

THE PENNSYLVANIA GEOLOGY GAME



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Purpose of game: To learn about various sites around PA that pertain to rocks and minerals (and water)

Target audience: Ages 10 to high school

Time need to set up: Allow at least 20 minutes to assemble board and cut out all cards

Time needed to play: This is flexible. You can use only a few task cards and play for about 20-30 minutes, or you can use more task cards and play for 60-90 minutes.

Number of players: 2 to 4 players (maybe up to 6, but for more than that, consider making a second game)

Materials needed: Copies of patterns pages with some printed onto card stock, scissors, glue stick and/or clear tape, a number cube (die), a few pennies or dimes (for closing roads), a piece of thin clear plastic, a few permanent markers to make a dot on the clear plastic

How to assemble the game:

1) Make copies of the pattern pages using a color printer, if possible.

-- If you don't have a color printer yourself and don't know anyone who does, you can always take the file on a memory stick (jump drive) to a copy shop such as Office Depot or Staples and they can print the pages for you. Highest priority for color would be the site cards, then the map pieces.

-- If you have heavy card stock paper available, use it for the site, mineral, and event cards. If you don't have card stock, the game can still be played with these printed onto regular paper.

-- Mineral cards and site cards: Make one set on card stock. (Blank on reverse side.)

-- Event cards: The page with the EVENT CARD labels is provided so that you can print this on the reverse side of your event cards, if you want to. If you are unable to do two-sided printing, just copy the text and leave the flip sides blank.

-- PA counties page: Make a copy for each player. These can be used to help locate the sites on the site cards.

-- Map pages can be printed on either card stock or regular paper. If you want the board to be durable for future use, use card stock and/or have the board laminated at a print shop.

2) Cut apart all the cards and put them into separate piles.

3) Assemble the map

There are two ways to assemble the map. You will notice that there are glue tabs along the sides of some of the pages. You can use these tabs to overlap the pages and use glue stick on the tabs. If you'd rather have clear tape along the creases so that when it gets folded the tape takes the brunt of the fold (instead of the paper itself folding) you can copy the pages onto card stock, cut off the glue tabs, put the pages next to each other with the edges "flush," then apply tape along the seams. Wide mailing tape works very well for this.

4) Make "tokens" for each player. You will need a sheet of clear plastic that is thin but reasonably stiff. A copier transparency would work, as would a piece of plastic from a "bubble wrapped" item you purchased at a store. Plastic food wrap is a little too thin. Cut a 1" x 1" square piece for each player and put a colored dot in the center, about 1/8" diameter using a permanent marker. Each player should have a unique color dot. This is a strange type of token (compared to those standard playing tokens like you use in Monopoly) but these flat clear token will work very well for this game.

NOTE ABOUT THE MAP:

This map is highly simplified and does not show many smaller rivers, state parks, etc. Please feel free to add any rivers, towns, roads or sites that you want to. There are blank site cards that you can use to add extra sites.

OPTIONAL: Cut some 30-mile measuring strips using the scale shown on the map. There are a few EVENT CARDS that require measuring distances.

Getting ready to play:

- 1) Put the EVENT cards on their designated space on the board. Put some ENERGY BOOST cards on their designated spot. (You don't have to put out all of the ENERGY cards. You can start with 10 or so. If you run out you can add more.)
- 2) Distribute site cards and mineral cards to the players. You have a lot of flexibility here. You can control the length and the complexity of the game by determining how many cards to give to each player. For a short game with younger students, use only 3 or 4 site cards and a few mineral cards. For older students, use more. Also you will want to think about whether you will be playing the game just once or several times. If you will be playing several times, you can give out fewer cards per game. If you can only play it once you may want to maximize the potential of the game and use most or all of the cards.

General guidelines for a not-too-long game with ages 10-13:

- 1 Cave card
- 1 Coal mine card
- 4 other site cards
- 1 limestone card
- 3 other mineral cards

It is up to you whether to distribute the cards at random or let the players choose sites that are of interest to them. If you let them choose, make sure they do not choose simply on the basis of location (choosing sites that are all in one place!).

BONUS FEATURE OF SITE CARDS: Many of these sites have videos that go with them. I have started a playlist called "PA Virtual Field Trips" on www.YouTube.com/TheBasementWorkshop.

Also, if you'd like to know more about mineral collecting in PA, go to Google and search using key words "John Betts mineral gallery Pennsylvania." The first listing will be for a fabulous virtual museum of mineral specimens collected right here in PA. You may want to add more mineral cards if you are especially interested in rock and mineral collecting.

NOTES:

- LIMESTONE can be found just about anywhere in PA. Random sites had to be chosen for the sake of simplifying the game board. Effort was made to try to coordinate these sites with places where limestone is actually mined currently, but this cannot be guaranteed.
- The sites marked COAL represent places where there are active coal mines (as of 2014).
- There are thousands of GAS wells across western PA, so random sites had to be chosen. The main point is that gas is mainly located in western PA, in bituminous areas. Eastern PA has anthracite coal and a wider variety of minerals. (For more info on PA coal, check out the coal videos on the playlist mentioned above.)
- The mineral collection sites (except for the chert) are probably not the only areas where you can find these minerals. However, they do roughly correspond to exact locations, especially concerning the counties the minerals are found in. Effort was made to be approximately correct, if that makes sense. ;) In other words, you won't be learning anything wrong. All sites are valid, but you could legitimately add other sites in many cases. However, adding too many sites makes the game board look cluttered and confusing to the players.

How to play:

- 1) The goal is to get across the state, having visited all your sites on the way across. The first player to visit all his sites and then get to the other side wins the game. (But we all win because we learned so much! :)
- 2) Players need to choose one of the highway signs as their starting point. It does not matter whether they choose to go west to east, or east to west. Players put their plastic "tokens" on their chosen starting point.
- 3) Players should take a few minutes to find all their site locations on the map so they know where they need to go. County locations are given in the site descriptions (on the site cards). Find the county on the county map and you'll have an approximate idea of where to look for the site on the large map. This is great practice for learning the counties.
- 4) Players move by rolling the die. They may use all of the "hops" on their roll, regardless of whether they stop at a destination. For example, if you roll a 5 and you are only 2 hops away from your destination, you may move 2 spaces, turn over your destination card, then continue on 3 more spaces. This is done in order to keep the game moving quickly. (The other option was to use a pair of dice, but a single die with bonus rolls seemed easier.)

5) Visiting a site: When players land on one of their sites, they turn that card over, indicating they've completed that task. The same for rock/mineral collecting-- just turn the card over after landing on the rock/mineral site.

6) "TO PASS OR NOT TO PASS?" YOU DECIDE...

The game was originally designed to have a "no passing" rule, in order to make it more challenging for older players. No passing means that players can't "hop" over each other's tokens. The players have to take alternate routes to avoid running into each other. However, if this rule complicates the game too much for your players, you can eliminate it.

7) ENERGY BOOST cards:

These are collected when a player lands on a COAL or GAS site. (GAS means "natural gas," of course, not liquid gasoline.) Coal and gas often occur in the same area. (To make speed up the game, you can allow players to pick up a boost card as they go past the energy dots, not requiring them to make the one hop over to the circle.)

Energy boost cards are kept in your hand for whenever you really need an extra roll. For example, if you roll a 2 and need some extra hops to get to a destination, use one of your boost cards and get a bonus roll. (To use the card, just return it to the pile and let it be recycled.) You can only use one energy boost per turn.

NOTE: These coal sites represent areas that are still being actively mined for coal. The site cards that feature coal mines are old mines that are no longer operating and are just for tourism. Operating coal mines can't give tours.

8) EVENT cards:

When a player rolls a 1, an event card is drawn. (The player can still move his one space, then draw the card.) Often, the card will give instructions that involve all the players. (In this way, everyone is kept actively engaged in the game even during other players' turns.) Follow the instructions on the event card. A few cards have you blocking off a roadway for a short time. You can use pennies or dimes on the ends of the roadway, just like cones are used to mark real construction sites. You can determine exactly where to put the coin. It won't matter whether it is on an intersection or not--just choose how to want to do it. The main point is to keep the game lively and interesting. After an event card is used, put it on the bottom of the pile.

NOTE: If you are playing a short game and don't think you'll use all of the event cards, sort through them ahead of time and pick out the ones that are most appropriate for your group.

OPTION: Feel free to add your own event cards to the game. You may have some great ideas for twists and turn of fate that add drama to the game!

POP QUIZ CARDS: You will notice that some of the questions are multiple choice. If you are playing with 4 players, this means that if the first two players miss the question, the third player will only have one option left and will automatically get it right.

FOR SITUATIONS NOT COVERED IN THESE RULES:

If you come up with an unusual situation that is not covered here, just agree on a rule that suits everyone playing the game, and that will be your new rule. As long as everyone plays by the same rules, the game is fair.

EXTRA RESOURCES:

For information about non-fuel mineral resources in PA here is a booklet that could be used with ages 10 and up:

http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_014590.pdf

(This booklet has a lot of info about limestone. There are other uses for it besides the ones mentioned on the limestone mineral card. It's amazing how many things you can do with the chemicals in limestone! Lots of good info about all the other minerals, too.)

For a virtual online museum containing pictures of hundreds of collected mineral specimens from PA:

www.johnbetts-fineminerals.com/jhbnyc/mineralmuseum/gallery.php?st=501&init=&loc=Pennsylvania

For virtual field trips to some of the sites on the map:

www.YouTube.com/TheBasementWorkshop

LIST OF SITES

PETROGLYPHS

Sugar Grove petroglyphs (Greene)
Smith's Ferry petroglyphs (Beaver)
Indian Rocks petroglyphs (border of York and Lancaster)
Parkers Landing petroglyphs (Clarion)
Indian God Rock (Venango)

ROCKS

Dinosaur Rock (Lebanon)
Ticklish Rock (Sullivan)
Balanced Rock (huntingdon)
Jakes Rocks (Warren)
Devil's Den (Adams)
Rock Garden at World's End State Park (Sullivan)
Archrock Roadcut (Juniata)

MINES / COAL

Lackawanna Coal Mine (Lackawanna)
Seldom Seen Coal Mine (Cambria)
Pioneer Tunnel Coal Mine (Skuykill)
Number 9 Coal Mine (Skuykill)
Centralia underground mine fire (Columbia)

GLACIER FORMATIONS

Moraine State Park (Butler)
Boulder Field at Hickory Run State Park (Carbon)
Whaleback (Northumberland)
Shohola Stone (Pike)
West Liberty Esker (Butler)

CAVES

These are easily found by looking for the bat symbols.

Lincoln Caverns
Indian Caverns
Crystal Caverns
Penn's Cave
Laurel Caverns
Woodward Cave
Coral Cave

FOSSIL SITES

Ambridge, ferns (Beaver)
Swatara Gap (Lebanon and Skuykill)
Dinosaur tracks (Montgomery)
Centerfield Coral Reef (Monroe)

WATER RELATED

Potholes at Conewago Falls (Dauphin)
Bushkill Falls (Pike)
Ohiopyle Falls (Fayette)
Archblad Pothole (Lackawanna)
Frankfort Mineral Springs (Beaver)
Slippery Rock Gorge / McConnells Mill (Lawrence)
Boiling Springs (Cumberland)

SCENIC VIEWS

PA Grand Canyon (Tioga)
Mt. Davis (Somerset)
Mt. Nittany (Centre)
Presque Isle (Erie)
Cherry Springs Vista (Potter)

Note: I originally had the Johnstown Flood Museum also listed as a site. When typing up the cards, this seemed like an extra that would not fit nicely on the pages. I left it on the large map, but took it off the list of places. If you would like to add this site card, just use one of the extra blank cards and make a card for it.

LIST OF ROCKS and MINERALS and where to look for them:

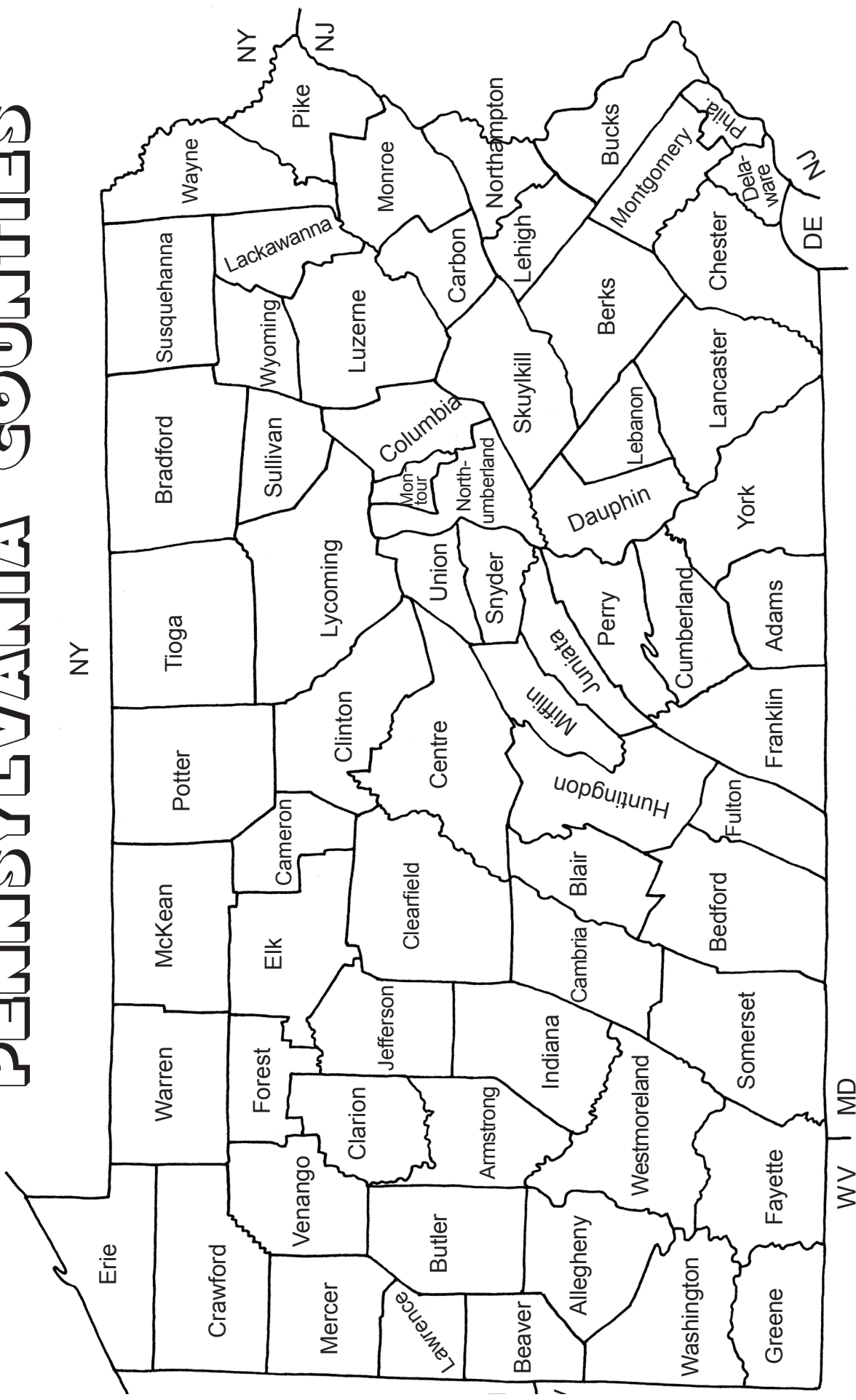
Aggregate (Erie, Crawford, Warren)
Amethyst (Delaware, Chester)
Beryl (Delaware, Chester)
Calcite (York, Lancaster, Delaware)
Copper (York, Lancaster, Montgomery)
Diabase (Chester)
Feldspar (Delaware, Chester)
Garnet (Delaware, Chester)
Gneiss (Delaware) (*pronounced: "nice"*)
Gold (Lancaster, York)
Graphite (Bucks, Lehigh)

Gravel (Pike, Tioga)
Iron (Centre, Huntingdon,
Lead (Blair, Lancaster, Montgomery)
Limestone (all over PA)
Magnetite (Chester, Berks, Lebanon, Philadelphia)
Malachite (Lebanon, Berks, Chester)
Nickel (Lancaster)
Öolitic chert (Centre) (*pronounced: "oh-oh-lit-ik"*)
Pyrite (Centre, Chester, Lebanon, Lancaster, Luzerne,
Berks, Montgomery)
Rutile (Chester)
Salt (Bradford, Crawford, Indiana)
Shale (many places in PA but in this game the sites
are Pike, Susquehanna, Potter)
Silver (Lancaster, York)

NOTE: This list is to show trends, not always exact locations (although in the case of öolitic chert, it is found in only this one tiny place in the state). For example, there could be a salt deposit somewhere other than the three counties listed, but by and large these three counties are a fairly accurate representation of where salt is found.

Iron is found in other places, but in smaller quantities. Gravel might be found in counties adjacent to those listed. Also, this is not a complete list. You might want to add other minerals such as zinc (Montgomery, Lehigh, Cumberland), mica (Berks, Chester), talc (Lancaster), asbestos (Chester, Delaware, Lancaster, Northampton) or uranium (Carbon) or others you may know about.

PENNSYLVANIA COUNTIES



The first counties to be established were Philadelphia, Chester and Bucks, in 1682. The last was Lackawanna in 1878.
 The Native Peoples of Pennsylvania were the Lenape (Delawares), The Susquehannocks, the Shawnee and the Seneca.
 The names of 12 counties (and many other place names) come from the languages of these native peoples.

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<h2>SINKHOLE</h2> <p>PA is basically a limestone state. Groundwater can erode the underground limestone fairly easily, causing empty areas that can suddenly collapse, forming depressions called sinkholes. A sinkhole just opened up (not really--only in our game) along 322 between Brookville and Philipsburg. Anyone on this section of road right now will need to move forward or backup until they are clear of this area. This section of road will remain closed until someone rolls a 6. (Tip: Use pennies to block off this section.)</p>	<h2>HELICOPTER</h2> <p><i>This card is only for the person who picked it up.</i></p> <p>Give yourself a helicopter ride to any location or road dot inside a State Park or State Forest. (If you don't want to use this card, you may trade it to another player for one of their energy boost cards. They may use this card on their next turn instead of rolling the die.)</p>	<h2>EARTHQUAKE</h2> <p>The most severe earthquake PA has ever had was 5.2 on the Richter scale. That's enough to rattle windows, but not enough to cause major damage.</p> <p>If your token is within 30 miles of one of the epicenter symbols, move 3 spaces in any direction that is away from the quake.</p>
<h2>SIRENS</h2> <p>The person holding this card just got stopped for speeding. To slow you down a bit, you must pick up an extra mineral card.</p>	<h2>HELICOPTER</h2> <p><i>This card is only for the person who picked it up.</i></p> <p>Give yourself a helicopter ride to any exit on Interstate 80. If you don't want to use this card, you may trade it to another player for one of their energy boost cards. They may use the helicopter on their next turn instead of rolling the die.</p>	<h2>EARTHQUAKE</h2> <p>There have been over 100 quakes in PA since 1724. Often the tremors are felt in neighboring states. (The most recent quake felt by Pennsylvanians (in 2011) originated in Virginia, not PA.)</p> <p>If your token is within 10 miles of an earthquake symbol, move 5 spaces in any direction that is away from the quake.</p>
<h2>ROAD WORK</h2> <p>Close the Turnpike from Monroeville to Bedford. (If you are on this section of road right now, move enough spaces so that you are no longer on it.) As soon as someone rolls a 6 you can open the road again. (Use pennies at either end of the road to remind everyone it is closed.)</p>	<h2>ROAD WORK</h2> <p>Close 476 from Scranton to Allentown. (If you are on this section of road right now, move enough spaces so that you are no longer on it.) As soon as someone rolls a 6 you can open the road again. (Use pennies at either end of the road to remind everyone it is closed.)</p>	<h2>FLOODING</h2> <p>Flash flooding is often a problem in PA. Unfortunately, flooding has closed Route 8. If you are on it now, move enough spaces to get to safety. As soon as someone rolls a 6 the road will be safe for travel again. (Use pennies on the road as a reminder it is closed.)</p>

<p>If any player has ever visited the PA Grand Canyon or hiked any part of the Appalachian Trail (in real life) he or she may move 2 extra spaces right now.</p>	<p>The Appalachian Trail goes along the Appalachian Mountains from Georgia to Maine. Part of the trail goes through PA.</p> <p>If you are south of the dotted Trail line, you may move your token to any mineral site south of the Trail.</p> <p>(If you have already turned over all your mineral cards, you may move your token 4 spaces.)</p>	<p>If you, the person holding this card, have ever actually been to any of the caves on this map (in real life), you may move your token to any of the caves on the map. (Hint: Even if you have already turned over your cave card, look to see if there is a cave close to where your other destinations are.) You may pass and not use this card if you'd rather stay where you are right now.</p>
<p>Roads that go east to west have even numbers. If you are on an east/west road, you may go 2 space east or west.</p> <p>(If the road you are on is not marked, you can't use this card even if the road looks like it is running east to west. The road has to be numbered.)</p>	<p>Ground Hog Day (February 2) is a big event in PA! The official Ground Hog Day town is Punxsutawney. In their sunrise ceremony, if the ground hog sees his shadow this means there will be six more weeks of winter. This is one day you hope will be cloudy!</p> <p>Anyone within 50 miles of Punxsutawny gets to move 3 extra spaces right now.</p>	<p>If you, the person holding this card, have ever actually been to any of the tourist coal mines on this map (in real life), you may move your token to any of the four coal mine spaces. (Hint: Even if you have already turned over your mine card, look to see if there is a mine close to where your other destinations are.) You may pass and not use this card if you'd rather stay where you are right now.</p>
<p>Traffic on the turnpike is very heavy right now. The signs are flashing, "Be prepared for delays." If you are on the turnpike, you will only be allowed to move 1 space on your next move (but without drawing an event card). You won't have to roll the die; you already know you will be moving 1. Sorry, but these things to happen when you travel!</p>	<p>If the place where you are right now (where you are sitting, playing this game) is within 30 miles of a PA border, all players may go to one of their destinations instantly (like a science fiction transporter!).</p>	<p>The dotted line represents the southern edge (approximately) of a huge ancient glacier. This glacier covered the top of North America! Many geological features in this area were affected by the melting glacier. (It created potholes and eskers.)</p> <p>Anyone who is north of the dotted glacier line may move up to 3 spaces in any direction. Go ahead and move right now.</p>

<p>POP QUIZ!</p> <p>Ask this question to the person on your right. If they guess correctly, they may move 4 extra spaces. If they don't get it right, ask the next person. If they miss, keep going around the circle. If no one gets it right, the questioner (you) may take the extra 4 moves. But give the right answer before you do!</p> <p>What radioactive gas is commonly found in the ground all over PA, but in especially great quantities in eastern PA in the areas where anthracite coal is found?</p> <p>a) methane b) xenon *c) radon</p>	<p>POP QUIZ!</p> <p>Ask this question to the person on your right. If they guess correctly, they may move 4 extra spaces. If they don't get it right, ask the next person. If they miss, keep going around the circle. If no one gets it right, the questioner (you) may take the extra 4 moves. But give the right answer before you do!</p> <p>What is the PA state tree? (the eastern hemlock)</p>	<p>POP QUIZ!</p> <p>Ask this question to the person on your right. If they guess correctly, they may move 4 extra spaces. If they don't get it right, ask the next person. If they miss, keep going around the circle. If no one gets it right, the questioner (you) may take the extra 4 moves. But give the right answer before you do!</p> <p>What is the PA state bird? (the ruffed grouse)</p>
<p>POP QUIZ!</p> <p>Ask this question to the person on your right. If they guess correctly, they may move 4 extra spaces. If they don't get it right, ask the next person. If they miss, keep going around the circle. If no one gets it right, the questioner (you) may take the extra 4 moves. But give the right answer before you do!</p> <p>How many National Forests does PA have? (1: Allegheny National Forest)</p>	<p>POP QUIZ!</p> <p>Ask this question to the person on your right. If they guess correctly, they may move 4 extra spaces. If they don't get it right, ask the next person. If they miss, keep going around the circle. If no one gets it right, the questioner (you) may take the extra 4 moves. But give the right answer before you do!</p> <p>Who carved PA's petroglyphs? a) Iroquois *b) Algonquins c) Sioux</p>	<p>POP QUIZ!</p> <p>Ask this question to the person on your right. If they guess correctly, they may move 4 extra spaces. If they don't get it right, ask the next person. If they miss, keep going around the circle. If no one gets it right, the questioner (you) may take the extra 4 moves. But give the right answer before you do!</p> <p>What is the PA state fossil? (the trilobite)</p>
<p>POP QUIZ!</p> <p>Ask this question to the person on your right. If they guess correctly, they may move 4 extra spaces. If they don't get it right, ask the next person. If they miss, keep going around the circle. If no one gets it right, the questioner (you) may take the extra 4 moves. But give the right answer before you do!</p> <p>What radioactive element can be found in some PA rocks? *a) uranium b) plutonium c) thorium</p>	<p>POP QUIZ!</p> <p>Ask this question to the person on your right. If they guess correctly, they may move 4 extra spaces. If they don't get it right, ask the next person. If they miss, keep going around the circle. If no one gets it right, the questioner (you) may take the extra 4 moves. But give the right answer before you do!</p> <p>What PA rock formation played a role in a Civil War battle? (Devil's Den) Gettysburg</p>	<p>POP QUIZ!</p> <p>Ask this question to the person on your right. If they guess correctly, they may move 4 extra spaces. If they don't get it right, ask the next person. If they miss, keep going around the circle. If no one gets it right, the questioner (you) may take the extra 4 moves. But give the right answer before you do!</p> <p>What is the most abundant type of rock in PA? (limestone)</p>

	<p>If you are holding a site card for a water feature, you may move 2 extra spaces right now.</p> <p>(Water features would include waterfalls, Boiling Springs, Frankfort Mineral Springs, and Presque Isle beach.)</p>	<p>If are holding a card for a rock formation that involved glaciers, you may go there immediately.</p> <p>(This would include West Liberty Esker, Shohola Stone, Archbald Pothole, Jakes Rocks, Boulder Field and Whaleback Anticline.)</p>
	<p>Anyone who has all their cards turned over, or has only one card left, must take another site card.</p>	<p><i>These instructions are only for the person who picked up this card.</i></p> <p>Trade one of your cards for another player's card. <i>(Hint: You might want to choose a card for a location you happen to be close to at the moment.)</i></p>
	<p><i>These instructions are only for the person who picked up this card.</i></p> <p>You are traveling with a seismographer (a person who studies earthquakes). Move your token to a road dot that is close to any of the earthquake epicenter symbols, so that the scientist can do some research there.</p>	<p><i>These instructions are only for the person who picked up this card.</i></p> <p>Trade one of your cards for another player's card. <i>(Hint: You might want to choose a card for a location you happen to be close to at the moment.)</i></p>

THE BLANK CARDS CAN BE USED TO ADD YOUR OWN EVENT CARDS.