

TRUE MATH™

Math Facts to Use and Amuse!

Aristoplay's TRUE MATH™ is the second in a series of question-and-answer games that are everything *but* trivia. Like Aristoplay's popular NOVA™ TRUE SCIENCE® game, TRUE MATH™ will surprise, challenge, and even entertain you! Of course, TRUE MATH™ will also inform you. The 900 questions are based on math of the most relevant and intriguing kind:

- *math that makes you think about the real world*
- *math that encourages you to solve everyday problems using common sense, logic, and thinking skills.*
- *Sometimes, it's simply math that makes you smile.*

Our goal in creating TRUE MATH™ is not to test your skills at reciting multiplication tables. Practicing computation has its place in math education. But TRUE MATH™ is more about mental math—using your head to estimate whether an answer is even in the ballpark, for example. It's about applying math in situations we all encounter in our lives. It's about understanding how math is the language of science, architecture, engineering, art—almost any discipline.

As you zip around the game board, you will answer questions in six categories: **Numbers, Money, Size & Scale, Geometry, Logical Thinking, and Random Access** (anything goes). On the "True/False" level, decide if a statement is true or false by using knowledge, logic, or if all else fails, guesswork. With a 50-50 chance of being right, anyone can feel great about playing the game and learning math on this level. The "Genius" level has challenging short answer questions. Some are downright hard. But here's a hint: Some Genius questions build on information in the True/False cards. It pays to read the full answer to each question.

Strategy and luck count, too. **Binary Boosts** (roll again) and **Chaos Spaces** (jump across the board), and **Pop Quizzes** (use knowledge to win an opponents' card) can turn the game around. Plus, a **Euclid's Gamble** rule allows you to wager a card on the knowledge of another player. Ready to play? Let math entertain you . . .

PLAYERS

2 to 4, ages 10 and up

GAME MATERIALS

Geodesic Game Board

4 Playing Pieces

200 TRUE/FALSE cards

100 GENIUS cards

1 die

Rule Booklet

Have scrap paper and pencils handy. Calculators are allowed, but not essential.

OBJECT OF THE GAME

Be the first player to score 50 points by answering TRUE/FALSE (5 point) and GENIUS (10 point) questions in any of the six categories. Then take the Final Exam by answering three out of three TRUE/FALSE or two out of three GENIUS questions on the same card to win.

RULES FOR PLAYING

1. SETTING UP: Choose a playing piece and put it on START.

Shuffle well the TRUE/FALSE cards and deal out one per player to give players a head start in collecting points. Split the rest of the cards roughly in thirds, and put each deck question-side down on the three TRUE/FALSE spaces on the board.

Shuffle well the GENIUS cards and put this deck on the GENIUS space, question-side down.

2. CARD CATEGORIES: Note the categories (Numbers, Money, Geometry, Size & Scale, Logical Thinking or Random Access) of the four top cards. They match the Polygons on the board and indicate where you should try to land. For example, when a Money card is showing, head for the Money Polygon to get a chance to answer a question from the Money card(s).

3. WHO GOES FIRST: The youngest player starts; play continues to the left.

4. TO TAKE A TURN: Roll the die and move your piece in any direction. Once you pick a direction, stick with it for that turn. You can't go back and forth between spaces; you have to move forward. Spaces include Dot, Polygon, Binary Boost and Chaos. Here's what happens when you land on each one.



5. DOTS/ POP QUIZZES: When you land on a Dot, your turn ends UNLESS an opponent who has cards is on the same Dot. Then you can take a Pop Quiz and try to win a card from your opponent. To take a Pop Quiz your opponent asks you all three questions on any one of his or her cards. If you correctly answer three TRUE/FALSE or two GENIUS questions, you win the opponent's card. Otherwise, you don't. Either way, your turn ends.



6. BINARY BOOST: Take another turn by rolling again.

7. CHAOS SPACE: If you land on a pink or green Chaos Space, jump to any Chaos Space of the same color. Keep moving according to the roll on your die. Example: You roll six. Move two spaces to a pink Chaos Space, jump to another pink Chaos Space, and move three more spaces.



8. POLYGONS: You don't need an exact roll to land on a Polygon. Just stop when you reach one and give up any remaining moves on the die.

The player on your left draws all top cards that are in the same category as the Polygon on which you have landed (i.e. Geometry cards if you're on the Geometry Polygon). For GENIUS cards, see rule 9 before the card is drawn. If no top cards match the category, your turn ends.

For each card drawn, your opponent asks the question that matches the die. Example: You rolled a 4. The player asks the 3-4 question. If you answer correctly, you win the card. If not, the card goes to the bottom of the deck. Either way, your turn ends.



9. EUCLID'S GAMBLE (Optional advanced rule): Before a player answers a GENIUS question, other players may wager one of their cards on the outcome. Secretly place any card question-side up to bet "Yes, the answer will be right." Put it question-side down to bet "No, the answer will be wrong." (Cover your bet with scrap paper.) The player taking a turn answers the GENIUS question and wins or doesn't win the card as usual (rule 8).

Winning Bet: If you bet correctly, draw a card of equal value to the one you wagered. Example: You wager a TRUE/FALSE card that the player will get the question right. The player does, and so you draw a TRUE/FALSE card from the deck of your choice.

Losing Bet: Forfeit the wagered card to the bottom of a deck.

10. WINNING: Earn 5 points per TRUE/FALSE card or 10 points per GENIUS card. The cards can be in any categories. When you have 50 points, head for Finish.

When you land on Finish (you don't need an exact roll), take the Final Exam. The player on your left draws the top card from any deck and asks all three questions. If you answer three TRUE/FALSE questions or two GENIUS questions correctly, you win. If not, return the card to the deck and try again next turn. You don't have to roll; just stay on Finish. The first player to pass the Final Exam wins.

VARIATIONS

SHORTER GAME

Play to 35 points, skip the Final Exam, or set a time limit. In the last case, the winner is the player with the most points when the time is up.

EASIER PLAY

Skip the Euclid's Gamble rule, the Final Exam phase, and all of the GENIUS cards. Split the TRUE/FALSE cards evenly on the four spaces on the board.

MORE CHALLENGING PLAY

Split the GENIUS deck in half and place the two decks on the board. Put TRUE/FALSE cards on the other two spaces. Play to 75 or 100 points.

MORE STRATEGIC PLAY

During a Euclid's Gamble, allow players to bet more than one card. If the player answering the question gets it right, he or she wins double the points (two cards instead of one), no matter how others bet.

TEAM PLAY

Two or more players can team up to answer questions. Team play is recommended in a classroom setting.

QUESTIONS YOU MAY HAVE

Can I use a calculator?

Sure, go ahead. But you don't need one. The problems are solvable in your head or on scrap paper. In many cases, you don't have to calculate the solution; you just need to estimate whether an answer is reasonable.

Do I have to stop on a Polygon?

No. If no matching cards are showing, *avoid* stopping on a Polygon. (The next question explains why.) The Polygon counts as a space as you move past it.

What if I start my turn on a Polygon, and a matching card is showing?

Can I just answer the question?

No. You still have to roll and move, as usual. This means you'll have to leave the Polygon. The only way to get back to the Polygon on the same turn is to land on a Binary Boost, roll again, and get a high enough second roll to return where you started.

If I land on Numbers and two Numbers cards are showing, can I win both of them?

Yes, as long as you answer the questions correctly. You can try to win all the cards showing in a matching category. For each card, answer the question that matches the roll of your die (1-2, 3-4, or 5-6). You can only answer questions that are showing at the time you land on Polygon. Example: You land on Numbers, draw a Numbers card, and a second Numbers card is just below it. You can only go for the first Numbers card on this turn.

If I land on a Polygon and both a True/False and a Genius card are showing, which one do I answer first?

The TRUE/FALSE question. After you answer it, your opponents can

place bets (see Euclid's Gamble, rule 9). Then you answer the GENIUS question.

Can two players land on the same Polygon or Chaos Space?

Sure. Nothing special happens, though. You can only do a Pop Quiz when the other player is on a Dot and has cards.

Are the 5-6 questions harder than the 3-4 and 1-2 questions?

No. All the questions on a card are about the same level. The GENIUS cards are harder than the TRUE/FALSE cards. Sometimes, they're *much* harder.

During a Euclid's Gamble, does the person reading the question have an advantage in betting?

No. All players must place their bets *before* the card is drawn. As soon as the player draws the card, the betting is closed.

Do I have to place a bet?

No. The Euclid's Gamble is optional. So is the Pop Quiz actually, but you have nothing to lose by going for it.

Can I bet on a player answering Genius questions during a Pop Quiz?

No. You can only bet on players who are on a Polygon and are about to answer a GENIUS question from the deck.

What if I land on a player who doesn't have any cards for me to win?

Landing on a player who is on a Dot and who is holding cards is the only way you can do a Pop Quiz. If the player isn't on a Dot or doesn't have cards, nothing happens. Your turn just ends.

Can I make two Chaos jumps on one turn?

No. The limit is one jump per turn.

What if I lose a card on the way to Finish and no longer have 50 points?

You'll have to recoup your loss before taking the Final Exam.

How can you stop someone who's really far ahead?

One way is to follow the leader and keep trying to land on him or her. Of course, you'll still have to pass the Pop Quiz to win a card.

What do we do about question disputes?

We recommend extreme leniency. The kinder you are to your fellow players, the kinder they will be to you. Certainly, the answers that are explanations or definitions don't have to be word for word. You can also call a replay in which the player answers the next question on the card. If you believe a card has a wrong answer, see "If You Spot an Error" at the end of this booklet.

A BRIEF WORD ABOUT THE CATEGORIES

Casting a net into the sea will yield a fraction of the school of fish swimming right next to the boat. If that net were called "mathematics," it would be squirming with numbers, equations, and formulas.

Now imagine a "math net" so broad that it's capable of capturing thousands of species of fish, fish that had steered clear of math type things. One of the goals of TRUE MATH™ is to widen the "mathematics" net to lure in new "species" from all walks of life who are turned off to math. The 900 questions in TRUE MATH™ do this in a number of ways.

First, the questions link math to art, science, nature, engineering, architecture, economics, shopping, sports, cooking, and many other areas of interest. If you're a nature lover, math questions about nature are more palatable and interesting. If you recognize math while cooking in your kitchen, driving on the road, playing in a ball game, it becomes more relevant and fun.

Second, our definition of math itself is broad. In TRUE MATH™, the 900 questions include numbers (of course), but also shapes, patterns, problem solving strategies, thinking skills, and (also important) just-for-fun stuff.

Third, TRUE MATH™ is a game. What could be a more enticing way to learn a difficult subject? The questions have humor, fascinating facts, and hands-on activities to do on the spot.

The point is simple: math is for anyone, anywhere, any time.

Here's a brief description of the six broad categories in the TRUE MATH™ game.

Numbers:

Sometimes we take numbers for granted. Take zip codes. We use them often. We even have one of our own. But do we really know what those numbers mean? Postal workers could tell you because it's their job. Each number in the code corresponds to a geographic area.

Understanding numbers and codes can enrich our lives. Consider area codes, bar codes, magazine labels, bank accounts, three-letter designations for airports (another type of code), and so on. Knowing how to read these everyday codes is math at its most relevant.

Computation skills dominate this category, which includes: adding, subtracting, multiplying, dividing, fractions, decimals, negative numbers, Roman numerals, pre-algebra, very large numbers, equations, prime numbers, greater than and less than, rounding, factors, multiples, square numbers, percents, and ratios.

Estimation is also a key skill here (and with Money). One criticism of math education is that students know how to compute on paper and pencil. But when they get an answer that's way off, they don't always recognize it. Practicing estimation and thinking skills is a good remedy.

Money:

Money could fall under the Numbers category. But we gave it separate billing for a simple reason. In real life just about everybody has money, wants it, gives it, exchanges it, and works for it. Money is a universal, daily application of math that begins at a very young age. Adults who "can't do decimals" can (somehow) add money values with dollars and cents. Children who struggle with multiples (5, 10, 15), can (strangely) count out multiples of bills. It's a topic that unfailingly seems to motivate everyone.

A few other skills and topics in the Money category include: computation, mental math (computing in their heads), estimating, making change, budgeting, and very large numbers.

Several questions deal with the currency itself—how it's made, how much it costs to make it, whose picture is on it, and how many are in a bank roll. We all handle currency every day, and these questions help

children appreciate it. A few are just fascinating trivia. And then there's economics: wages and salaries, paying taxes, budgeting, understanding the national debt, investments (Treasury bills, bonds), and so on.

Size & Scale:

You probably recognize 32°F as the freezing point of water. You even have a clear picture of how cold that is. But cold compared to what? What if it were -40°F ? 32°F would seem balmy. Or what if it were 109°F in the shade? 32°F is, well, freezing cold. It's all relative. Scales assign values (often arbitrary ones) so that we can compare abstract things like temperature. They help us define "how much colder" or "how much warmer" something is.

"Getting a feel" for these scales is what this category is about. You have a good idea what 32°F feels like, but what about 32° Kelvin? Is that hot or cold? To understand these abstract values, children can assign something concrete to them—an experience or an image. The more experience with scales, the better they get at using and understanding them.

Here's another example. How much does your basic sixth-grader weigh? Suppose the answer is 100 pounds. You have reference points: your weight, weight that you've lifted, and so on. What about a pro basketball player? Again, say the weight is 300 pounds. It's still within range of your experience. But you could also picture that he weighs three sixth-graders. Next, a car. How much does it weigh? How many basketball players? Sixth graders? Here's where you stretch yourself. Once you come up with an image for the car (7 basketball players, or just over a ton), you have a new reference point. The car can help you "see" the weight of a truck, which can help you "see" a blue whale, and so on.

The goal of this category is to practice with sizes and scales so that the numbers mean something concrete. Players will learn whether a 350 calorie hamburger is fattening or lean, 150 decibels is loud or soft, and so on. Here are just a few of the many scales presented: height (metric and English), weight, volume, area, girth, calories, clothing sizes, germination rates of seeds, speeds, time, distance, population, hair growth, periodic table, hardness of a rock, area, volume, and many more.

Geometry:

Here's math with *and* without numbers. Geometry deals with shapes, lines, circles, planes, grids, and so on. But it generally requires numbers and measurements to do it: area, perimeter, circumference, length, angle, and so on. The discipline dates back thousands of years and was practiced by Greeks, Egyptians, Babylonians, and others. Euclid (as in Euclid's Gamble) was a well-known geometer in ancient Greece.

Here, as in Size and Scale, we encourage hands-on math. Take time out to try answers: walk 90° right and take five steps forward; do it four times in a row. Did you make a square? Besides being fun, the hands-on activities will etch the math indelibly in your mind.

Geometry is also a category that has fascinating applications in other disciplines: art, architecture, science, nature, and so on. It also challenges students to practice spatial relations: folding up a two-dimensional object in your mind to form a pyramid, for example. Spatial relations and visual thinking have recently become a hot math topic because of the applications in new disciplines, such as computers and technology.

Logical Thinking:

This category may not seem much like math at first. But it is. Logic and reasoning are thinking skills that all mathematicians possess—and many others, too (police officers, detectives, lawyers, scientists, archaeologists, and so on). Actually, practicing logical thinking will develop a part of the brain we all use. It's our strongest weapon for solving non-creative problems, sorting and interpreting facts, and debating a point of view.

The Logical Thinking category has several types of questions. Pattern questions entail completing or recognizing a pattern. The pattern could be numbers, letters, movie titles, or whatever. That's not important. The math skill we're after here is seeing how a group of things relate to each other. Deductive and inductive reasoning questions involve drawing conclusions. In deductive reasoning, you look at a set of facts and draw a conclusion. Example: You eliminate the suspects in a murder until you zero in on the only one who could have committed the crime. Inductive reasoning is a little different. You rent videos night after night and they're all horrible. By inductive reasoning, you could assume that your next video will be horrible, too. But here's the difference: your next

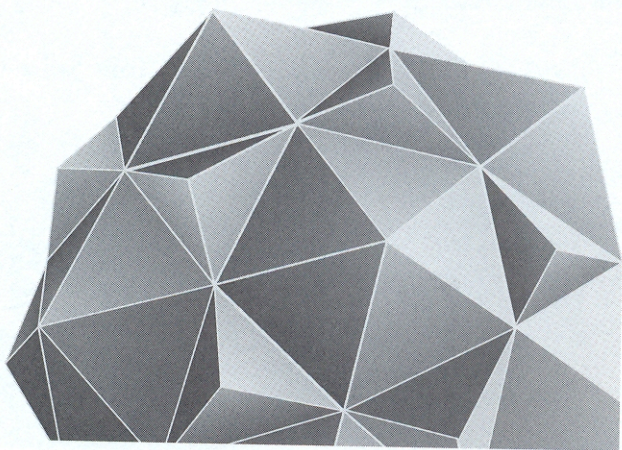
video *could* be terrific. For example, a new manager with taste could take over. With the crime, you arrested the only suspect possible. No one else could have done it.

An important set of questions involve Boolean logic, a seriously vital concept in the world of computers, among other places. You use Boolean logic when you do a computer search that includes the words “and,” “or,” and “not.” For example, you ask the computer to search for “lions and tigers, not bears.” All the articles that come up have the word lion and tiger in them. Any that also have “bear” don’t appear. In general, Boolean logic is a way to classify and sort things (this, this, and this, but not that). If you’re familiar with identification keys (for trees, flowers, or whatever), they work the same way, too. In TRUE MATH™, the questions look like this: If your face is sunburned *and* you’ve been out in the sun, then it’s time to come inside. A logical conclusion, wouldn’t you say?

A few questions are silly ones to keep you on your toes. You’ll see what we mean when you play!

Random Access:

This category is all of the above, and more. Random access is from a computer term—random access memory or RAM. The computer uses this memory when you call up programs to run. We’re sure you’ll be able to call up TRUE MATH™ facts from random memory pockets of your brain!



The Book of Think, by Marilyn Burns (Little, Brown; 1976).

The I Hate Mathematics Book, by Marilyn Burns (Little, Brown 1975).

Math for Smarty Pants, by Marilyn Burns (Little, Brown; 1982).

Comparisons, by The Diagram Group (St. Martin's Press; 1980).
Sizes and scales galore.

Family Math, by Jean Kerr Stenmark et al (University of California; 1986). Simple, hands-on activities parents and children in grades K-8 can do at home. Includes what kids learn in math and when, resources, and steps for organizing a family math program.

Five Equations that Changed the World, The Power and Poetry of Mathematics, by Michael Guillen, PhD. (Hyperion; 1995). The stories of the five most important scientific achievements in human history, and the genius and eccentricity behind them.

Great Book of Math Puzzles, by Philip Heafford (Sterling; 1993).

How to Encourage Girls in Math & Science, by Joan Skolnic, Carol Langbort, Lucille Day (Prentice-Hall; 1982).

Lateral Thinking Puzzlers, by Paul Sloane (Sterling; 1991). For those who like the Logical Thinking category.

Make It Simpler, by Carol Meyer and Tom Sallee (Addison-Wesley; 1983). Problem solving strategies.

Puzzles and Problems, Exploratorium Quarterly Vol. 17 No. 2 (The Exploratorium; summer 1993). For back issues, write: The Exploratorium, 3601 Lyon St., San Francisco, CA 94123.

IF YOU SPOT AN ERROR

Naturally, we fact-checked, copy-edited, and proofread all 900 questions to the best of our ability, and just as naturally there is bound to be an error, or even two, that we overlooked. If you think you have found one, we would be grateful if you'd let us know. Please send a copy of the card, a clear explanation of why you think a question is wrong, and your source, to the address below. We'll check into it. If you're right, we promise to correct the error in the next edition of TRUE MATH™, and we'll recognize you for your contribution. Thank you.

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