of a real mountain, why do you think that would be?

If you've got your Case Journals, answer the questions in it now!

Volcano Baseball

Briefing



Volcanoes are one of nature's most powerful forces. In this activity, the pressure's on as you try to set off a grand-slam eruption!

Activity

What You'll Need:
A set of Volcano Baseball playing cards
Four chairs for bases
Station cards for the bases

How to Play:
In this game, you and your friends are all powerful volcanoes. The object is to be the first to erupt. You do that by rounding four bases, just like in baseball.

Here's the path you'll take:
HOME PLATE: This is where pressure builds up in the hot, liquid rock called **magma**, found deep inside the Earth.

FIRST BASE: Once the pressure's high enough, **carbon dioxide** dissolves into the magma.

SECOND BASE: The magma rises to the surface. As it rises, the pressure drops.

THIRD BASE: Because the pressure drops, the carbon dioxide escapes from the magma as a gas and forms bubbles.

Once enough of these gas bubbles form, the volcano blows its top and you're headed for home!

To play, everyone starts off at home plate. Leave the cards in the center of the bases, where the pitcher's mound would be.

Choose an order for people to take turns. You'll take turns in this order throughout the game, no matter what base you're on.

On each turn, a player picks one card from the center deck. Usually it will have between zero and 5 points on it. Those points represent pressure building, gas dissolving, magma rising, or bubbles forming, depending on what base you're on. Save the card and don't show it to anyone else.

Once you get a total of 10 points in your hand, you're ready for the next phase of the eruption! Show your cards, discard them face up in the center, and move up to the next base!

Nobody can pick from the discard pile. If the center deck runs out, shuffle the discard pile and turn it face down.

Sometimes you'll get a card that says "SWITCH!" When you draw this card, you can use it right away, or say nothing and save it for a future turn. When you use it, you can make anyone ON THE SAME BASE AS YOU switch cards with you – even if you don't have the same number of cards!

Two tricky things about the Switch card:

1. You can't know what another player actually has in their hand before you switch, and you can't switch back, so guess wisely!

2. Once you move up to the next base, you have to throw away your Switch card with the rest of your cards.

The first one to make it back to home plate (and ERUPT) is the winner!

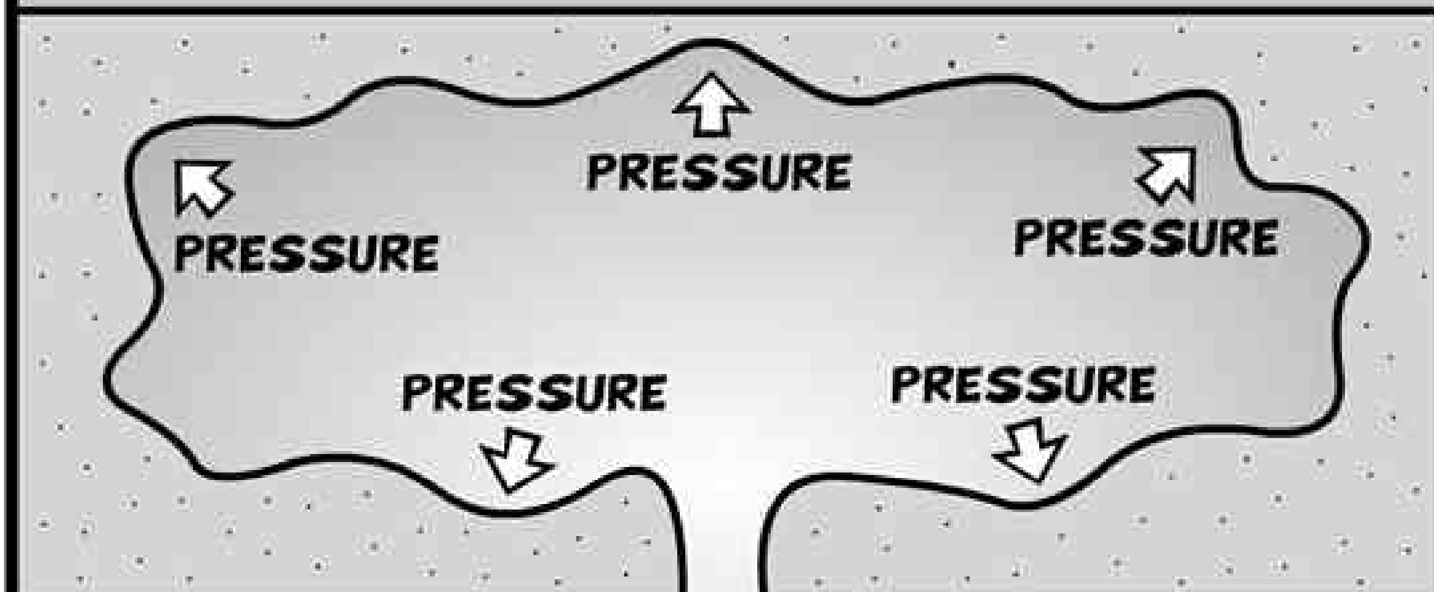
Debriefing

The eruption of a volcano is a chain reaction: heat underground creates pressure, which dissolves the carbon dioxide gas in the magma, which means the gas escapes when the magma rises to the surface, which creates bubbles, which causes the eruption. Why do you think the game made you collect 10 points before moving to the next level?

If you've got your Case Journals, answer the questions in it now!

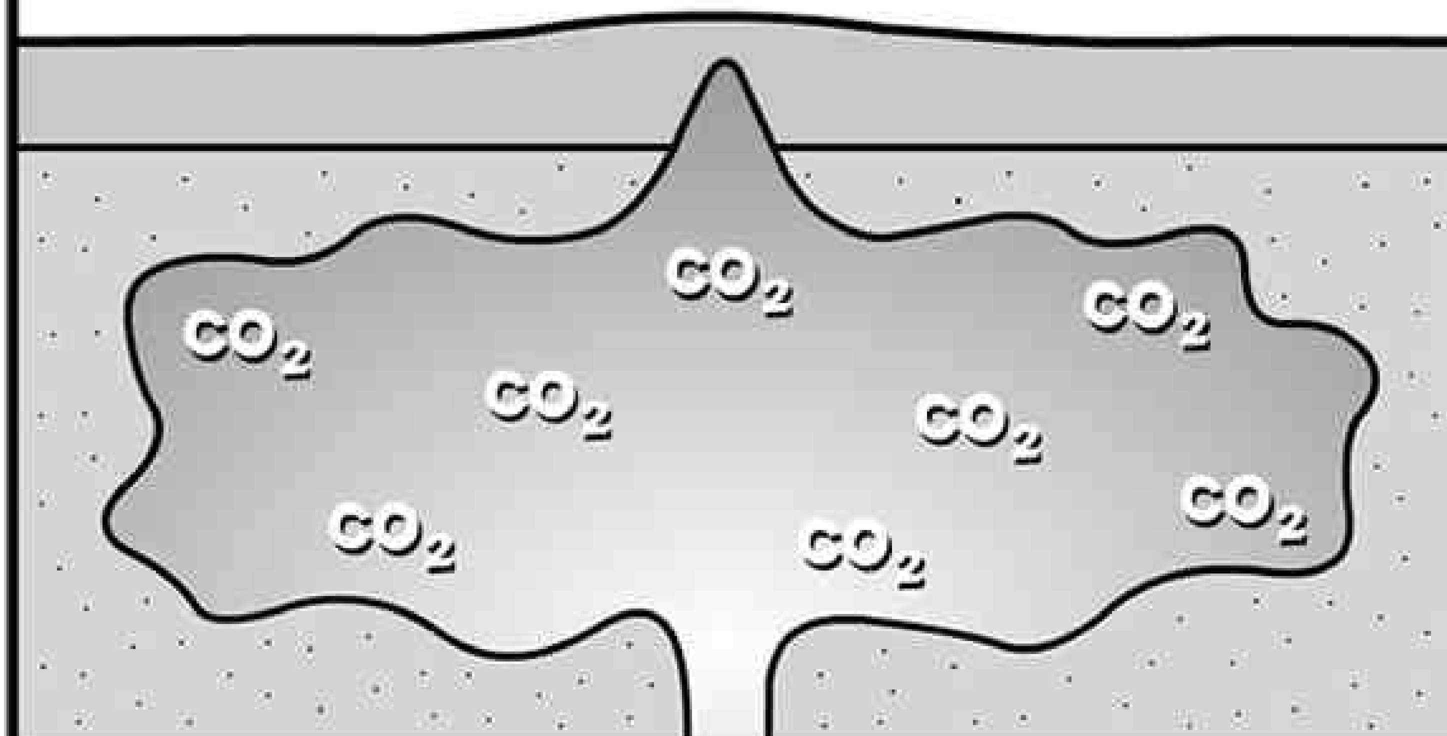
SWITCH !	0	1	2	3
4	5	SWITCH !	0	1
2	3	4	5	

HOME PLATE

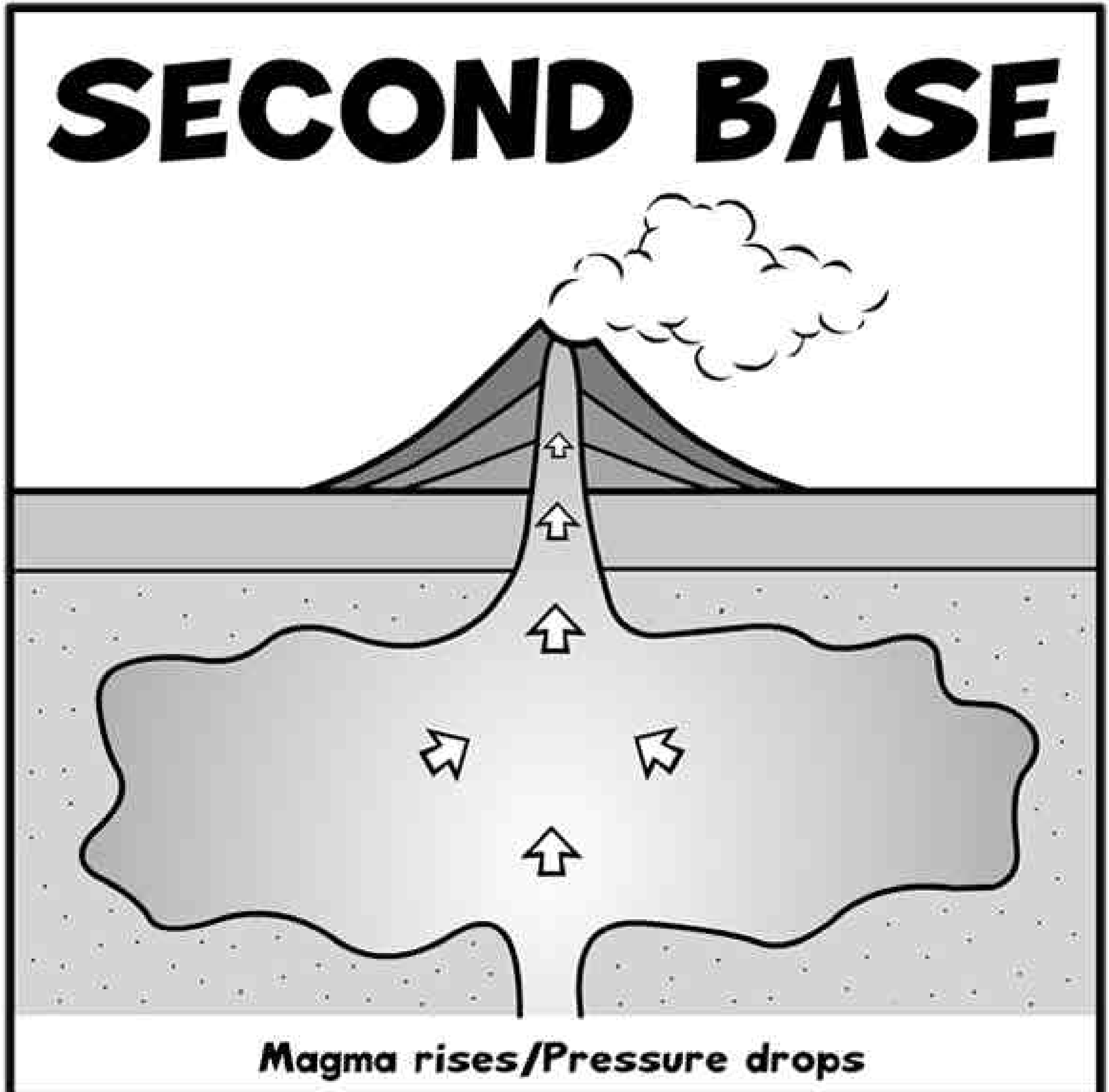


Pressure builds up in the magma beneath the earth

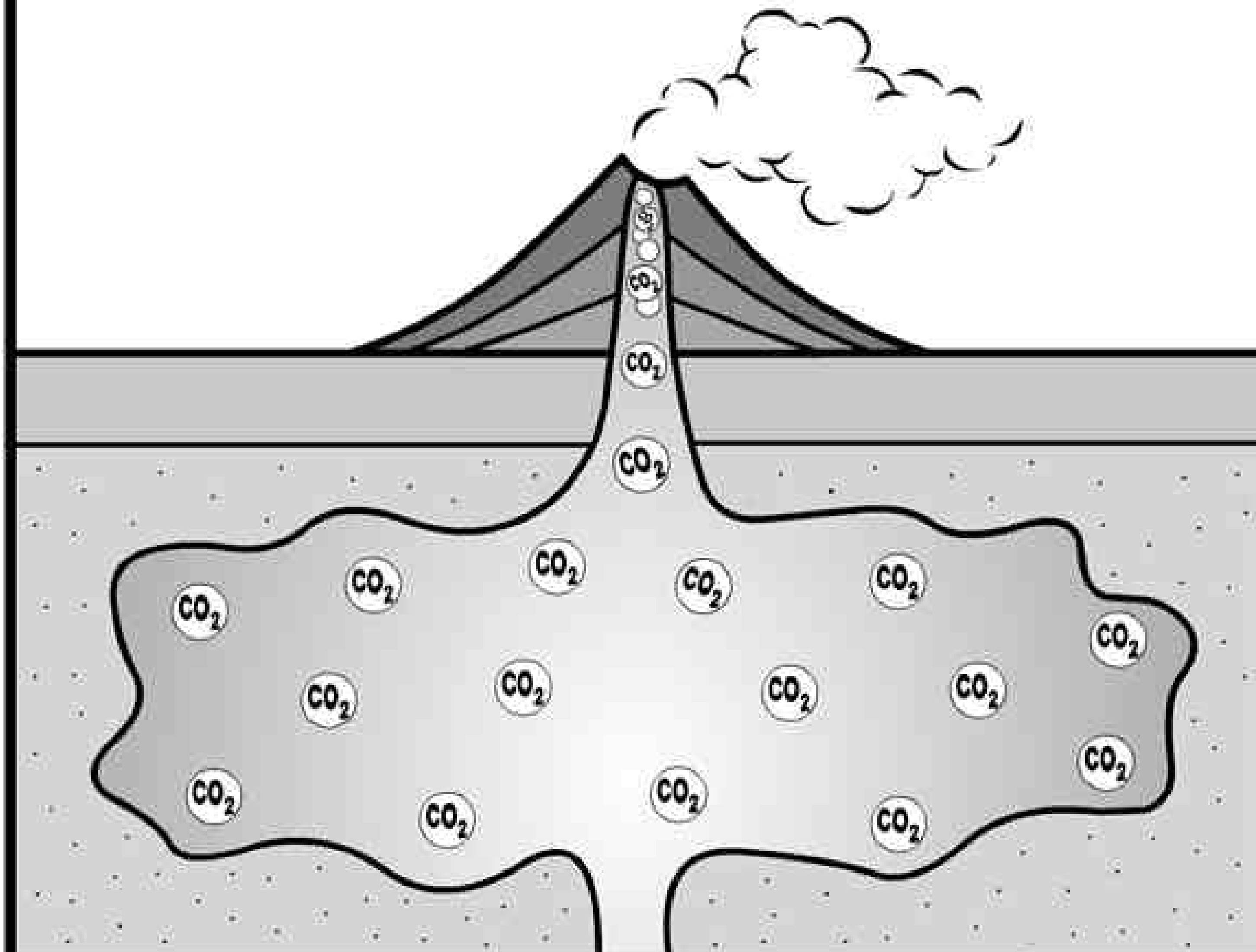
FIRST BASE



Carbon dioxide dissolves into the magma


SECOND BASE
Magma rises/Pressure drops

THIRD BASE



Carbon dioxide escapes and forms bubbles

Physickus warpera "Warper"

When I Was Your Age...

Briefing

Mountains, rivers, and canyons may seem like they've always been the same. But they change with age just like you do. It just takes a lot longer. In this Write Away, you'll take a look back at life from an "earthy" point of view.

Activity

You'll need:
A six-sided die (optional)

What to Do:
Pick a natural structure from this list, or roll the die to pick one at random:

1) The Grand Canyon, Arizona
2) Mount Everest, Nepal
3) The Big Island of Hawaii
4) A "hoodoo" in Bryce Canyon, Utah
5) A "cirque" in Glacier National Park, Montana
6) Crater Lake, Oregon

Imagine you're telling your life story to a younger natural formation. What would you say? Write about what it was like growing up.

Use this form below to help you tell your story.

To learn about these formations, click on More Info.

Debriefing

These formations haven't stopped changing. In the future, they'll all look different. Think about what's been happening to the formation you wrote about. How do you think it will look a million years from now?

If you've got your Case Journal, go ahead and answer the questions in it now!

More Info

The Grand Canyon, Arizona

Before the **Grand Canyon** was a canyon, layers of rock were deposited in the area, like thick blankets. For hundreds of millions of years, those layers were building up instead of wearing down.

The canyon itself was mostly carved out by the **Colorado River**, which carries away bits of rock as it flows. That started about five or six million years ago, and it's still going on today.

Besides the river, heavy rainfalls, melting snow, and small streams have shaped the inside of the canyon. Today, you can see each of the different layers of ancient rock that make up the canyon, because each layer has a somewhat different color. The colors come from the different combinations of minerals that make each layer unique.

For more information see the National Park Service's page on the geology of the Grand Canyon:

http://www.aqd.nps.gov/grd/parks/grca/#geology

Mount Everest, Nepal

At over 29,000 feet, **Mount Everest** boasts the highest peak on Earth. It's part of the **Himalayas**, a stunning mountain chain in Nepal, near India.

The Himalayas are the result of a collision between two giant **continental plates**: India and Asia. Continental plates are big hunks of land that float on top of the Earth's hot, liquid **mantle** (a layer of the earth made of molten rock and minerals).

Today, India and Asia are connected, right where the Himalayas were. But hundreds of millions of years ago, they were totally separate. Yet they were slowly drifting toward each other.

At a top speed of 6 inches per year, those continents were no speed demons – but because they're so big, even a very slow collision can cause some major mayhem.

When they collided, the heavy parts of the Indian plate sank underneath the Asian plate and into the ocean. The lighter parts crumpled up into the Himalayan mountains. This happened in super-slow motion, over millions of years.

For more information, see NOVA Online's "Birth of the Himalaya"

http://www.pbs.org/wgbh/nova/everest/earth/birth.html

The Big Island of Hawaii

The **Hawaiian Islands** are all actually underwater **volcanoes**. They began when hot liquid **magma** (melted rock) under the Earth's surface erupted from beneath the ocean floor, like a zit popping. After the magma erupted, it cooled and hardened, forming layers of rock. Eventually, these layers of rock piled up until they poked out above the surface of the water.

The oldest Hawaiian islands, like **Kauai**, are no longer volcanically active, and covered with lush green plants. The **Big Island of Hawaii** is the youngest island. Its central volcano, **Mount Kilauea**, is still erupting. Many parts of the Big Island are covered with black volcanic rock, because lava recently flowed there. Other areas, which have been left alone for a while, are thick with green plants.

For more information, see "How Our Hawaiian Islands were Formed"

http://tqjunior.thinkquest.org/5410/island_formation_web_page/html_folder/formation_intro.html

A "hoodoo" in Bryce Canyon, Utah

Hoodoos are weirdly shaped rock formations that occur in many places, especially in the American Southwest. **Bryce Canyon National Park** in Utah is famous for its hoodoos. Hoodoos are striking because they can be long, tall, and skinny, like fingers; rounded and smooth, like mushrooms; or hollowed-out, like archways.

Hoodoos are the result of millions of years of **erosion**, mostly from water. **Rain** is one big shaping force. When rains come to a dry place like Bryce Canyon, only a thin layer of soil absorbs the water. The rest builds up and runs off in a flood, carrying bits of rock away with it.

Snow and **ice** are also powerful shaping forces. When snow melts in the winter sun, the water can rush into cracks in the rocks. At night, when the snow re-freezes, it expands and pushes the rocks apart. This is called **frost wedging**. Melting snow and ice also carries away bits of rock in the spring thaw.

Hoodoos often get their strange shapes because the original rocks are made out of different kinds of minerals. The softer minerals dissolve and wash away, leaving the harder minerals behind.

For more information see the National Park Service's guide to Bryce Canyon:

http://www.nps.gov/brca/geowind.htm

A "cirque" in Glacier National Park, Montana

Cirques are large bowl-like valleys carved into the ground. They're footprints left behind by **glaciers** – huge, slow-moving slabs of ice. Glaciers creep across the land at rates of several inches per year, picking up hunks of rock, twigs, earth, and other stuff as they go. A cirque is formed when the glacier rotates in a spiral, like water going down a drain. The rotating motion carves out a round well that's deep in the center.

Cirques are usually found in high places. After it's formed, a cirque can fill with water and become a lake called a **tarn**.

For more information, see this page from About.com:

http://geology.about.com/library/bl/images/blcirque.htm

Or check out Glacier Links for Kids:

http://www.athropolis.com/links/glacier.htm

Crater Lake, Oregon

Crater Lake is the deepest lake in the United States and seventh deepest in the world. (It's nearly 2,000 feet deep!) Yet it was formed relatively recently, in Earth time.

The lake sits on top of the **Cascade Mountains**, which were once a hot spot for active volcanoes. On the spot where the lake now stands, a volcano called **Mount Mazama** began forming about 420,000 years ago. It grew into a big, sprawling volcano with several vents.

About 7,700 years ago, Mount Mazama blew its top in a huge, powerful eruption. The eruption spewed out so much lava and hot ash that it emptied itself out. The hollow shell of the mountain couldn't support its own weight, and the whole mountain collapsed in just a few days! Native Americans probably saw this happen. This may explain why for centuries, Native American **shamans** (healers and spiritual guides) did not permit their followers to even look at the lake.

Over the years, the crater that was left behind filled with rain and melted snow, creating the lake we see today.

For more information see the National Park Service's page on Crater Lake:

http://www.aqd.nps.gov/grd/parks/crla/

Shape It Up

Briefing

Mountains, rivers, and canyons don't just spring up out of thin air. It takes millions of years to shape them. In this Mind Game, you'll get to see how that works without waiting so long!

Ready? Go to the activity now!

Activity

What to Do:

When the game begins, you'll see two pictures.

The picture on the left is your GOAL. In other words, that's what you're trying to make.

The picture on the right is what you're starting out with.

Across the bottom of the screen are buttons, representing different forces of nature: wind, flowing water, volcanoes, and glaciers. Click on the button that you think is needed to reach your goal.

If you pick the wrong button, we'll tell you, and you'll get another chance.

If you choose correctly, you'll get a new set of buttons to choose from. These represent different amounts of time: 100 years, 10,000 years, or 20 million years. Click on the amount of time that you think will get you closest to your goal – without going past it!

Once you choose your time, see what you end up with. Does it match your goal? If not, try again! If it does, move on to the next challenge!

Finished? On to the debriefing!

Debriefing

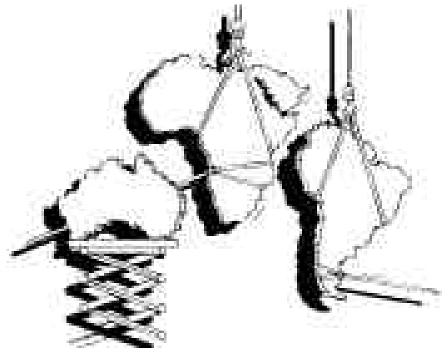
How did you choose which forces to use? Were you surprised by how much time it took to reach your goal? What would happen if you had even more time?

If you’ve got your Case Journals, go answer the questions in it now!

Reunite Pangaea

Briefing

Have you ever heard the expression "The world keeps getting smaller?" Well, about 200 million years ago, the planet wasn't any smaller, but it sure would have been easier to get from one place to another. In this Fab Lab, you'll reconstruct what that world looked like!



Activity

200 million years ago, all the continents of the world were part of one giant super-continent called Pangaea. What did it look like? Why don't you try and figure it out?

What You'll Need:

Scissors
A stopwatch (optional)
Map of the World

What to Do:
1. Your printable map should have two pages: The first page has a map of the world as we know it today. The second page has all the continents separate from another, like puzzle pieces.
2. Using your scissors, cut out the continents and major islands from the SECOND page:

North America
Greenland
South America
Africa
Madagascar (it's a large island off the southeast coast of Africa)
Eurasia
India (It's attached to Asia now, but cut it out as a separate piece)
Australia
Antarctica

3. Now lay your continents out on a separate sheet of paper, so that they match the map

of the world today.
4. Try and figure out how these continents and islands would fit together millions of years ago, when they were one big continent!

If you get stuck, click here for hints.

If you're playing with a group:

You can turn this activity into a race. Whoever makes a picture of the real Pangaea first is the winner. Choose an adult or a friend to be the Leader. He or she can print out a picture of the real Pangaea here.

When you think you've got it right, tell your Leader. He or she will check your picture against the real Pangaea. If it's close enough, you'll be told your finishing time. Add 30 seconds to your time for every hint you took.

The person who finishes with the best final time is the winner!

Debriefing

Take a look at the Map of Pangaea as scientists believed it once looked.

Scientists believe that over hundreds of millions of years, the continents broke apart and moved into the positions they're in today. That theory is called continental drift. And it's still going on! Come back to Earth in a hundred million years and the world map may look very different!

If you've got your Case Journals, answer the questions in it now!

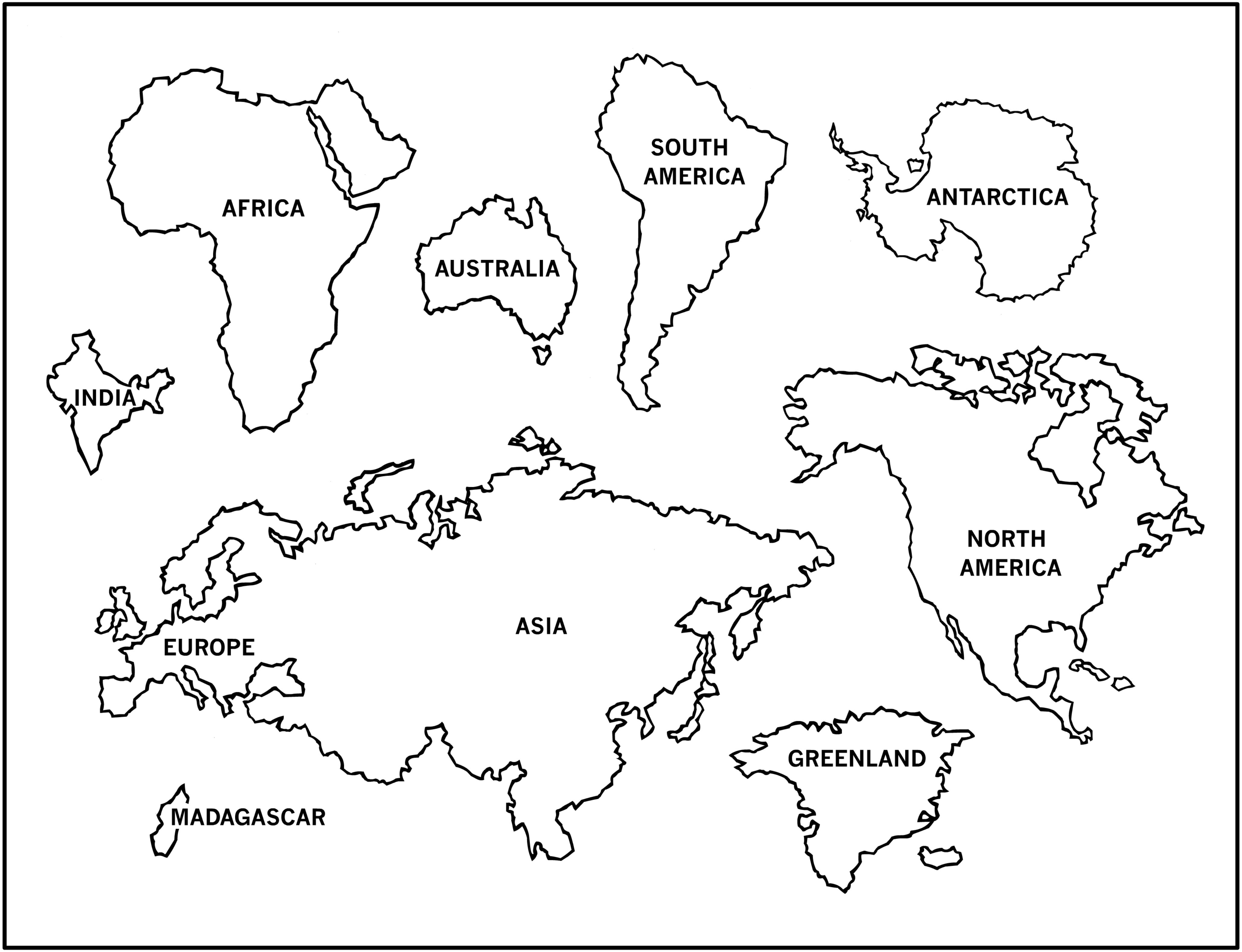
More Info

1.Look at the edges of the continents. Think of them as pieces of a puzzle. They don't fit together exactly, but they're pretty close!

2.Use Africa as the center of your picture.

3.Continents are big and heavy. They don't do a whole lot of fancy twists and turns. So putting them back together might be easier than you think!


GREENLAND
NORTH
AMERICA
EUROPE
ASIA
INDIA
AFRICA
SOUTH
AMERICA
MADAGASCAR
AUSTRALIA
ANTARCTICA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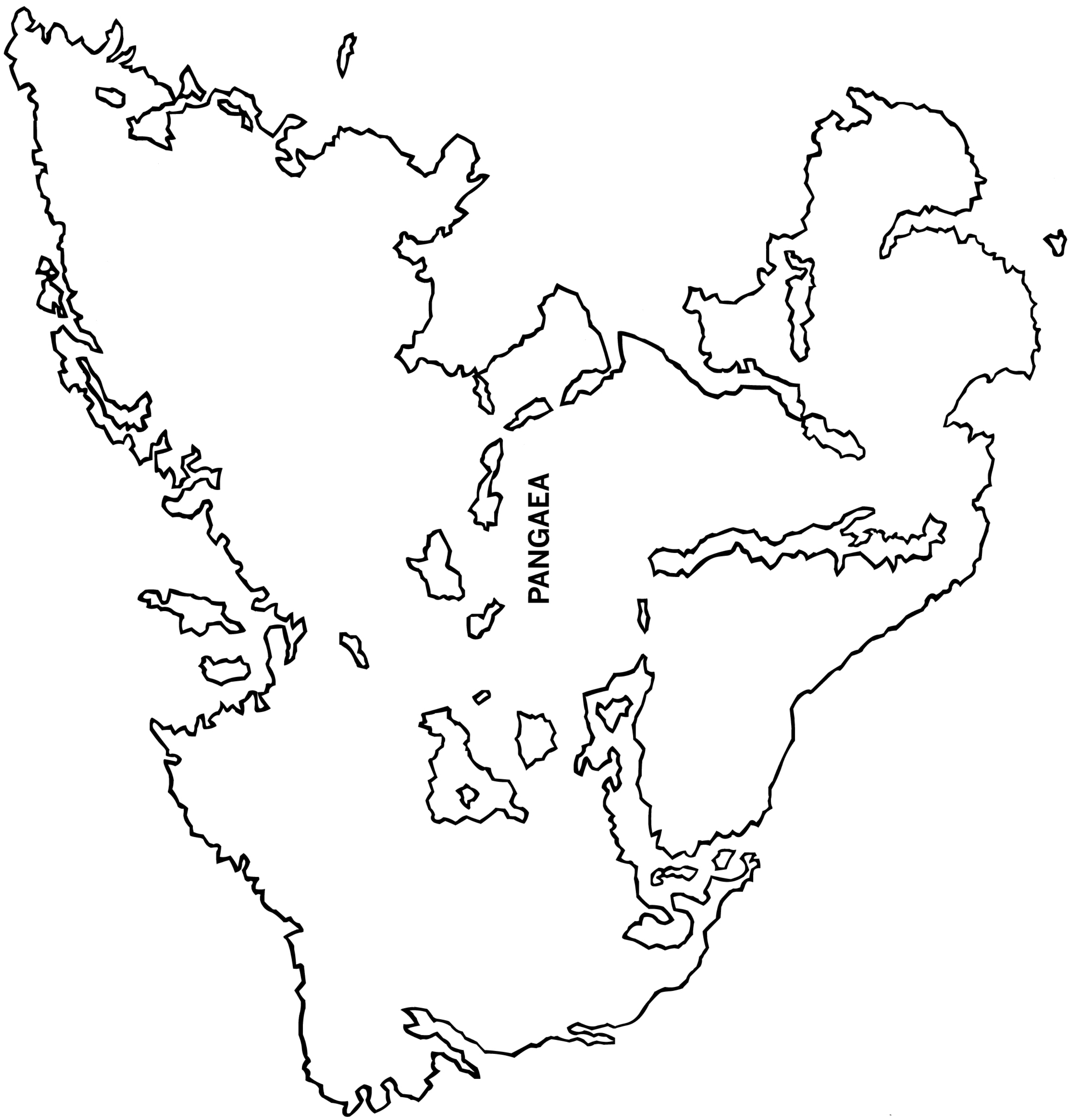

PANGAEA

Mission Overview: Terrora

This two-week Mission highlights a number of features of our home planet and its every-day functions. Specific topics of interest include gravity, the water cycle, air pressure, and how the Earth's rotation creates the night/day cycle. This is a content-heavy unit that can benefit from students doing additional research either before or during the Mission. However, the activities are designed to be executed with minimal outside knowledge.

The activities for this mission include: **Gravity Launch,** an online activity in which students must use the Earth's gravity to launch a spacecraft to a specific target; **Dunk n' Flip,** a simple demonstration that the air around us takes up space and exerts force; **Solar Spin,** a physical model of the Earth's rotation; **Go with the Flow,** a pictorial representation of the water cycle, and **My Life as a Drip,** another look at the water cycle from a first-person (or first-water droplet) perspective.

The Project 2061 Benchmarks for Science Literacy

4B. The Physical Setting, The Earth

By the end of 5th grade, students should know that:

1. Things on or near the earth are pulled toward it by the earth's gravity.

2. Like all planets and stars, the earth is approximately spherical in shape. The rotation of the earth on its axis every 24 hours produces the night-and-day cycle. To people on earth, this turning of the planet makes it seem as though the sun, moon, planets, and stars are orbiting the earth once a day.

3. When liquid water disappears, it turns into a gas (vapor) in the air and can reappear as a liquid when cooled, or as a solid if cooled below the freezing point of water. Clouds and fog are made of tiny droplets of water.

4. Air is a substance that surrounds us, takes up space, and whose movement we feel as wind.

To learn more , consult these resources:

Books:

Incredible Earth

Clifford, Nick.Incredible Earth. DK Publishing, 95 Madison Avenue, New York, NY 10016-7801: 1996. 42pp. $15.95. ISBN 0-7894-1013-3.

Kid's Book of Weather Forecasting

Breen, Mark et al.2000. iv+138pp. $12.95. 99-089954. ISBN 1885593392.

Stone Wall Secrets

Thorson,Kristine and Robert. Tilbury House Publishers, 132 Water Street, Gardiner, ME 04345: 1998. 40pp. $16.95. 97-49982. ISBN 0-88448-195-6.

Web Links:

Make a model of the water cycle at Boston's Museum of Science website:

http://www.mos.org/oceans/planet/watercycle.html

The strength of a planet's gravity depends on how much mass the planet has. More gravity means you weigh more; less gravity makes you lighter. Visit the Exploratorium link below to see what you would weigh on other worlds!

http://www.exploratorium.edu/ronh/weight/index.html

This is a site intended for explaining aspects of the water cycle in a simple manner to younger children:

http://www.kidzone.ws/water/

This is an excellent database that provides a wealth of information on gravity, its history, and its effects:

http://library.thinkquest.org/27585/frameset_intro.html

A great site that offers a great deal of information of astronomical information on the earth:

http://www.enchantedlearning.com/subjects/astronomy/planets/earth/

Activity Notes for Leaders: Terrora

Mind Game: GRAVITY LAUNCH

If you've seen the movie "Apollo 13" you might have some familiarity with this activity. In that film, astronauts who lost power in their spacecraft had to rely on the Moon's gravity to slingshot them back to the Earth. This online game shows that when you launch something in space, the gravitational pull of objects like the Earth and the Moon can dramatically affect its course of direction. Kids should practice the game until they figure out how to compensate for the Earth and Moon's gravity.

Fab Lab: DUNK N' FLIP

This is a two-part lab that demonstrates that air has weight and takes up space. In the first part, students stuff a paper towel into the bottom of a cup, and immerse the cup upside down in water. They should see that the paper towel stays dry, because air gets trapped between the paper towel and the water. In the second experiment, they observe that the weight of the air over a piece of newspaper can make it difficult to knock a stick off a table. If students have trouble with these concepts, remind them that an ordinary balloon is simply a rubber tube filled with air. If air didn't take up space, it couldn't make the balloon expand.

Move Crew: SOLAR SPIN

In this activity, students model the rotation of the Earth around the Sun, and observe its effects on the day-night cycle. One thing worth pointing out is that although the child playing the Sun will have to rotate to shine a light on the "Earth," the actual Sun does not rotate. Its light shines in all directions. It's also worth noting that the Sun is 93 million miles away, and yet it still lights up our whole planet. Ask the kids playing the "Earth" why it looks like the Sun rises and sets in the sky.

Smart Art: GO WITH THE FLOW

In this game, students make a "story-board" of the water cycle, showing that water never disappears, but simply moves around and changes from a solid to a liquid to a gas and back again. The activity page includes more information on the water cycle and links to helpful web sites.

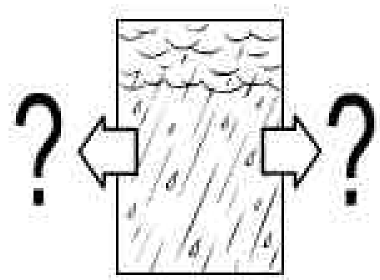
Write Away: MY LIFE AS A DRIP

A variation on Go with the Flow, except here the children write an autobiographical story from the point of view of a drop of water.

Go With the Flow

Briefing

Water really gets around. Sometimes it’s up in the clouds, sometimes it falls down as rain, sometimes it flows in rivers, and sometimes it ends up in your drinking glass. But it never appears out of thin air, and it never really disappears. It just changes from one form to the next. In this Smart Art, you’ll show how that happens!



Activity

You’ll need:
Go With The Flow Start Images

What to Do:
In this Smart Art, you’ll help complete an illustrated story about the changes that water goes through.

Start by clicking on "Go With The Flow Start Images," above, and printing them. Four pages will print.

Each kid doing the activity should choose ONE of these pages to start with. (Make more copies if you need to. It's okay if some kids start with identical pictures.)

Now look at your page. It should look kind of like a newspaper comic strip -- except that most of the panels are blank! However, you’ll notice that the first panel has been drawn in. It’s a picture of water in some form.

What would happen to the water after this? Where would it end up next? Draw that in the very next panel.

When you’re done, trade pictures with another kid, or pass your picture to the kid on your left.

Now look at your new picture. This time, there should be TWO panels drawn in. What happens after this? Draw where the water goes next in the next panel, and then pass your picture to someone else.

Keep passing the pictures around, drawing in one panel at a time. When you're finished, you should have several completed picture-stories.

To do this right, you'll want to know about the water cycle. Look in the More Information section if you have any questions.

Debriefing

There's no limit to the number of different stories your team may have come up with. Try and find two stories that started from the same drawing. Did they follow the same pattern? Were both equally believable?

If you've got your Case Journal, go ahead and answer the questions in it now!

More Info

There are all kinds of ways that water moves around and changes its form. Here are some of them:

Evaporation: When lakes, rivers, and oceans get heated up, the water rises off the surface as vapor and into the air.

Condensation: If water vapor gets high enough in the Earth's atmosphere, it can clump together and form clouds.

Precipitation: Also known as rain, snow, sleet, or hail! That's when water falls from the clouds in liquid or solid form.

Collection: There are all kinds of places where water can be stored for a long time: in lakes, rivers, oceans, and other bodies of water; in the snow on mountaintops, in the ice of icebergs and glaciers, or in the ground, where it's known as groundwater. Eventually, the water can escape these places by evaporating, melting, or trickling out to another place.

Animals and Plants drink water (or absorb it through their roots). Later on it comes out, either through sweat, urine, or **transpiration** (something plants do that's like sweating through their leaves).

Water can also flow from one place to the next. For example, most rivers flow into oceans. Water can melt off the top of a mountain and flow into a lake. Groundwater can trickle out of the ground and into a body of water.

And don't forget **irrigation**: man-made systems of sewers, water pipes, and plumbing. That's how water gets into your house, school, or a public fountain. Usually the water comes from a lake, river, or man-made body of water called a reservoir.

If you want to learn more about the water cycle, check out these Web sites:

KidZone's Water Cycle Page

http://www.kidzone.ws/water/

The EPA's Water Cycle Page

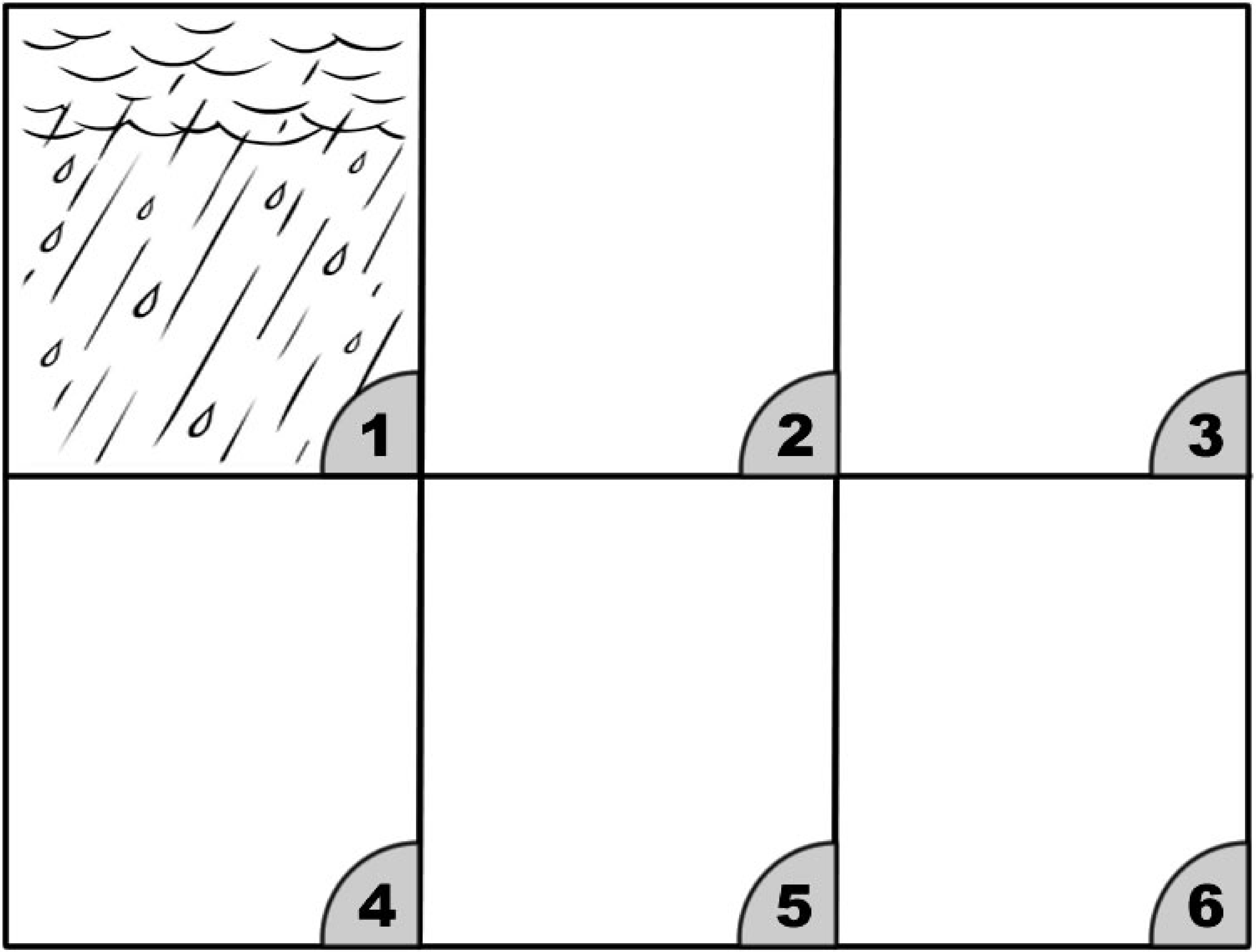
http://www.epa.gov/region07/kids/wtrcycle.htm

"Follow a Drip through the Water Cycle" (from the U.S. Geological Survey)

http://ga.water.usgs.gov/edu/followdrip.html

"Water: A Never Ending Story"

http://www-k12.atmos.washington.edu/k12/pilot/water_cycle/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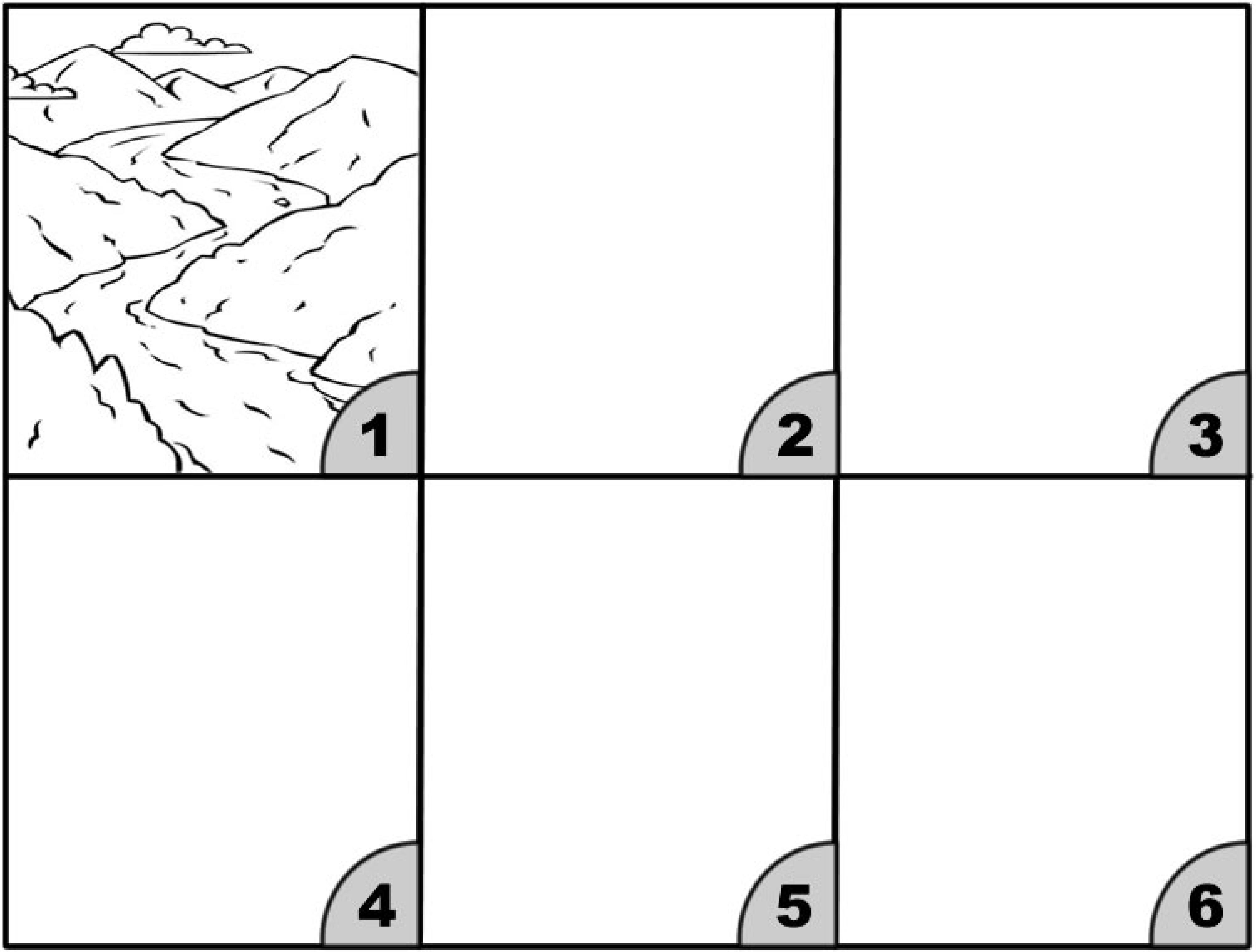
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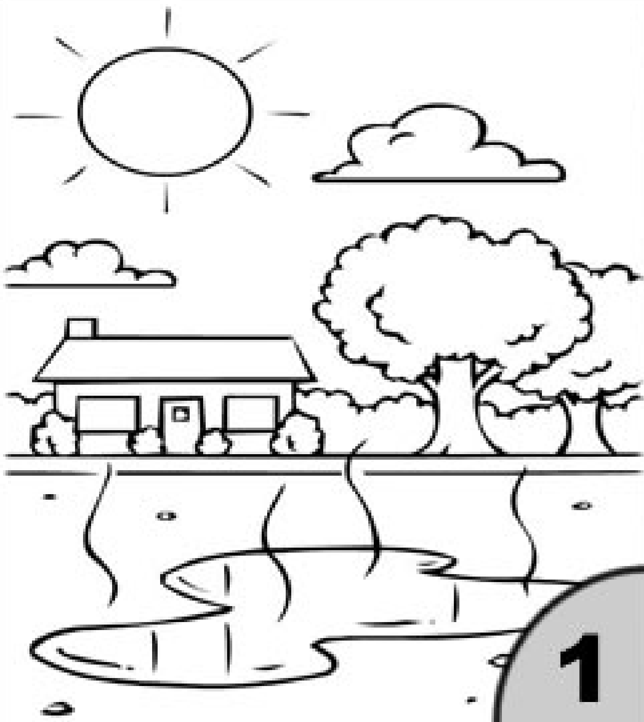

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Solar Spin

Briefing

When it's morning in Milwaukee, Wisconsin, it's midnight in Melbourne, Australia! How can that be? In this Move Crew, you'll demonstrate how it happens!

Activity

What You'll Need:
A flashlight

How to play:
Phase 1
Pick one kid to be the Sun. That kid uses a flashlight that will shine directly on the "Earth."

Now pick two kids to play two halves of the Earth. One kid will be the Western Hemisphere: that's the half of the Earth that contains North and South America. The other will be the Eastern Hemisphere: Europe, Asia, Africa, and Australia.

The two Hemispheres should stand back to back, and link hands. Then they can start slowly walking around the Sun in a circle. That's just like the Earth's orbit.

Meanwhile, the Sun shines its light on the Earth. Keep still and shine your light directly on the kids playing the Earth. (In real life, the Sun shines in all directions, of course.)

Once you've got the hang of this, move on to phase 2!

Phase 2
Besides orbiting the sun, the Earth also rotates. To do this, the two kids playing the Earth should spin around in little circles, like a top. Keep on orbiting the Sun at the same time, and try not to get dizzy!

Now, pick two kids to live in the Western Hemisphere, and two kids to live in the Eastern Hemisphere. Have them sit on opposite sides of the Earth's orbit.

Whenever their "hemisphere" faces the Sun, it’s daytime, so the kids should act awake: stand up, stretch, yawn, jump up and down, and so on.

Whenever their "hemisphere" faces away from the Sun, it’s night-time, so the kids should lie down and pretend to sleep. (But keep one eye open so you know when it’s daytime again!)

See how smoothly you can do this. If it’s a piece of cake, try Phase 3!

Phase 3
If you want a tougher challenge, have all four kids pick a different spot on the Earth. (For example, they might pick the Western Hemisphere’s left kneecap, or the place where the two Hemispheres join hands). Each kid should get up and go to sleep as day breaks and night falls in their spot.

Debriefing

What happens when two towns are on the opposite sides of the Earth? Can it ever be morning in both spots at the same time? Why or why not?

Do you have relatives in another Time Zone? Have you ever called them and found out it was another time of day where they live? Why do you think that happens?

If you’ve got your Case Journal, go ahead and answer the questions in it now!

My Life as a Drip

Briefing

Think about the water you drank from the school fountain today. Where do you think it came from? How far do you think it traveled in a day? A week? A year? How long do you think it's been around? In this Write Away, you'll tell the life story of a single drop of water.

Activity

You'll need:
A six-sided die

What to Do:
In this activity, you'll imagine that you're a drop of water, and write a short story about your life. We'll give you the beginning and the ending; your job is to tell what happened in between.

To choose your beginning, roll the die and take the sentence that matches the number you rolled:

1) "Once I was floating around inside a cloud…"
2) "Once I was just a drop of water in the middle of the ocean…"
3) "Once I was a little flake of snow on the top of a mountain…"
4) "Once I was trapped in the ground underneath a river…"
5) "Once I was part of a huge, thundering waterfall…"
6) "Once I was lying in a puddle in the middle of a parking lot…"

Now choose your ending. Roll the die again and pick the sentence that matches the number you rolled.

1) "…and that's how I ended up in this lake."
2) "…and then some fifth-grade kid drank me up."
3) "…and now I'm just part of an iceberg."
4) "…and then a dandelion sucked me up with its roots."
5) "…and now I'm stuck here in this sewer."
6) "…and I've been floating around in this swimming pool ever since."

Make sure it takes at least three steps to get from your beginning to your ending. In other words, at least three different things should happen to your drop of water in between the beginning and the ending we've given you.

Need more info? No problem! Just see below.

Debriefing

Now think again about that water you drank today. How long do you think it's been around? The answer is, pretty much as long as the Earth has! It just keeps moving from place to place, and from solid, to liquid, to gas.

If you've got your Case Journal, go ahead and answer the questions in it now!

More Info

There are all kinds of ways that water moves around and changes its form. Here are some of them:

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"Water: A Never Ending Story"

http://www-k12.atmos.washington.edu/k12/pilot/water_cycle/

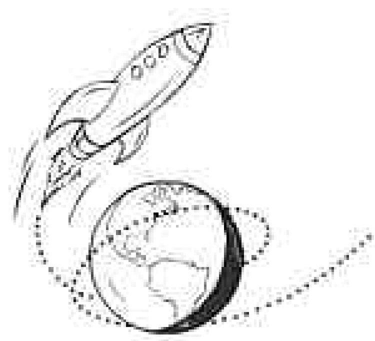
Physickus terrora "Terrora"

Gravity Launch

Briefing

You'll never fall off the Earth because gravity's always there to pull you back. Here's a Mind Game where you use that force to accomplish your mission to space.

Ready? Go to the activity now!



Activity

What to Do:

This game has 3 challenges:

Round 1: Reach a base on the other side of the Earth.

Round 2: Reach a base on the far side of the Moon.

Round 3: Connect with TWO bases, one in front and one on the far side of the Moon.

You have 3 controls to pilot your ship:

Thrust: How much force your rocket ship will use to fly.
Angle: Set up the path you'll take off on your mission.
Launch: Blast off.

Experiment with different settings and see if you can complete each of your goals in as few tries as possible.

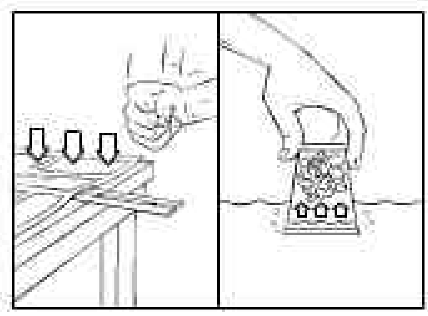
Debriefing

Did you find you spent more effort working against gravity? Or did you launch your ship and let gravity take over for you? Use your Case Journals to record all your results now!

Dunk and Flip

Briefing

What's inside an empty cup? What's weighing down on the grass in an open field? What's strong enough to hold up a truck or knock down a tree? The answer to all of these is air! Think the air's just a whole lot of nothing? Try this Fab Lab and see for yourself!



Activity

What You'll Need:
Paper towels
A clear plastic cup
A watertight container deep enough to contain the entire cup
A few sheets of newspaper
A ruler, yardstick, or wooden stick at least 12 inches long

Part One: Dunk!
1. Fill the container about halfway with water.
2. Crumple up a paper towel and stick it in the bottom of the cup. Pack it in tight, so it doesn't fall out easily.
3. What do you think will happen to the paper towel if you put the cup in the water upside down? Write down your answer before you move on.
4. Turn the cup upside down and slowly sink it into the water. Keep going until the entire cup is underwater.
5. Slowly bring the cup back out of the water.
6. When the cup is completely out of the water, flip it back over and take out the paper towel.
7. Write down your observations. Is the paper towel wet or dry? Why do you think that is?

Part Two: Flip!
1. Place the ruler or wooden stick on a table. About half of the stick should hang over the edge of the table, like a diving board.
2. Tap the end of the stick that's hanging over the edge of the table very gently. Then tap it with a little more force. Keep doing this until the stick flips off the table.
3. Try this a couple of times. See if you can feel exactly how much force it takes to make the stick flip over.

4. When you're ready, put the stick back on the table again. This time, lay a piece of newspaper flat over the part of the stick that's on the table. (Half of it should still stick out.) The newspaper should be perfectly flat, with no air under it.
5. What do you think will happen when you hit the stick now? Write down your prediction.
6. Tap the stick with the same amount of force as before. What happened? Tap it harder if you need to. See how hard you have to hit it to make it flip over.
7. Crumple up the newspaper into a ball. Put it back on top of the stick and hit it again. What happened this time?

Debriefing

What kept your paper towel from getting all wet? The answer is air! When you sunk the cup into the water, there was air trapped between the water and the paper towel. The air takes up space, so the water couldn't go all the way into the cup and get the paper towel wet.

How about the stick? You guessed it – air again! When the stick was under the flat newspaper, it was pinned down by all the air weighing down on the surface of the paper. In fact, the air can put thousands of pounds of pressure on just a normal-sized piece of paper.

If you've got your Case Journal, go ahead and answer the questions in it now!

Mission Overview: Fragg

This two-week Mission is about systems: any kind of system, from the solar system to the digestive system to complex machines or social systems. Students should come out of this unit with an understanding that “system” is a general label that can be applied to any situation in which parts work together to make a whole. The unit also explores properties of systems: for example, that the parts of a system affect one another and that a system may not function properly if one or more parts are missing or broken.

The activities for this mission include: **Break It Down,** an online activity in which students take parts from a system to see if it still works; **Thumbs Away!,** in which students discover the importance of one small body part; **The Sum of Your Parts,** a game that changes as players with unique functions are removed; **Contraption!**, an opportunity to design a whimsical Rube Goldberg-like system, and **Systems Within Systems,** which encourages students to discover how common it is for systems to nest within each other.

The Project 2061 Benchmarks for Science Literacy

11A. Common Themes, Systems

By the end of 5th grade, students should know that:

1. In something that consists of many parts, the parts usually influence one another.

2. Something may not work as well (or at all) if a part of it is missing, broken, worn out, mismatched, or misconnected.

To learn more about systems, consult these resources:

Books:

Fun Machines
Smithsonian Institution. Gareth Stevens Publishing, 1555 N. River Center Drive, Suite 201, Milwaukee, WI 53212: 1993. 48pp. $18.90. ISBN 0-8368-0956-4.

Machines
Kerrod,Robin. Benchmark Books, 99 White Plains Road, Tarrytown, NY 10591-9001: 1996. 64pp. $16.95. 95-4469. ISBN 0-7614-0032-X.

Websites:

A common component in many mechanical systems is the gear. Learn how it works here:

http://www.howstuffworks.com/gear.htm

This site provides brief descriptions on the manner in which systems of small components work to make simple machines achieve greater tasks:

http://www.mos.org/sln/Leonardo/InventorsToolbox.html

Your body is a system, too! Learn how the parts work together at:

http://kidshealth.org/kid/body/digest_SW.html

Activity Notes for Leaders: Fragg

Mind Game: BREAK IT DOWN

In this online activity, students are shown an elaborate contraption and have to remove parts, piece by piece, without grinding the entire system to a halt. This activity should spark discussions about the roles different parts can play in a system: Some parts are absolutely essential to the system, some parts are helpful but expendable, and some parts are mostly decorative and not really relevant to the way the system functions.

Fab Lab: THUMBS AWAY!

In this activity, students learn about the importance of a very important body part: the lowly thumb. By trying to do ordinary tasks without using their thumbs, the children will learn how the thumb plays an essential role in the system of their hand. This activity might lead to a discussion about different strategies people use for overcoming physical disabilities.

Move Crew: THE SUM OF YOUR PARTS

In this game, each player plays a unique role on a team. The other players discover how the team (a system) is hampered when one of its components is removed. The students are also encouraged to think about situations in which an additional player would hurt, not help, the team's scoring ability.

Smart Art: CONTRAPTION!

Here, the children are given the chance to make a complex machine that does something simple. This activity is inspired by the drawings of the famous cartoonist Rube Goldberg, who drew elaborate inventions that took a comically complicated approach to an easy problem. Although their drawings can be whimsical and silly, the students should be to explain how each part of their invention affects the other parts and helps the job get done.

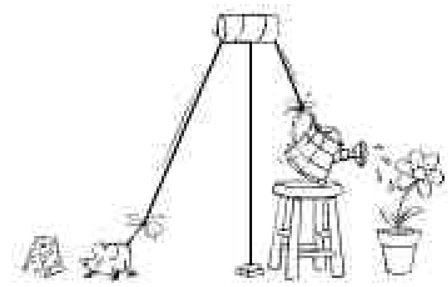
Write Away: SYSTEMS WITHIN SYSTEMS

This writing exercise helps children see that large systems are often made up of smaller systems, which in turn are made of still smaller systems. It also encourages them to recognize that anything can be a system: not just machines but also living creatures, schools, cities, or parts of the universe.

Contraption!

Briefing

Rube Goldberg (1883-1970) was a famous cartoonist who used to draw all kinds of crazy "inventions." The inventions were really systems with lots of wacky parts. For example, he once designed a pencil sharpening-machine that involved a woodpecker, an electric iron, a kite, and a flannel shirt. In this Smart Art, you'll come up with your own weird system!



Activity

What You'll Need:
A six-sided die (optional)
Case Journal Page (optional)

What to Do:
You're going to design an invention. The first question is: what will your invention do? Pick from the list below or roll the die to choose one at random:

1. Brush your teeth
2. Polish your shoes
3. Rake leaves
4. Pick up your dirty clothes
5. Erase the blackboard
6. Mop the floor

Now, your job is to draw an invention that does this thing automatically. The invention has to use at least four of the following parts:

A hockey stick
A blender
A hamster on an exercise wheel
A live chicken
An electric fan
A tuba
A water fountain
A pogo stick
A skateboard

A balloon
A magnet
A spatula
A see-saw
A slide

You can add your own ideas too, as long as you use at least four of these!

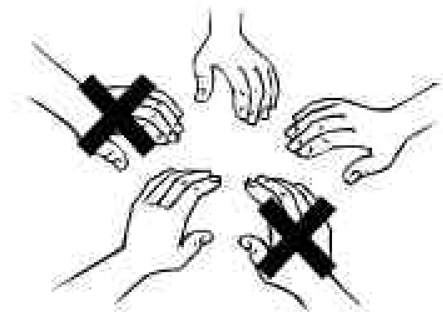
When you draw your invention, make sure that all the parts work together. In other words, every part should affect one of the other parts of the system. There shouldn't be anything that's just for decoration.

Debriefing

Think about systems that you see in real life, like your body, a car, a school, and so on. How was the system that you drew different from systems like these?
If you've got your Case Journals , go ahead and answer the questions in it now!

Sum of Your Parts

Briefing



Sometimes, a system can work even if one part is broken. For example, if some gears on a bicycle are broken, the bike might still work--just not as well. And sometimes, adding an extra part might actually make it run worse!

Here's a challenge that let's you build a human "system" and then take away pieces to see how things have changed.

Activity

What You'll Need:
A pencil with an eraser on the end
A six-sided die
A roll of tape
A marker
A stopwatch or a nearby clock
Diagram of the Playing Field

How To Set Up:
Create a playing field on the floor or a table top. Use the roll of tape to create this pattern. It should be about 4 feet long and 3 feet wide.

Use the marker to create the part of the field that has "x x x x x" written on it.

Give everyone a job to do. Each kid is a single part of the system. (See the list below.) If you have less than six kids on your team, give out the parts starting with #1, and leave out the parts at the end.

Place the die in the lower left triangle with the "1" face up.

Give the pencil to the person who is going to be part #1 ("the Driver").

What to Do:
The team is a "system" that moves a die from the start space (in the lower left) to the end space (in the lower right.) The challenge is to see how many times you can do this in two minutes.

Each time the die goes off the playing field, you have to start over again.

Each team member is a separate part of the system:

Part #1) "The Driver" Use the pencil to push the die around the field. You can touch the die only with the pencil's eraser. If the die rolls over, touches the tape or leaves the playing field, you have to start over again – unless another player can help you (see below).

Part #2) "The Flipper" If the die rolls over so any number other than "1" is showing, you may reach in and flip it so the "1" is face up again. The Driver can continue from that spot WITHOUT starting over.

Part #3) "The Jumper" If the die is right next to the "x x x x x" wall, you can reach in and pick up the die. Then put back down on the other side of the wall, as if it "jumped" over the wall.

Part #4) "The Bumper" If the die gets too close to the tape, you can tap it with your finger and push it back on the playing field.

Part #5) "The Time Stopper" Anytime the Driver has to start over, you can stop the clock so it doesn't waste any time. It's your job to start/stop your watch, or just keep track of the time.

Part #6) "The Replacer" If you're in the system, the Driver never gets to touch the die. If, for any reason, the die has to go back to the start, it's your job to pick it up and put it there.

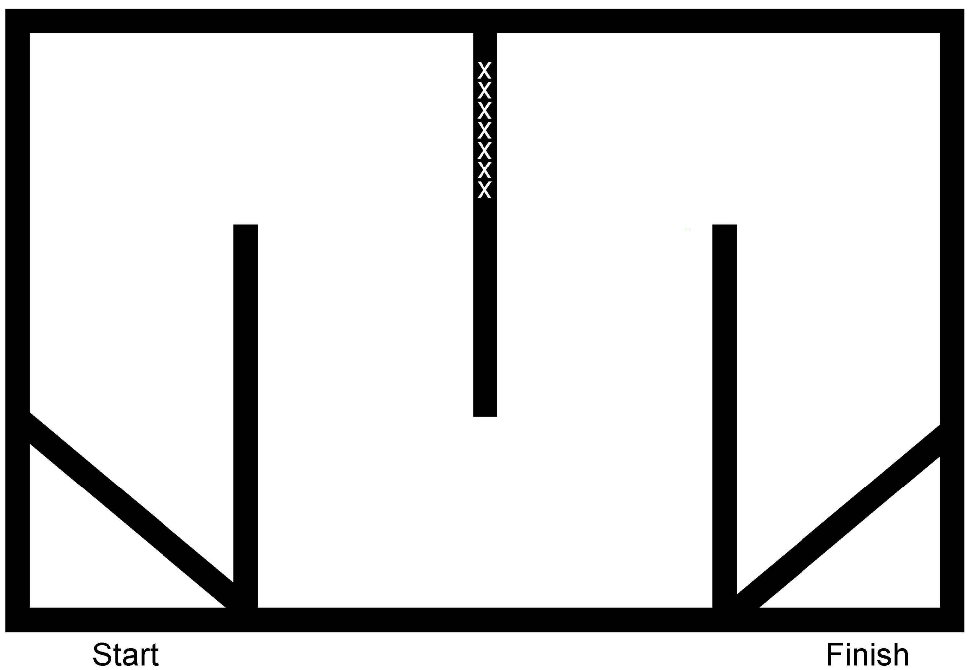
Play a two-minute round with all team members performing their parts. Then, pick a part (other than #1) to remove from the system and try again. Did your score get better or worse?

Keep removing different combinations of parts and see how this changes your score.

Debriefing

When you took parts away, did it always get harder? Was there a piece that made the job easier when you took him/her out of the system?

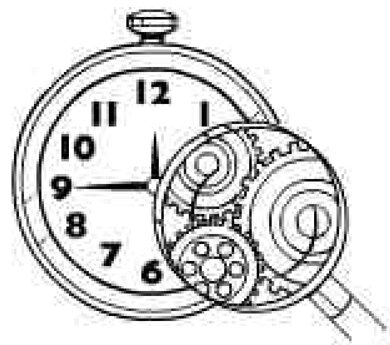
If you've got your Case Journals, free up your thumbs and answer the questions in it now!


XXXXXXX
Start
Finish

Systems Within Systems

Briefing

Think about a system – you, for example. Your whole body is a system. But can you think of smaller systems inside your body? Now think outwards – are you a part of any system that you can name? In this Write Away, you'll look at systems inside systems, inside other systems!



Ready? Go to the activity now!

Activity

What You'll Need:
A six-sided die (optional)

What to Do:
Pick a system from the list below or roll the die to choose one at random:

The Solar System
The Interstate Highway System
A car factory
A major sports league, like the NBA or the NFL
A musical group (orchestra, rock band, etc)
The United States of America

First, write down the name of your system. Next to that, try and explain what it is or what it does (in about one sentence).

Then, write down three different parts of that system, and how those parts help the system work.

Then, think about the three parts. Are any of these parts also kind of system? (Are they made up of other parts that work together? If the answer is yes, then it's a system too!)

Choose the part that seems most like its own system, and circle it. Now, write down three important parts of THAT system.

Now look at those three parts. Are any of those parts also systems themselves? Choose one, circle it, and write down three important parts of THAT system.

Finished? On to the debriefing!

Debriefing

Do you think you could have gone even further? Where do you think the systems finally stop getting smaller?

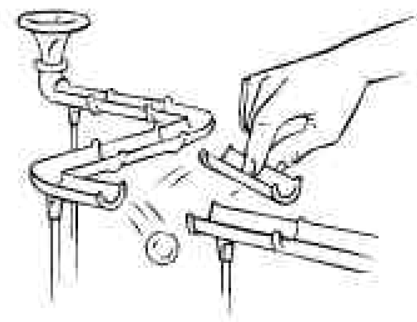
Now think about the system you started with. Is that just a part of another system? What system would that be?

If you've got your Case Journal, answer the questions in it now!

Break It Down

Briefing

If a button breaks on a machine, such as a radio or a computer, you can probably still make it work, just not so well. But if an important electronic chip inside breaks, you're in trouble! In this activity, you'll see if how much you can knock out of a system without stopping it completely!



Ready? Go to the activity now!

Activity

What to Do:

On the screen, you'll see a system of blocks with tubes and levers inside. Marbles drop into the top of the system and come out on the right side. As long as they keep hitting the lever at the bottom, the flag will keep waving and the system will keep running.

Your job is to remove as many blocks as you can, without stopping the marbles from hitting the flag pole lever.

To remove a block, just click on it!

If the flag on the right starts going down, it means your system isn't working as well as it was before.

You'll score one point for every block you were able to remove before the flag hit the bottom of the pole.

Finished? On to the debriefing!

Debriefing

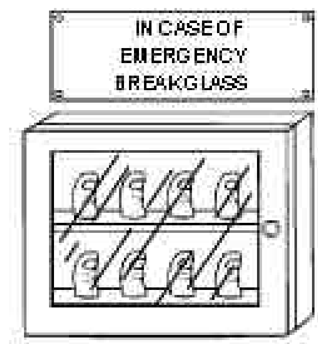
How did you decide which blocks to remove? Did some of them turn out to be more important than others? Were there any blocks that the system was actually better off without?

If you've got your Case Journals, go answer the questions in it now!

Thumbs Away!

Briefing

One of the greatest systems around is your body. Inside and out, it's packed with parts that work together to do amazing things. Take away one of these parts, and your body probably wouldn't work nearly as well. In this Fab Lab, you'll find that out first-hand!



Activity

What You'll Need:

Heavy tape, yarn, or two pieces of fabric, like bandanas or long handkerchiefs.
A shirt or coat with buttons or a zipper (that you can unbutton or unzip without totally undressing!)
Loose-leaf paper
Paper clips
A tennis ball or another soft ball

What to Do:

With your palm facing up, curl your thumb into the palm of your hand.

Wrap the tape, yarn, or fabric around your hand so your thumb can't move. If you're using yarn or fabric, tie it up tight. Make sure all of your other fingers are free to move normally.

Do the same with your other hand. You may need someone to help you!

Your job now is to try and do the following things without using your thumbs:

1. Write your full name (clearly enough so someone else can read it!)
2. Button up a shirt or a coat, or zip up a coat that's completely unzipped
3. Pass out five pieces of loose-leaf paper to five different people
4. Clip several pieces of paper together with a paper clip
5. Play catch with a tennis ball and another thumbless kid. Each of you must catch the ball three times in a row.

Your challenge is to do all of these things in under five minutes. Go!

When you're finished, try to do some other ordinary things without your thumbs. What happens?

Debriefing

Your thumbs are an important part of the system that makes up your hand. (Other parts include your fingers, your palm, and your wrist). What happened when part of the system was missing? Was it harder to do things than you expected?

If you've got your Case Journals, free up your thumbs and answer the questions in it now!

Mission Overview: Voltra

This two-week Mission is based on the historic importance of the Industrial Revolution, and how inventions like the steam engine forever changed human society and influenced modern technology. In particular, the unit focuses on technologies that allowed us to harness power in an efficient and cost-effective manner. The unit also encourages students to look back and see how much has changed since the Industrial Revolution occurred.

The activities for this mission include: **Power Play,** an interactive challenge to make a machine that harnesses energy from a power source; **The March of Progress,** a card game that demonstrates how technologies build on each other; **Divide and Conquer,** an activity that demonstrates the efficiency of the assembly line; **What's New?**, which encourages students to recognize how many recent technological innovations are taken for granted in their daily lives, and **Power of One,** a creative exercise in imagining a world limited to only one kind of power.

The Project 2061 Benchmarks for Science Literacy

10J. Historical Perspectives, Harnessing Power
(There are no Benchmarks for Grades 3-5)

By the end of 8th grade, students should know that:

1. Until the 1800s, most manufacturing was done in homes, using small, handmademachines that were powered by muscle, wind, or running water. New machinery and steam engines to drive them made it possible to replace craftsmanship with factories, using fuels as a source of energy. In the factory system, workers, materials, and energy could be brought together efficiently.

2. The invention of the steam engine was at the center of the Industrial Revolution. It converted the chemical energy stored in wood and coal, which were plentiful, into mechanical work. The steam engine was invented to solve the urgent problem of pumping water out of coal mines. As improved by James Watt, it was soon used to move coal, drive manufacturing machinery, and power locomotives, ships, and even the first automobiles.

To learn more consult these resources:

Books:

Industrial Revolution.
Wilkinson,Philip,and Michael Pollard. Chelsea House Publishers, Inc., Ste 400 P.O. Box 914, Broomall, PA 19008-0914: 1995. 93pp. $18.95.
ISBN 0-7910-2767-8

Full of Energy.
Hewitt,Sally.Full of Energy. Franklin Watts, 90 Sherman Turnpike, Danbury, CT 06816: 1998. 30pp. $20.00. 97-3550. ISBN 0-516-20792-X

Web Links:

A site that shows the major milestones in harnessing energy:

http://www.energyquest.ca.gov/time_machine/index.html

See a working model of a steam engine:

http://www.howstuffworks.com/steam.htm

A site that looks into some of the evolution of the steam engine during the Industrial revolution and the inventors behind these innovations:

http://inventors.about.com/library/inventors/blsteamengine.htm

A site sponsored by the World Almanac that presents kids with a time line of major technological inventions in the last century:

http://www.worldalmanacforkids.com/explore/inventions.html

An informative site that discusses Henry Ford and his creation of the modern assembly line:

http://www.pbs.org/wgbh/aso/databank/entries/dt13as.html

Activity Notes for Leaders: Voltra

Mind Game: POWER PLAY

This online activity challenges players to think about how different energy sources are put to work on wildly divergent tasks. Gone are the days when a spinning windmill's purpose was to rotate a giant grinding stone. Encourage your kids to think about some devices which produce a physical effect that is completely different from the original energy source. Point out how burning oil can power an air conditioner to cool down a room, and that flowing water through a hydro plant can run a hair dryer.

Fab Lab: THE MARCH OF PROGRESS

This is a card game that shows how technologies build on one another. The key to the game is that you can't progress to the next level of technology until certain predecessors have already been invented. Of course, this game is relatively simple and linear; more advanced students might talk about how one invention can lead to two or more inventions, or how one invention can depend on several previous technological innovations.

Move Crew: DIVIDE AND CONQUER

This is an assembly-line activity. First, the students assemble a number of objects on their own from a pile of components. Then they assemble the same objects in an assembly line, and learn which technique is more efficient. You can point out that the assembly line was a key development in the history of manufacturing, and that led to many products today, including cars, toys, and food products.

Smart Art: WHAT'S NEW

In this activity, students study a drawing of a house, and are asked to identify which activities wouldn't have looked the same 200 years ago. Then they draw a new version of the same household using 200-year-old methods to do the same work. Kids should be reminded that electric and battery power were non-existent at the time.

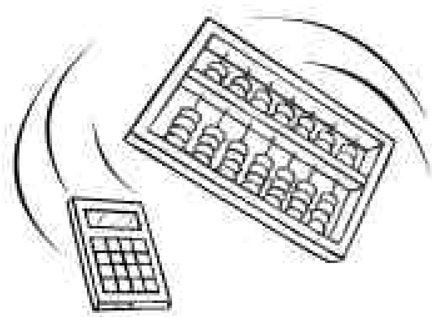
Write Away: POWER OF ONE

This is a whimsical exercise in which the kids are asked to imagine a world that could rely on only one kind of power. Encourage them to be creative in figuring out how their energy source is harnessed and converted into usable work.

What's New?

Briefing

Think of the first three machines you used today. How many of those were around 200 years ago? In this Smart Art, you'll take a look back in time to show just how much things have changed!



Activity

What You'll Need:
A picture of a modern day house.

What to Do:
Look at the picture of the modern day house.

What's going on here that couldn't have been done 200 years ago? What tools and machines are they using that weren't around back then?

Imagine that all these people in the house have to get the exact same stuff done, but it's the year 1800. How would they do it?

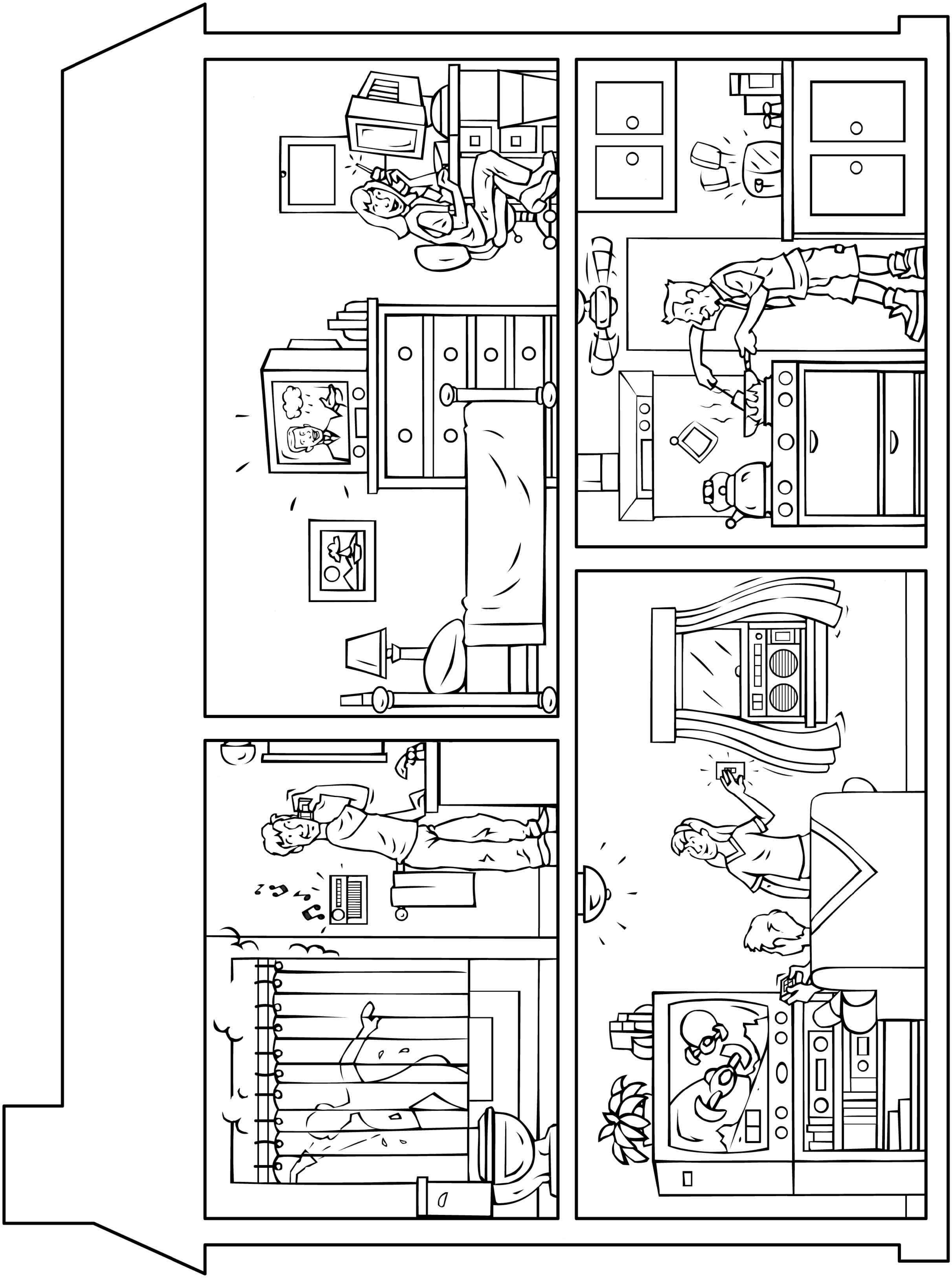
Draw a picture in your Case Journal of what the same house would look like 200 years ago. Make sure that everything that's being done in this picture is still getting done somehow!

Debriefing

How many things did you have to change? How much longer do you think it would take these people to do their chores?

Was there anything in both houses that stayed the same?

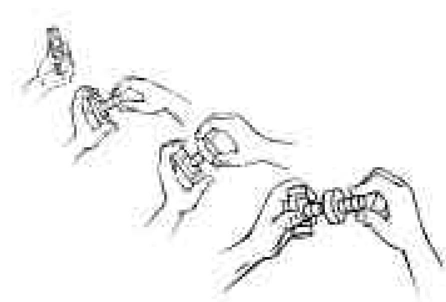
If you've got your Case Journals, go ahead and answer the questions in it now!



Divide and Conquer

Briefing

The Industrial Revolution really got going with the invention of the assembly line. Before then, most things were made one at a time--and each one was put together by a single person. With this activity, you'll see what happens when people divide up tasks and work together.



Activity

What You'll Need:

The big bag of "automobile parts" (If this is the first time playing this activity, you'll need to spend a minute or two preparing all the pieces)

You can use this picture to help you put the car together.

A stopwatch or a nearby clock to record your times

How to Play:

The goal in each round is to make completed cars out of ALL the parts.

ROUND ONE

1.Sort the auto parts into piles. Each pile should have only one kind of part in it.

2.Look over the assembly instructions.

3.In this round, each player will put together as many cars as possible, all by themselves, from start to finish. Everyone works at the same time.

4.Record the time it takes for the whole group to make all the cars.

ROUND TWO

1. Take the cars apart and sort the parts into piles again.

2. This time, assign everyone a specific job. For example, one person's job might be just to put the wheels on.

3. Everyone takes ONLY the piles of parts that they need to do their job.

4. Line up in the best order you can think of to get the job done quickly. The person who has to put the first pieces together should be on one end. The person who has to put the last pieces together should be on the other end.

5. To make the cars, each person does their job and passes what they've done down to the next player.

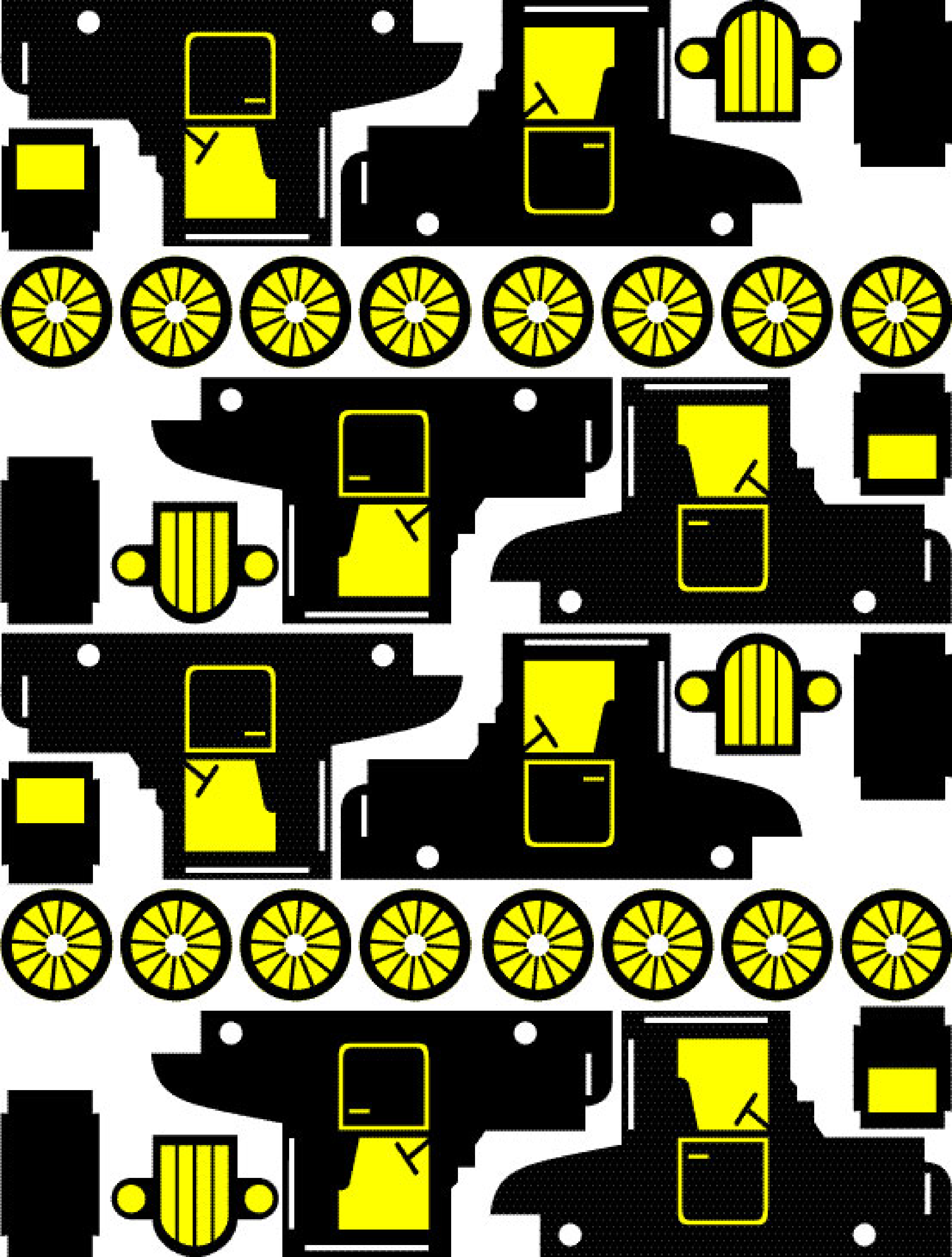
6. Record the time it takes to make all the cars in an assembly line.

Debriefing

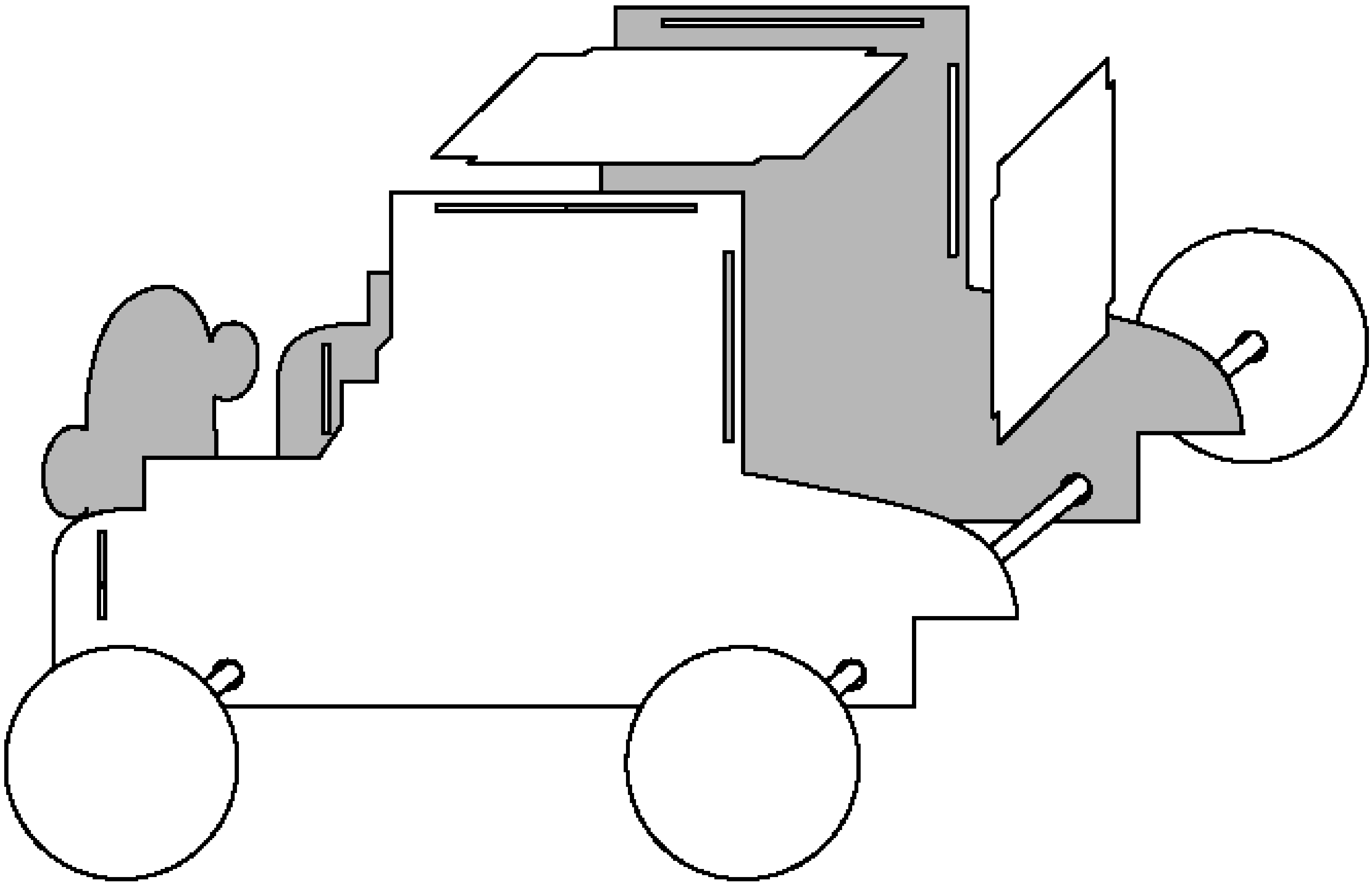
Which method was faster? Why do you think there was a difference?

Did the assembly line get better with practice? If you had to make 100 cars, which method would be better?

If you've got your Case Journals, answer the questions in it now!



Assembly Diagram



Power of One

Briefing

Every day, you and your family use a lot of different kinds of fuel: gasoline for cars and buses; natural gas for heating and cooking; electricity, which is made from other energy sources like coal or nuclear power; and so on. But suppose your whole world had just one energy source? In this Write Away, you'll imagine what that would be like.

Activity

What You'll Need:
A six-sided die (optional)

What to Do:
Imagine that you live in a city with only one source of power. Choose from the list below, or roll the die to pick one at random.

1. Geysers
2. Waterfalls
3. Flocks of sheep
4. A volcano that keeps erupting slowly
5. A colony of big birds
6. Tightly coiled metal springs

Write about what life in this strange town would be like. Fill in the blanks in your Case Journal.

Debriefing

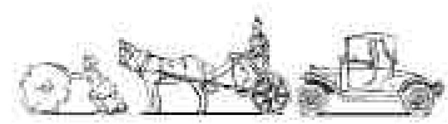
Look at your story again. Does everything you wrote about use ONLY your energy source, or does it require other kinds of energy? Is it possible to do everything with just one kind of energy? Why or why not?

If you've got your Case Journals, go ahead and answer the questions in it now!

The March of Progress

Briefing

Every year, you get better and better at almost everything you do. The same thing happens with technology, but sometimes it takes a lot longer for the changes to happen. In this Fab Lab, you'll follow the growth of some of the most important kinds of technology in the world!



Activity

What you need:
A set of "The March of Progress" cards

About the game:
The object of the game is to collect all the cards from one suit, IN ORDER. By doing that, you'll be re-creating the development of an important technology in history.

There are five suits in the game, which represent different lines of technology: Land Travel, Communication, Flight, Timekeeping, and Farming.

Within each suit, there are five different cards, numbered 1 through 5. The cards numbered "1" show the earliest forms of that technology. The cards numbered "5" show the latest technology. The other cards are steps in between.

Just like in real life, you can't skip from step 1 to step 4! So for example, you can't skip from a hot-air balloon right to the space shuttle. You've got to go through the passenger planes and jet planes first.

Here's how to play:
Everyone sits in a circle.

Shuffle the cards and deal four cards to each player.

The player to the left of the dealer goes first.

On each turn, a player starts by drawing one card from the deck.

Now the player has two choices. EITHER:
1. DISCARD any card that you don't want, face up, into a discard pile in the center of the circle, OR:
2. PLAY one of your cards. You do this by laying the card down, face up, in front of you. See "RULES FOR PLAYING CARDS" below.

Players may draw from the discard pile if they choose, but only the top card.

If the center deck runs out, shuffle the discard pile and turn it over face-down.

The first person to play a complete set of cards from one suit is the winner!

RULES FOR PLAYING CARDS:
You have to play your cards in order, by suit. So:

The first card you play can be from ANY suit, but it MUST be a #1 card.
The next card you play must be a #2 card from the SAME suit.
The next card you play must be a #3 card from the same suit, and so on.

So for example, you can't play a #1 and a #3, and then play a #2 later. And you can't play a #1 from Farming and then a #2 from Flight.

You can save cards in your hand, but you always have to discard or play exactly one card on every turn.

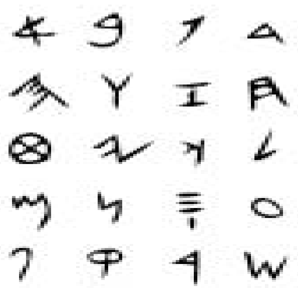
* Exception: You can play any #1 card at any time, but if you already have other cards laid down YOU MUST DISCARD THEM ALL ON THAT TURN. This is called "Switching Off."

Debriefing

What did you find out that you didn't know before? Were there stages of your technology you'd never heard of? How much time passed between some of the important stages on your cards?

If you’ve got your Case Journal, go ahead and answer the questions in it now!

COMMUNICATION 1

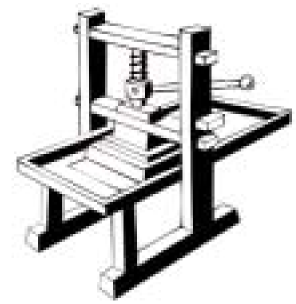


WRITING

(3,500–1,700 B.C.)

Writing allowed people to send messages to others who weren't with them. Early forms of writing were pictures and symbols; alphabets developed later.

COMMUNICATION 2

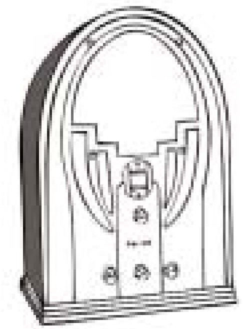


MOVABLE TYPE

(1454)

Once letters could be arranged and re-arranged, a single machine could be used to print any piece of writing. And it became a lot easier to make quick copies.

COMMUNICATION 3

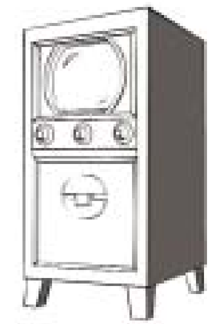


RADIO

(1906)

Radio broadcasts allowed voices and music to be transmitted over long distances.

COMMUNICATION 4



TELEVISION

(1927)

TVs added pictures and moving images to broadcasting.

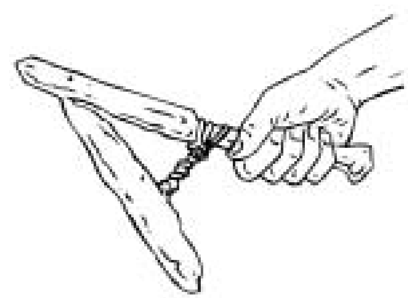
COMMUNICATION 5

INTERNET

(Late 1900s)

Interconnected computers allow instant communication of words, sounds, images, and programs among people around the world.

FARMING 1

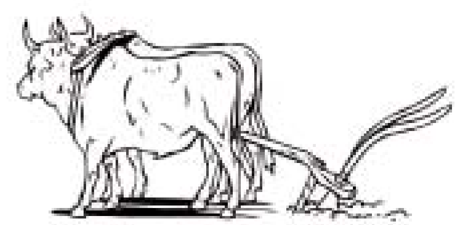


HAND TOOLS

(Prehistoric)

The earliest farmers used stone tools to plow the soil, followed by simple metal hand tools.

FARMING 2

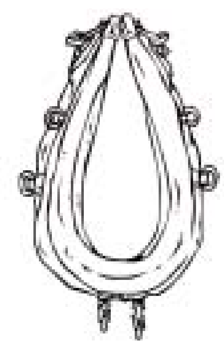


OX-DRAWN PLOW

(4000–3500 B.C.)

First used in China and Mesopotamia, oxen and cattle made it easier to plow large fields and grow more food.

FARMING 3

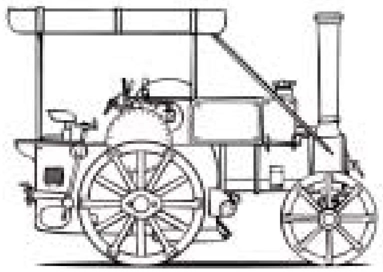


HARD HORSE COLLAR

(1000s)

This simple invention made it possible for horses, which are stronger than cattle, to pull plows.

FARMING 4



STEAM TRACTOR

(Late 1800s)

This made it possible to plow fields without having to rely on animals.

FARMING 5

COMBINE HARVESTER

(Late 1800s)

Harvesters cut stalks of grain, separate it from straw, and remove chaff while moving though the fields. This made farming more efficient than ever before.

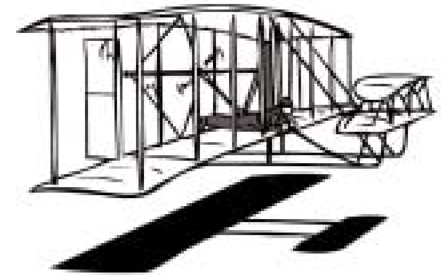
FLIGHT 1

HOT AIR BALLOON

(1783)

Balloons allowed human beings to fly for the first time in history.

FLIGHT 2



AIRPLANE

(1903)

The first working airplanes were launched the Wright Brothers in Kitty Hawk, North Carolina. (The best flight lasted 59 seconds!)

FLIGHT 3

PASSENGER PLANE

(1910s–1930s)

Planes quickly became powerful and reliable enough to carry passengers from one place to another.

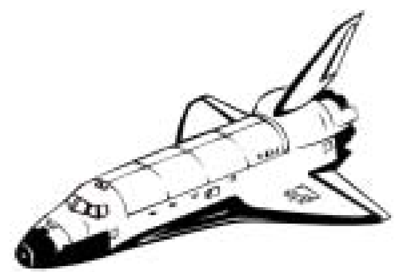
FLIGHT 4

JET PLANE

(1939)

Powerful jet engines helped airplanes go longer distances faster. Today, people can travel to almost any major city on Earth in less than 24 hours.

FLIGHT 5

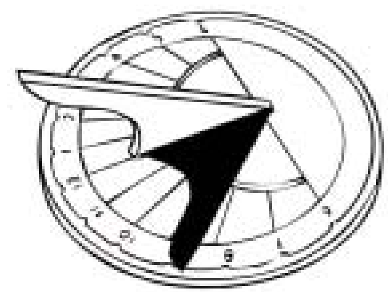


SPACE SHUTTLE

(1981)

Built like an airplane but made for space travel, NASA's space shuttle Columbia became the first re-usable spaceship.

TIME KEEPING 1



SUNDIALS

(2,600 B.C.)

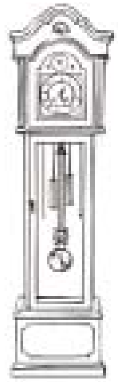
People learned to tell the time from a shadow cast by a pole or wedge.

TIME KEEPING 2

WATER CLOCKS
(1,450 B.C.)

Containers of dripping water measured time by how fast they drained. Unlike a sundial, a water clock works at night or on cloudy days.

TIME KEEPING 3



PENDULUM CLOCK
(1656)

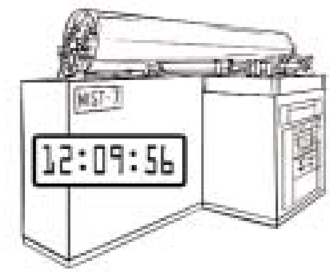
The first accurate mechanical clocks were correct to within one minute per day.

TIME KEEPING 4

QUARTZ CLOCKS
(1929)

Quartz clocks use vibrating crystals to measure the time. Today, they are cheap and very accurate.

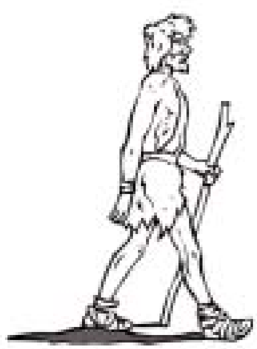
TIME KEEPING 5



ATOMIC CLOCK
(1949)

The atomic clock is the most accurate clock in the world. It uses the vibration of radioactive atoms to tell the time. It is accurate to within 30 billionths of a second per year!

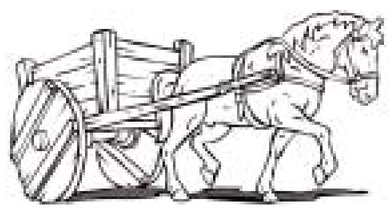
LAND TRAVEL 1



WALKING
(Prehistoric)

The original form of transportation!

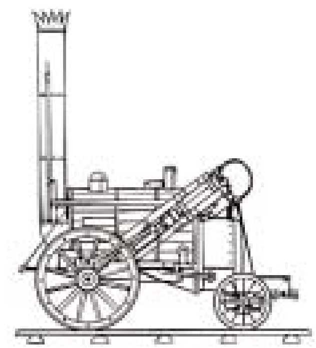
LAND TRAVEL 2



HORSE-DRAWN CART
(3,500 B.C.)

This was the #1 form of land transportation all the way through the 19th century.

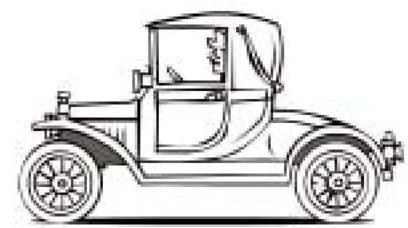
LAND TRAVEL 3



STEAM ENGINE LOCOMOTIVE
(1825)

This made land travel possible at high speeds without help from animals.

LAND TRAVEL 4



GAS POWERED CAR
(1887)

Smaller, simpler, more efficient internal combustion engines helped make cars affordable and practical.

FUEL CELL CAR
(Coming Soon?)

Today, scientists are working hard to develop new engines that use less fuel and create little or no pollution.

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