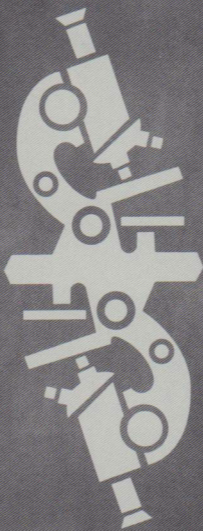


SCIENCE



TAROT

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WHAT IS SCIENCE TAROT?

Tarot cards decorated with symbolic images have been used for centuries for entertainment, insight and exploration. The images on the cards depict mythic human experiences and archetypes.

The Science Tarot reinterprets the tarot with 78 original artworks inspired by scientific discovery of the natural world. This combination offers an engaging, personal invitation into diverse fields of science, including astronomy, chemistry, physics and biology.

Science Tarot cards can be laid out in patterns and read just like traditional tarot. By viewing the science concepts on each card, associations trigger new insights about our lives, the world around us and our place in it.

The Science Tarot is a fascinating set for illumination and discovery, and many science stories can be enjoyed through its lens.

Find out more at
<http://www.sciencetarot.com>

DISCOVERING YOUR OWN STORY

We are who we are in part because of the stories we share. Familiar tales can offer meaning, guidance and context for the experiences of our lives.

Mythologist Joseph Campbell identified a series of events and steps represented in the stories of nearly every culture, which he called "The Hero's Journey." This is a journey of common human experiences in which our heroes engage the challenges before them, the resources around them and the strengths within them to ultimately achieve integration into the world.

In the Science Tarot, Campbell's Hero's Journey is adapted to tell each suit's unique story from Ace to Ten. You can follow your own personal Hero's Journey through the myths and archetypes represented in these science stories.

A GUIDE TO THE HERO'S JOURNEY ADAPTED FOR SCIENCE TAROT

Step 1:

A call to adventure

Step 2:

Refusal of the call or reluctant hero

Step 3:

Meeting the wise mentor

Step 4:

The threshold that marks the beginning of the adventure

Step 5:

Initiation by ordeal, task, or test

Step 6:

Resolution of trials, and revisiting the mentor

Step 7:

Return with new knowledge into everyday life

Step 8:

Using new knowledge to defeat the dragon

Step 9:

Death of old self, creation of new self

Step 10:

Completion of quest

THE FACE CARDS AS PORTRAITS OF SCIENTISTS

Each face card profiles a different scientist along their particular life path. Each type of face card is linked to a symbolic neurotransmitter inspired by biological anthropologist Helen Fisher's work on personality types.

Explorer (Page): A seeker whose initial curiosity about the world opens a gateway to scientific inquiry. The symbolic neurotransmitter is dopamine.

Innovator (Knight): The devoted researcher whose persistence and invention reveal new insights. The symbolic neurotransmitter is serotonin.

Storyteller (Queen): The negotiator whose intelligence and empathy welcome others into scientific discovery. The symbolic neurotransmitter is oxytocin.

Visionary (King): The director who drives scientific study forward into new territory with vision and hope. The symbolic neurotransmitter is testosterone.

A WALK THROUGH THE SCIENCE TAROT

Wands as Creation
Icon: Bunsen Burner

We begin our journey with the stars, where the elements that form planets and generate life are manufactured. Through astronomy and cosmology, we explore our human impulses to survive and create.

*"The cosmos is also within us,
We are made of star stuff."
- Carl Sagan*

Pentacles as Exchange
Icon: Magnifying Glass

Elements created in the stars now interact, forming molecules, planets and organisms. Through the fields of geology and chemistry, we explore our own interactions with the world around us.

*"We are all connected:
To each other, biologically;
To the earth, chemically;
To the rest of the universe atomically."
- Neil deGrasse Tyson*

Swords as Observation

Icon: Scalpel

From matter emerges consciousness, which divides the world into observer and observed. Through physics, math and the scientific method, we explore our own power to shape the world.

"There's real poetry in the real world, Science is the poetry of reality."

- Richard Dawkins

Cups as Integration

Icon: Beaker

The stories of science and human experience lead us back into the world again, not simply as observer but as participant. Through biology and ecology with the scientific method, we explore the realm of human emotions and relationships.

"The whole is more than the sum of its parts."

- Aristotle

Major Arcana as Science Stories

Powerful stories offer helpful stepping stones to each of us: shared experiences, moments of transformation and familiar characters. Each Major Arcana card invites us to find our own story within the realm of science.

"[Tell science stories] about nature that are true and complex ... but still have the power to enthrall, to excite, to remind people there is a deep beauty, a many leveled beauty in the world."

- Robert Krulwich, Radiolab

WANDS AS CREATION

We begin our journey with the stars,
where the elements that form planets
and generate life are manufactured.
Through astronomy and cosmology, we
explore our human impulses to survive
and create.

*"The cosmos is also within us,
We are made of star stuff."
- Carl Sagan*



Artwork by Janelle Schneider

ACE OF WANDS: NEBULA



Apparently from nothing, the star stuff comes together and begins to take shape. But what will become of this gathering of dust, this mass of potential, this nebulous form just beginning to emerge?

The suit of wands represents your physical presence in the world: the work you do, the art you create, the roles you play, the person you know yourself to be. Wands is the suit of fire and of creation.

The beginning of a star's life represents the first step on that path. A universe of possibilities awaits, and though the path forward may be difficult to see, there is a gathering garden from which a star will burst into life.

Hero's Journey, Step 1: This is a call to adventure, an opportunity to discover a new self.

2 OF WANDS: STAR NURSERY



Clouds of stardust gather material over time, growing dense and building in gravity. The energy of a young protostar increases and its mass rotates as the atoms draw together. Will the body that forms become a star or remain an unformed cloud in space? Both possibilities seem likely.

This marks an ambiguous moment. A path offers itself, diverging in a new direction, but is it the right direction for you?

Moving forward in full awareness requires a moment of consideration. Only when the sacrifices and transformations demanded by the journey are fully understood, and for a moment rejected, does the full meaning and gravity of the choice become clear. Life on this new path will never be the same again, yet life on the old path may be no life at all.

Hero's Journey, Step 2: Refusal of the call. The hero is reluctant to change.

3 OF WANDS: COLLISION



The most energetic entities in the universe, quasars are likely formed by collisions between galaxies. While the stars within each galaxy are too far apart to physically impact, their clouds of gas and dust interact, rapidly losing angular momentum and draining into the black holes that form the center of many galaxies.

Though the black hole itself is dark, the abundant gas and material drawn furiously toward the gravitational core bursts into radiance, producing more energy and light than all the stars in both galaxies combined.

This card brings together two strong forces to create something new. The collision may introduce a student to a mentor, or an artist to a collaborator, but the result will shine like nothing that either participant could have created alone.

Hero's Journey, Step 3: Meeting the wise mentor. An outside influence offers personal guidance.

4 OF WANDS: BROWN DWARF



Somewhere in a distant galaxy, a brown dwarf waits in a dim corner of space. Once it was on a journey to become a star: clouds of dust and gas drifted together and were compressed and heated by gravity. It seemed inevitable that its future would be spent as a brilliant sun. But the journey came to a halt. Too little mass had gathered, creating too little gravity for fusion to spark. The celestial body that had promised to become a star now instead spends its life waiting at the threshold, unable to cross.

Every path we take eventually leads us to a threshold. One day we may gather the courage and strength required for this adventure, and we'll leap into whatever lies ahead. Or we may remain comfortably at the threshold and watch others begin the journey that we never experience ourselves.

Hero's Journey, Step 4: At the threshold. The adventure is about to start.

5 OF WANDS: FUSION



Fusion reactions create the light of our sun and every star in the night sky. We experience these reactions from a great distance, but perceived up close, the explosive forces are so violent and massive that all else might be forgotten.

Gravity builds within a star as critical mass gathers, starting reactions once impossible but now inevitable. At last, hydrogen atoms fuse together at the star core, releasing furious energy and brilliant light into the darkness of space. The fusion process is violent, long-lived, and full of potential catastrophe.

This kind of conflict can be challenging, exhausting and painful but necessary. In the future wait all the hopes and possibilities of life; in the past lie all the imperceptibly slow movements that led to this cataclysmic flash. This moment delivers an overwhelming challenge, and you must respond to it.

Hero's Journey, Step 5: Initiation. An ordeal or test reveals a hidden self.

6 OF WANDS: EQUILIBRIUM



In the middle of its life, a star is balanced between two tremendous forces: gravity pulls the burning gases inward, and the pressure gradient forces the mass outward. Hydrostatic equilibrium is reached when the forces pushing out equal those pulling in.

A star in a state of equilibrium represents this period of stability in the middle of a long, turbulent path. Illumination and respite can be found in the balance between seemingly opposing forces, which earlier brought only trial and tribulation. Now is the time to take a breath, celebrate achievements and reflect on the steps taken to reach them.

Hero's Journey, Step 6: Revisiting the mentor. Balance is restored.

7 OF WANDS: EXPANSION



The red giant is at a great, expansive stage of the star's life and has grown to thousands of times its original size. Inner creation defines this moment in your life story as well.

The shell around the giant's collapsing core becomes hotter and starts fusing its hydrogen into helium, making the star brighter and the outer shells expand and grow cooler and less dense. Although fiery pressures mark the beginning of your journey, these expansive later years allow creation with a wider reach and a dense inner core.

We speak of "finding your voice" to describe this mature state. Other duties and diversions may fall by the wayside as work consumes the days filled with creation and productivity.

Hero's Journey, Step 7: Return with new knowledge into everyday life. The hero reveals a deeper determination.

8 OF WANDS: BIG BANG



The universe was born billions of years ago with an explosion of such tremendous force that the galaxies that formed from the scattered debris are still speeding away from one another.

As you send your work into the world, a universe of possibilities expands and influence grows more powerful. The writer, inventor and scientist launch works into the public sphere to challenge, support and inspire their colleagues worldwide.

Their creative energies released today will continue to influence lives for many years to come.

Hero's Journey, Step 8: Defeating the dragon. The hero wins freedom.

9 OF WANDS: SPACE



Space is vast and almost entirely dark. As we begin to grasp the immensity of the cosmos, we comprehend the emptiness that lies between the stars and galaxies, and what vacuous distances separate us from all the stars in the night sky.

This grand perspective marks a moment of reflection and internal revelation on your relationship to the world.

Reaching this point helps you to understand your place in the universe. After experiencing triumphs and setbacks, your work is in the world, and you experience the world's response. By tapping into inner strength and taking the time to reflect, you can come to understand the small but unique contribution you alone are able to make, your one small star in a much larger cosmos.

Hero's Journey, Step 9: Death of old self, creation of the new self. The hero will forever pay the price for these achievements.

10 OF WANDS: SUPERNOVA



A massive star in mid-life generates tremendous energy through nuclear fusion, transforming hydrogen and helium into elements as heavy as iron. When its fuel burns away and its structure grows unstable, the star may finally explode, sending vast amounts of light and material into space.

The heavier elements we know on Earth, metals like gold and silver as well as elements critical to living things, are generated in this type of cataclysmic event, a supernova. All the heavier elements on Earth and in the universe are generated in these supremely powerful explosions.

A human being delivers a lifetime's energy into the world, a lasting fruitful gesture of a creative life, work that draws material from the world and returns it transformed. This card marks the culmination of achievement where our efforts give back to the world something precious.

Hero's Journey, Step 10: Completion of quest. Every journey ends with the beginning of another.

PAGE OF WANDS:
CAROLINE HERSCHEL, EXPLORER



Caroline Herschel was a 19th century astronomer who made several extraordinary discoveries of comets, despite being thwarted from joining the formal scientific community because she was a woman.

Her fascination with the night sky led her to perform extensive research into comets, nebulae and other astronomical phenomena, ultimately winning her unprecedented recognition from the political and scientific authorities of her time.

Caroline Herschel was driven by a passion for discovery. Setbacks and difficulties are to be expected, but ultimately the explorer grows stronger as these obstacles are sidestepped, challenged or overcome. The crucial step is to produce creative, personally fulfilling work now, and remain confident that future success will follow.

The Hero as an Explorer: A seeker whose initial curiosity about the world opens a gateway to scientific inquiry.

KNIGHT OF WANDS:
HYPATIA OF ALEXANDRIA, INNOVATOR



In Roman-ruled Egypt in the fifth century A.D., lived Hypatia at the Library of Alexandria, the greatest center for research and scholarship of the time. Hypatia was a philosopher, mathematician, astronomer and inventor. Her diligent studies led her to numerous scientific discoveries and inventions, such as the astrolabe shown in her left hand, which is used to predict astronomical positions.

Hypatia was passionately outspoken about the value of science, even at a time when the political climate made her views unpopular. She inspires us to be true to ourselves in spite of the opinions of others, and to work diligently to achieve clear, precise understanding and fulfillment of our own creative potential.

The Hero as an Innovator: The devoted researcher whose persistence and invention reveal new insights.

**QUEEN OF WANDS:
CARL SAGAN, STORYTELLER**



Carl Sagan was an astrophysicist whose imagination and critical thinking helped to advance human understanding in the fields of astronomy, cosmology and natural science. Although his scientific contributions were many, he is best known for producing books and television shows that brought the wonder and excitement of scientific exploration to a worldwide audience. So great was his passion for communication that he helped create the recorded messages sent into space on the Voyager spacecraft: human greetings offered to whatever distant life forms might someday discover them.

Carl Sagan's balance of analytical discipline and enthusiastic wonder allowed him to grasp and achieve what either characteristic alone could not. A charismatic storyteller unites many such diverse qualities—warmth and criticism, strength and vulnerability, passion and practicality—into a single engaging personality, bringing together a diverse audience to listen and explore.

The Hero as a Storyteller: The negotiator whose intelligence and empathy welcome others into scientific discovery.

**KING OF WANDS:
GALILEO GALILEI, VISIONARY**



Galileo Galilei was a 17th century astronomer and physicist whose pioneering and defiant works have earned him praise as the father of modern science. He was the first to use a telescope to study the stars and planets, discovering the moons of Jupiter among other astronomical bodies. He invented or improved several tools for scientific exploration and advanced the study of objects' motion through space.

Galileo also publicly championed Nicolaus Copernicus's heliocentric model of our solar system, based upon his observations with the telescope, which led to a dramatic confrontation with the Catholic church. Galileo's final years were spent under house arrest, where he continued to write scientific books and promote the ideas that transformed science and human history.

Galileo was a person with authority, integrity and discipline, who followed his inner compass. A visionary's maturity, decisiveness, passion and strength can blaze a trail for generations to follow.

The Hero as a Visionary: The director who drives scientific study forward into new territory with vision and hope.

PENTACLES AS EXCHANGE

Elements created in the stars now interact, forming molecules, planets and organisms. Through the fields of geology and chemistry, we explore our own interactions with the world around us.

*"We are all connected:
To each other, biologically;
To the earth, chemically;
To the rest of the universe atomically."
- Neil deGrasse Tyson*



Artwork by Kristy Whitehouse

ACE OF PENTACLES: FORMATION



Through the emptiness of space float dust, gases and the rubble of ancient collisions and explosions. The gravity of passing planets or nearby stars may sweep this debris into loose bands suspended in the emptiness. Chance collisions may join together stray atoms or asteroids hurtling through space.

The gravity of these fragments seems insignificant, yet the connection they share slowly builds with each new speck. As these particles pull together over countless centuries, a rough shape forms and grows larger. In time this massive collection of material becomes a single entity: a planet, wandering through the emptiness of space, slowly orbiting a distant sun. The word "planet" means "wanderer".

Elements of future success may be distant or unrecognizably small, but this card marks the start of the long process of drifting together. Gather the insight to recognize the path's formation, the patience to follow it, and the courage to explore it.

Hero's Journey, Step 1: This is a call to adventure, an opportunity to discover a new self.

2 OF PENTACLES: ANTIMATTER



A particle of matter and an antiparticle of antimatter are created in the same instant. The two opposites trace mirrored paths, perhaps once again finding each other in shared annihilation. This occurs in the tiniest fraction of a second, repeatedly, endlessly.

Every opportunity tears open a torrent of opposites: pro and con, hope and fear, discovery and loss. We may choose to pursue the new opportunity and wrestle through the conflicts of these opposites, or we may let the opportunity close behind us.

This card offers a moment to reflect if this is the right opportunity for you at this time. The answer may not be obvious. For some, pursuing a great reward may lead to ruin. For others, taking a terrible risk may be the only acceptable choice. Whichever you decide, there is always another opportunity opening up on the horizon.

Hero's Journey, Step 2: Refusal of the call. The hero is reluctant to pursue this venture.

3 OF PENTACLES: BONDING



Two small hydrogen atoms bond with one larger oxygen atom to form a molecule of water, which has the chemical symbol H_2O . The properties of this combined formation of hydrogen and oxygen are dramatically different than their individual traits.

While hydrogen and oxygen are both highly reactive, water does not burn. While both are gases at room temperature, water forms a liquid. Water has unusual properties that make it well suited to host life. Molecules of water pull together and cling to other materials, and because water expands as it freezes, it floats, which allows aquatic life to survive in cold water that would otherwise freeze solid.

Sometimes a third element, an outside community, transforms two separate communities into one thriving, growing momentum. Strengths from individuals in each community may blend together in a new, bonded way in this changed environment. The result can stimulate creativity, growth, action, energy and enthusiasm. Elements that had scattered before may now flow together like water.

Hero's Journey, Step 3: Meeting the wise mentor. An outside influence offers useful information.

4 OF PENTACLES: MESON DANCE



A meson is formed when two subatomic particles, a quark and an antiquark, partner up for a kind of dance. Atoms contain protons and neutrons, which are composed of quarks with different energy levels. These quarks mill about their subatomic dance hall, coming together with suitable dance partners. Some will form mesons in a sort of a long tango.

This relationship falls apart when either partner changes. Now solo, each quark goes on to form other interactions, following a new path, and perhaps finding a new partner and a new dance.

This prolonged dance of the meson may explain our reluctance to delay the launch of an adventure. The mission is understood, the tools gathered, yet the real journey has not yet begun. We are comfortable in the known dance of daily routine and stable relationships, but what exotic encounters might yet await us?

Hero's Journey, Step 4: At the threshold. The necessary resources have been gathered.

5 OF PENTACLES: CATASTROPHE



Three billion years ago, the atmosphere of Earth contained no oxygen. Microscopic green cyanobacteria were one of the first life forms to develop the ability to photosynthesize: to transform sunlight, water and carbon dioxide into sugars for energy and release oxygen as waste. The levels of oxygen in the atmosphere skyrocketed.

Millions of life forms unable to survive in an oxygen-rich environment were poisoned and made extinct by the exploding populations of cyanobacteria and the oxygen pollution they created. While we may perceive this transformation as being vitally necessary for the development of life on Earth as we know it now, it was an "Oxygen Catastrophe" at the time.

We experience our own cataclysmic events that both destroy what came before and make possible what will come after. In this moment are traumatic setbacks, challenges and real suffering, yet it is this suffering we move through that shapes the success we later achieve.

Hero's Journey, Step 5: Initiation. An ordeal places the reward out of reach.

6 OF PENTACLES: GEOTHERMAL



Much life on Earth is made possible by the sun: its radiation provides daylight, warmth and energy. The life-giving fire of this bright star is echoed in the Earth's own molten core, which sends heat to the surface in the form of eruptions, steam vents and other geothermal activity. Without this fiery core, the Earth might be as cold and lifeless as the moon.

Throughout life, we benefit from the guidance of mentors who prepare us for the challenges we face. Their radiant influence can inspire growth and commitment that would otherwise be impossible. As the excitement of each adventure's beginning is diminished by moments of isolation and defeat, we may lose the wisdom and confidence gained through these relationships. Only by revisiting the mentor's guidance, and by discovering that same source of wisdom within ourselves, can we get back on the path to achievement.

The Earth's fiery core, always waiting deep beneath our feet, reminds us to consider what powerful energies may be found inside us to echo the bright stars in our lives that have guided us until now.

Hero's Journey, Step 6: Revisiting the mentor. Faith in the venture is restored.

7 OF PENTACLES: GLACIAL



Nature has daily cycles, monthly cycles, and yearly cycles, but the cycles that formed the dramatic landscapes of our world, the lakes and mountains and valleys and oceans, are those of geologic time. It takes millions of years for glaciers to create a valley like Yosemite or for a river to carve a Grand Canyon. But bit by bit, the world is completely transformed through these slow, gradual changes in the environment.

These natural forces, tremendous powers of nature, may operate so slowly as to escape notice. A glance at an autumn landscape first reveals fallen leaves and brown grasses, but a deeper investigation reveals the accomplishments of a slower, more powerful flow. The future will be drawn from that deeper channel. Align yourself with it to accomplish your goals, and have patience with the glacial perspective of time.

Hero's Journey, Step 7: Return with new knowledge into everyday life. The hero discovers the deeper meaning of prior efforts.

8 OF PENTACLES: DRIFT



Nothing feels as solid as the ground beneath our feet, yet the Earth's surface is composed of vast platforms of rock that slowly rotate and shift. Enormous pressure and tension build and release, resulting in tremors and earthquakes. Over time, great land masses slide apart or crush together, undersea valleys are lifted to the height of the tallest mountains and the map of continents is unrecognizably transformed.

A force like the virtually imperceptible yet unstoppable powerful continental drift operates in our own lives as well. The tiny impulses, minute pressures and casual responses that seem to bring no consequence to our everyday lives may build over years and decades to create a profound and unpredictable impact.

The experiences and knowledge gained on your journey can dramatically reshape your world. This can be an ultimately positive, but often traumatic, transformative process.

Hero's Journey, Step 8: Defeating the dragon. The hero claims the prize.

9 OF PENTACLES: AURORA



Bright, mysterious lights wash across the night sky in one of nature's most beautiful displays: the Aurora Borealis, or Northern Lights.

A stream of energized particles from the upper atmosphere of the sun accelerate along the lines of the Earth's magnetic field, energizing the nitrogen and oxygen atoms floating here. The colorful glow comes from electrons shed by these excited atoms in our Earth's upper atmosphere.

The invisible stream of particles that pass continuously between the Sun and the Earth streak the night sky with spectacular radiant color. It is a brilliant yet fleeting display of beauty and transformation on a grand scale. Personal success is finally achieved, the old cast off in favor of the new.

Hero's Journey, Step 9: Death of old self, creation of the new self. From sacrifices have come great rewards.

10 OF PENTACLES: EARTHLY RICHES



The Earth is constantly changing. Temperature and pressure transform minerals and decayed matter into layers of rock that build upon one another. The older strata are often hidden like layers within an onion, a secret history of our planet waiting to be exposed through earthquake, glaciation or some other process of upheaval.

As some layers are exposed, we find a tantalizing vision of our planet's formation and evolution. Sometimes the conditions were just right for the rock layers to create the things we find valuable: diamonds, coal, fossils.

This card shows the wealth that is built over time as our moments, stories, and experiences fall into the past and provide a foundation for our future. Discovering our buried treasures marks an occasion for gratitude and celebration.

Hero's Journey, Step 10: Completion of quest. Through these achievements, the landscape is transformed.

**PAGE OF PENTACLES:
OTTO LOEWI, EXPLORER**



Otto Loewi awoke and dashed to his laboratory. It was the early twentieth century and Loewi's work on how nerves communicate had not produced results, yet a dream suggested a key experiment that the scientist was eager to begin. The beating of a frog's heart, he discovered, could be accelerated by bathing it in liquid that had contacted another frog's beating heart. It must be a chemical, not an electric pulse, that carries the message between nerves. Loewi had discovered the first chemical neurotransmitter, acetylcholine.

This card represents the enthusiasm and dedication that pulled Otto Loewi out of bed in the middle of the night to pursue his mysterious vision. As we identify our goals, we may not always understand or anticipate the steps necessary to achieve them. Yet with passion and curiosity, we may find real success where others had recognized only dreams.

The Hero as an Explorer: A seeker whose initial curiosity about the world opens a gateway to scientific inquiry.

**KNIGHT OF PENTACLES:
JABIR IBN HAYYAN, INNOVATOR**



Abu Musa Jabir ibn Hayyan, also called Jabir or Geber, launched the transformation of alchemy into modern chemistry. A natural philosopher living in the Middle East in the eighth century, he insisted on practical experimentation in place of conjecture.

At a time when the world was thought to only have four Aristotelian elements of fire, water, air and earth, Jabir introduced scientific methods to explore and understand chemical reactions. In the course of his work, he is credited with the invention of many laboratory tools and processes still commonly used today.

While the alchemists sought to transform common metals into gold, Jabir led the transformation of tradition and superstition into science. Jabir's discipline, inventiveness, clear thinking and bold determination are the elements that produced this greater treasure.

The Hero as an Innovator: The devoted researcher whose persistence and invention reveal new insights.

**QUEEN OF PENTACLES:
FRANK OPPENHEIMER, STORYTELLER**



Frank Oppenheimer stands before the Exploratorium in San Francisco, the vibrant interactive science museum he founded after a career as a physicist and science educator. The simple exhibit in his hands is an example of many designed to engage people of all ages in the joy of experimentation, invention and discovery.

His work with his brother J. Robert Oppenheimer at the Manhattan Project had produced vital and controversial advancements in nuclear physics. Forever afterward, Frank Oppenheimer was driven to communicate with others the excitement and wonder of the positive realms of science and play.

His balance of authority with compassion, and creativity with compromise, united many communities to create an engaging public legacy that extends its influence for generations.

The Hero as a Storyteller: The negotiator whose intelligence and empathy welcome others into scientific discovery.

**KING OF PENTACLES:
MARIE CURIE, VISIONARY**



Marie Curie's commanding role in chemistry and the nascent field of radiology brought her from Nobel prizewinning laboratory work to the French-German battle front during World War I. Working with her husband at the turn of the century, Curie coined the term "radioactivity" and discovered two elements, radium and polonium.

Her personal efforts were responsible not only for the development of X-ray technology, but also for the production of mobile X-ray labs, called Petites Curies, which made lifesaving surgery possible on the battlefield. The determination and bravery that guided her through decades of scientific discovery served her countrymen well as she assisted with injured soldiers in the heart of the conflict.

Marie Curie was undaunted by personal or technical challenges and was driven from within to pursue the most vital and complex of goals. This visionary woman calls upon us to look into the distance, take command and do what must be done.

The Hero as a Visionary: The director who drives scientific study forward into new territory with vision and hope.

WORDS AS OBSERVATION

From matter emerges consciousness,
which divides the world into observer
and observed. Through physics, math
and the scientific method, we explore
our own power to shape the world.

*"There's real poetry in the real world,
Science is the poetry of reality."
- Richard Dawkins*



Artwork by Shari Arai DeBoer

ACE OF SWORDS: REDUCTIONISM



Reductionism aims to understand the exact mechanics of the universe. The expectation is that the universe can be dissected like the gears of a clock, into smaller and smaller pieces, until all particles are known and every action predicted. We anticipate greater knowledge with each smaller level we explore. We reduce worlds into ecosystems, animals into specimens, bodies into parts.

Reductionism is a very powerful tool. As we calculate the trajectory of falling objects or identify the components of biochemical reactions, we can uncover many of nature's patterns and laws.

This card introduces a path of discovery and insight that offers great knowledge and influence. As you cut and observe, isolate and dissect, hidden layers continue to emerge. How far can you go?

Hero's Journey, Step 1: This is a call to adventure, an opportunity to discover a new power.

2 OF SWORDS: ACTION



Sitting under the apple tree, we contemplate a choice to be made. The tree branch lifts an apple high in the air, and gravity continuously pulls it toward the ground. These equal and opposite forces hold the apple in place. But soon the balance may shift and the apple may fall, releasing the branch from its burden and shaking the leaves as they swing upwards.

Isaac Newton observed that every action caused an equal and opposite reaction and so reasoned that every reaction could be predicted from the action that triggered it. Like a game of billiards, Newton's world is a predictable knocking around of objects: the force of the impact equals the mass of the moving object times its acceleration. To send an apple flying in a specific direction, we only need to know where to hit it and how hard. To move a gigantic apple, we'll need to hit it with a great deal of mass, or we will need a running start.

A decision is hanging over your head. You can choose to leave the apple suspended in the tree, or you can apply enough force to bring it down. Either decision may bring good results, but if you wait too long, the apple may fall on your head.

Hero's Journey, Step 2: Refusal of the call. The hero is reluctant to use this new power.

3 OF SWORDS: REVOLUTION



For thousands of years, mankind believed that the Earth was at the center of the solar system and the universe. When the astronomer Nicolaus Copernicus examined the most detailed observations of his time, he found that the movements of the planets were not compatible with an Earth-centered model. Only with the sun at the center of each planetary orbit did the map of the solar system make sense.

When Copernicus published his findings in 1543, the news was not welcomed by the religious authorities of the day. Strong evidence challenging the traditional view of man's place in the universe would bring a painful transformation to the church, society, science and the life of Copernicus himself.

Sometimes our discoveries require sacrifice and a departure from established ways of thinking. This forced departure from a simpler life can be painful. From this moment on, we will think about ourselves and the world in a completely new way.

Hero's Journey, Step 3: Meeting the wise mentor. The hero begins a painful separation from the old life.

4 OF SWORDS: MATHEMATICS



Laws govern the complexities of the natural world, from the pitch of a bird's song to the acceleration of a falling leaf. Understanding these laws requires learning a new language, a language of numbers. Only through the discovery and study of mathematics can an understanding of nature progress.

The rules of mathematics represent centuries of dedicated curiosity by a great number of pioneers. Their efforts to understand, predict and even manipulate the effects of gravity, force, inertia, chemical reactions and many other aspects of the physical universe allow us to uncover and work with nature's processes.

The time spent developing insights and strategies now will make the rest of the journey possible. This gestation may be a simple step along the path, or it may prove a stumbling block while key relationships remain undiscovered. This process requires patience and peace. Take the time to build experience, strength and understanding before the next departure.

Hero's Journey, Step 4: The threshold. The hero slowly gathers strength for the journey.

5 OF SWORDS: RELATIVITY



Imagine a train pulling into a station. In this thought experiment the train has one special property: it can travel close to the speed of light. The clock on the train shows that only a few minutes have passed during its travel, but the station at which it arrives has aged many decades since the train began its journey. It is as if the train has traveled into the future.

The reason is relativity. Time is not consistent throughout the universe; objects experience time at a rate relative to their speed. As an object approaches light speed, time passes more slowly for that object. Einstein's theory of relativity exposed this more complicated world beyond Newton's simple system of action and reaction.

This is a jarring and unexpected moment of transition. The reliable rules and habits that helped us navigate earlier no longer apply. The challenge is to understand and navigate the new rules and new worlds that initially seem so inexplicable.

Hero's Journey, Step 5: Initiation. An ordeal reveals the hero's limitations.

6 OF SWORDS: QUANTUM SEA



By the twentieth century, physicists were exploring territory that could not be explained or predicted by Newton's collection of simple rules. Early experiments in sub-atomic physics offered results that seemed unpredictable and self-contradictory. One of the strangest beacons along this unfamiliar channel was light itself, which behaves both as a particle and as a wave.

Quantum electrodynamics (QED) theories provide safe passage through these difficult waters. QED successfully predicts the behavior of the sub-atomic world, which does not lend itself to intuitive understanding. Richard Feynman's diagrams offer a particularly effective way to visualize these interactions, providing a chart to navigate through the rough quantum seas.

Sometimes we cannot trust our immediate perceptions to understand our circumstances. Accepting the apparent contradictions we encounter can provide a deeper level of guidance to bring our vessel to the next safe harbor.

Hero's Journey, Step 6: Revisiting the mentor. The hero finds new strength to continue the journey.

7 OF SWORDS: CHAOS THEORY



Sometimes the slightest gestures shape and direct the most powerful forces. Perhaps the flap of a butterfly's wing might launch a series of events that ultimately lead to a tornado on the other side of the world.

Chaos Theory is the study of these fantastically complex systems in which predictable events may lead to unpredictable, uncontrollable outcomes. Physicists and mathematicians have begun to trace the links between cause and effect, using mathematical models like the Lorenz attractor, which coincidentally suggests the shape of a butterfly.

The results of our actions are often complex, powerful and unpredictable. Struggling to control the distant ripples we launch with every gesture can be a crippling mistake. It may be better simply to ride the wind and follow its course.

Hero's Journey, Step 7: Return with new knowledge into everyday life. The hero discovers the complex results of prior actions.

8 OF SWORDS: COLLIDER



As we study the universe's smaller and smaller parts, we seem to need larger and larger tools. A particle collider is an enormous hammer for propelling and smashing atomic and subatomic particles, so we can study the component parts that make up the universe. Each new collider and detector brings particle physics to a new limit, until a bigger one is built.

While these tools are triumphs of technology and the knowledge we gained using them is astounding, we may someday face a situation of diminishing returns.

Presented here is a path that seems to end just as it begins. Like a particle propelled through a collider, we may feel forced into one path. Until we can break out of this myopic vision, all of life will seem like a series of frustrating collisions.

Hero's Journey, Step 8: Defeating the dragon. Despite victories, the hero's true goal remains elusive.

9 OF SWORDS: BLACK HOLE



A black hole forms when a massive star burns away its tremendous energy through nuclear fusion, and its gravity pulls the remaining mass together like a shrinking balloon. So intense is the gravity pressing inward that nothing can stop the star's rapid collapse, not even the electrons forced into the same inconceivably small space.

Scientists call this state a singularity. Not even light can escape its tremendous gravitational pull. Once past the event horizon, everything is consumed and falls inward. Living in Earth's modest gravity, it is difficult to imagine the mass of many suns crushed into a single invisible point.

Dark times can seem as consuming and inescapable as a black hole. All direction, hope and possibility seem to drain out of life, and the one path available only leads further into the depths. Experience the darkness, accept the burden of hopelessness and pass willingly through the unhappiness. What waits at the center of a black hole no outside observer can say.

Hero's Journey, Step 9: Death of old self, creation of the new self. The hero confronts the void which threatens all.

10 OF SWORDS: UNCERTAINTY



Reductionism aims to understand the exact mechanics of the universe. The expectation is that the universe can be dissected like the gears of a clock, into smaller and smaller pieces, until all particles are known and every action predicted. We anticipate greater knowledge with each smaller level we explore. We reduce worlds into ecosystems, organisms into cells, molecules into atoms.

As the focus tightens at the subatomic, there is an unexpected limit: it is impossible to simultaneously know both the exact position and the exact speed of a subatomic particle. When Werner Heisenberg recognized this principle in 1925, it was a serious blow to scientific inquiry. It simply cannot be known where all the pieces are at all times, because the universe does not operate in this way. Uncertainty is the true nature of the quantum realm.

This is the ultimate disillusionment: our quest has come to a dead end. The reality so greatly desired is ultimately unattainable. It is time to find another path.

Hero's Journey, Step 10: The hero faces the ultimate cost of all that has been lost to achieve completion of the quest.

**PAGE OF SWORDS:
ROBERT HOOKE, EXPLORER**



The world is alive with fascinating detail, and Robert Hooke's microscope invited him to observe and understand every minute cell within it.

Hooke was the first to apply the word "cell" to the biological world, as the walls of living cells reminded him of monks' separate quarters. His myriad discoveries and precise illustrations were reproduced in his *Micrographia*, the first best-selling book on a scientific topic. Hooke and his contemporaries brought into focus many powerful discoveries too small or distant or see with the naked eye.

The explorer takes tool in hand to investigate the world for study and manipulation. Thoughtful decisions and clear perceptions are the powers gathered and begin with these steps. Use your tools, open your mind and explore a new, enchanting world.

The Hero as an Explorer: A seeker whose initial curiosity about the world opens a gateway to scientific inquiry.

**KNIGHT OF SWORDS:
DMITRI MENDELEEV, INNOVATOR**



Dmitri Mendeleev studies in his laboratory. An experienced chemist and teacher, Mendeleev noticed patterns in the properties of chemical elements. To puzzle out an order from the elements, he wrote each atomic number on paper and, as if playing with cards, repeatedly reorganized them and studied the patterns of their chemical properties.

Mendeleev uncovered a simple underlying structure that became the Periodic Table of the Elements. From this he could better understand similarities shared by families of elements, as well as predict the discovery and characteristics of several elements still unknown at the time.

Under the powerful tool of deduction and reasoning, the unknown landscape is revealed. Through diligent work and insights, you find that the playing field is slowly transformed.

The Hero as an Innovator: The devoted researcher whose persistence and invention reveal new insights.

QUEEN OF SWORDS: ERNST HAECKEL, STORYTELLER



Artist and biologist Ernst Haeckel remains widely known today for his many books of intricate illustrations in the realm of animal, plant and microscopic life.

In his lifetime his work helped explain Darwin's theories to the general public. His perceptive and wide-ranging analyses mapped a genealogical tree of Earth's life forms, dividing and defining living organisms according to species, genus, family and order. His drive to observe, categorize and communicate his findings about the world's species created a wellspring of practical knowledge.

Even as the world is divided into sections and categories, a storyteller gathers strength and wisdom to achieve a common purpose. While you may be tempted to let emotion dictate your actions, the situation may require direct observation and intellectual investigation instead.

The Hero as a Storyteller: The negotiator whose intelligence and empathy welcome others into scientific discovery.

KING OF SWORDS: CHARLES DARWIN, VISIONARY



Recalling his voyages to the Galapagos archipelago, Charles Darwin pondered for many years why similar animals on different islands were different species. Why would they not be all the same animal species on all islands?

Darwin's question and research revealed a vital underlying structure: his 1859 book *On The Origin of Species* established evolution through natural selection as the answer and, eventually, as the predominant scientific theory of natural history. The challenges of survival, reproduction and isolation allowed animals to develop into separate species, each matched to a unique habitat. Darwin's decisive and far-reaching insight brought a new understanding of nature and mankind's place within it.

A decisive, intelligent and powerful authority, a visionary may deconstruct the world into its component parts and rebuild it with renewed design.

The Hero as a Visionary: The director who drives scientific study forward into new territory with vision and hope.

CUPS AS INTEGRATION

The stories of science and human experience lead us back into the world again, not simply as observer but as participant. Through biology and ecology with the scientific method, we explore the realm of human emotions and relationships.

*"The whole is more
than the sum of its parts."
- Aristotle*



Artwork by Tammy Stellanova

ACE OF CUPS: INTEGRATION



When a larger organism engulfs a bacterium, it usually becomes lunch, quickly digested and discarded. But on a handful of occasions in Earth's history, the engulfed bacterium survived inside the cell membrane of its new host and, through endosymbiosis, the two become a single, more complex organism.

Over time, a purple bacteria and its host cell completely lost the ability to live apart, their DNA intermingled and their evolutionary paths inextricably united. These are mitochondria and are an integral part of every eukaryotic cell, linking us to our primordial beginnings.

The start of the Cups suit symbolizes love and emotional experience. When we learn to love another person, place or activity, we can open our hearts and become integrated together for the journey ahead.

Hero's Journey, Step 1: This is a call to adventure, an opportunity to experience a new relationship.

2 OF CUPS: ALLIANCE



Lichens are in a relationship so simple and effective that change becomes unnecessary. Some lichens have remained essentially unchanged for many millions of years, perfectly suited to play their quiet, critical role in the ecosystem.

In lichen, a fungus and an alga are integrated at the cellular level, yet they remain separate life forms. The fungus provides a helpful structure for the alga, while the alga uses photosynthesis to create food for the fungus as well as itself. Allied in this way, they flourish in the most forbidding environments, chewing away rock to make soil and paving the way for diverse ecosystems to take hold.

Here is a relationship that is balanced and effective but perhaps confining and stagnant as well. Do we cling to this comfortable stability or follow a risky path of growth and change?

Hero's Journey, Step 2: Refusal of the call. The hero is reluctant to follow this emotional path.

3 OF CUPS: SYMBIOSIS



The exquisite variety and breathtaking beauty of orchid flowers have long inspired gardeners to plant orchid seeds in cultivated soil, yet early attempts to grow these exotic plants met with failure.

The missing element was the unseen fungus mycorrhiza, which lives in the orchids' native soil, helping the orchid roots to absorb water and minerals. In return, the orchid provides the fungus with sugars generated by photosynthesis in the plant's leaves. With the fungus to aid the orchid in extracting nutrients from the soil, the plant thrives, and the fungus benefits as well.

Some partnerships are unable to flourish and reach their full potential without another factor, an unexpected helping hand. Great vitality and beauty can be achieved when a new influence completes the equation, allowing every member of the team to grow and benefit.

Hero's Journey, Step 3: Meeting the wise mentor. An outside influence offers comfort and inspiration.

4 OF CUPS: DORMANCY



Most fish will die without water, but the lungfish has evolved a strategy for survival through times of drought. When its freshwater home evaporates, the lungfish burrows into the mud and waits in a dormant state for many months until the water returns.

Living at the boundary between water and land, lungfish have gills but can also breathe air and move their fins in a manner of walking. These adaptations have allowed species of lungfish to survive virtually unchanged for millions of years.

Many of our own journeys pass through a time of dormancy, a moment of rest and preparation before crossing the threshold into the unknown future. This pause may be brief or lengthy as plans are finalized and strength is gathered. The long-dormant lungfish is like those who may wait forever at the boundary that separates the stable present from the unfamiliar future.

Hero's Journey, Step 4: The threshold. An opportunity for progress may go unrecognized.

5 OF CUPS: WILDFIRE



A charred, blackened landscape is a bleak and painful scene. In a single day a fire can destroy the majestic growth and delicate ecological balance achieved over decades or centuries of plant life.

However, beneath the devastation lies potential. Fires can play a vital role in the lives of ecosystems. By clearing the underbrush and creating space for sunlight to filter in, wildfires create an opportunity for new life to grow. In the chaparral shrublands of California, densely growing evergreen scrub oaks and other drought-resistant shrubs create excellent tinder for seasonal fires, and many within this plant community require fire for seeds to open, root and spring into renewed conditions.

This painful image of suffering and loss reminds us that many setbacks and disappointments are an integral part of successful growth.

Hero's Journey, Step 5: Initiation. A great loss can disguise a great hope.

6 OF CUPS: RETURN TO THE SEA



Back when the Earth's lands were empty, some sea dwellers left their watery home and found niches on the shores. Here they evolved into land mammals: breathing air, bearing live young and growing land-legs and a neocortex.

Eventually some of these mammals returned to the sea, retaining many of the changes brought on by life on the land. Whales and dolphins flourished as water creatures, bringing new strengths and means of survival into their ancient home.

The whales' and dolphins' return to the sea is a homecoming that offers hope, restoration of balance and recognition of progress.

Hero's Journey, Step 6: Revisiting the mentor. Hope and connection are restored.

7 OF CUPS: CHOICES



Which direction is the right one? Which choice will lead to success? Both predators and prey depend upon split-second decisions for survival. Slow gathering of information and patiently weighing options can produce informed choices, but when danger is near the results of such deliberation may come too late. Creatures in the wild rely on subconscious snap decisions to better their chances of success.

There are many tools available for making decisions: employing logic, analyzing options or asking advice. The most powerful tool for solving complex problems may be the one most difficult to fully understand: the subconscious mind that harbors emotions, identifies patterns and processes information in ways the conscious mind does not. When logic becomes overwhelmed with too many options, complexities and contradictions, it may be best to go with your gut.

Hero's Journey, Step 7: Return with new knowledge into everyday life. The hero hesitates before turning toward home.

8 OF CUPS: COCOON



Encased within a protective cocoon during its transformation, the caterpillar utterly loses its form. Every cell takes on a new purpose, and for a time the creature is neither caterpillar nor moth. Only when metamorphosis is complete does the stunningly beautiful Luna moth emerge from its cocoon and spread its wings to the sky.

Times of transformation can demand a protective distance from the world, a total retreat. When the dissolution and recovery is complete, the world's challenges are not so threatening. Until that time, growth must take place in safe isolation.

Hero's Journey, Step 8: Defeating the dragon. The hero retreats from the world as deep changes unfold.

9 OF CUPS: EMERGENCE



An ant colony produces complicated feats of mechanical and social engineering, yet each individual ant is directed through life by simple chemical messages and basic instinctive behaviors.

An ant colony is an example of an emergent system, in which the outcome totals more than the sum of its individual parts. Such patterns can be found in biology, physics, weather, technology, human society and other complex systems. As relationships develop between living creatures, buildings or chemicals, fantastic and unexpected results can be achieved. The rich complexities of emergent systems cannot be predicted merely through studying any one of their component parts.

What began in simplicity has grown into a magnificent splendor. Your small part in the greater whole may have felt unimportant, but the rewards are now unmistakable.

Hero's Journey, Step 9: Death of old self, creation of the new self. The hero's true desire is fulfilled.

10 OF CUPS: EVOLVING



Evolution is a continuous process of adaptation to the inevitable changes affecting an unpredictable environment. While some species perish as weather or resources change, others gain advantage in the new landscape, and their surviving offspring introduce a wondrous menagerie of newly evolved creatures equipped to survive, cooperate and compete in the transformed world.

The Ten of Cups reminds us of the wealth we have gathered within ourselves and our relationships with the people and living things around us.

Here is the culmination of our journey that began at the Ace of Wands. All of us are made of elements manufactured inside stars. We interact with the world around us, perceive ourselves as separate from it and, ultimately, reunite as part of the universe we were created in. As species grow and adapt in response to the changes in our world, so they and we are forever becoming a living part of the rich world of this planet Earth.

Hero's Journey, Step 10: Completion of quest. The hero's achievement reveals a future of profound depths and glorious possibilities.

PAGE OF CUPS:
MARIA SIBYLLA MERIAN, EXPLORER



Maria Sibylla Merian painted extraordinary and detailed observations of insects and plants in 17th century Europe. While her peers examined dead specimens preserved in alcohol, Merian catalogued her observations of living animals and plants in the wild.

Her scientific explorations were the first to document that butterflies emerge from cocoons after their metamorphosis from caterpillars and are not born through spontaneous generation as was commonly thought at the time.

With this type of passionate, openhearted exploration of the world and the relationships within it, Merian reminds us that the first steps of discovery are curiosity and observation.

The Hero as an Explorer: A seeker whose initial curiosity about the world opens a gateway to scientific inquiry.

KNIGHT OF CUPS:
BARBARA McCLINTOCK, INNOVATOR



Barbara McClintock discovered transposons: pieces of DNA code that produce different effects in an organism when they move to different locations along the length of a chromosome. Although her early discoveries involving the genetics of corn kernels were dismissed for decades, her insightful and diligent work spanning the next forty years was ultimately rewarded with a Nobel Prize in 1983.

The ability to work persistently and perceptively allows us to observe the tiniest of details and understand the subtlest of relationships.

The Hero as an Innovator: The devoted researcher whose persistence and invention reveal new insights.

**QUEEN OF CUPS:
JOHN MUIR, STORYTELLER**



John Muir spent years exploring and living in the Sierra Nevada mountains, where he correctly theorized that the region's cliffs and valleys were shaped by the formation and movement of glaciers. His books, articles and skills of persuasion supported the preservation of wilderness areas and natural resources. He was instrumental in the establishment of Yosemite as one of the United States' first national parks.

It is important to observe, embrace and preserve the things we love, and to communicate our emotions in empathetic ways. John Muir was a storyteller who communicated not simply the mechanics of nature but its value. His example reminds us that heartfelt reverence for nature and scientific study of the world around us can together enrich our feelings of spirituality and wonder.

The Hero as a Storyteller: The negotiator whose intelligence and empathy welcome others into scientific discovery.

**KING OF CUPS:
DAVID BOHM, VISIONARY**



David Bohm was a vital contributor to nuclear physics in the 1940s, when his collaborators included Albert Einstein and J. Robert Oppenheimer. Yet Bohm's diverse interests and unorthodox views reached well beyond this discipline. Over time, lifelong conversations with religious leaders like the Dalai Lama and philosophical traditions from around the world engaged his understanding of the physical world. His subsequent work influenced the fields of cognition and language as well as philosophy and quantum physics.

Bohm's interests and observations were diverse, but he recognized a common underlying order. Each of us cradles a vision within, a commanding insight to be reached through compassion and feeling. Here is the vista from which the powerful center of wisdom, compassion and emotion draw each of us into the world, and the world into each of us.

The Hero as a Visionary: The director who drives scientific study forward into new territory with vision and hope.

MAJOR ARCANA AS SCIENCE STORIES

Powerful stories offer helpful stepping stones to each of us: shared experiences, moments of transformation and familiar characters. Each Major Arcana card invites us to find our own story within the realm of science.

"[Tell science stories] about nature that are true and complex ... but still have the power to enthrall, to excite, to remind people there is a deep beauty, a many leveled beauty in the world."
- Robert Krulwich, Radiolab



Artwork by Kristian Johnson Michiels

Adapted original Major Arcana art by
Suzanne Forbes for publication

STUDENT **0: THE FOOL**



A student steps forward, eyes buried in a book, the reality of the world around him less important than the words and ideas on the page. While the staircase of books and theories gives him a good start and takes him ever higher, his next step will bring a hilarious fall. The tools and glassware waiting below promise an uncomfortable landing.

The Fool is that shortsighted enthusiasm which cannot be completely controlled or perfectly refined. The scientific method hones our critical thinking and understanding of the nature of reality by forcing us to prove our imaginative conclusions with repeated experiments. This can change our conclusions, and perhaps over time it can change our perspective of the world.

Every adventure begins with a step into the unknown. A willingness to risk appearing the fool, stumbling into success or failure with enthusiasm and positivity, can help sustain us on the journey.

RIBOSOME **1: THE MAGICIAN**



Ribosomes combine basic chemical tools to create the enzymes that act within all living cells. They are an ancient invention common to all living things on Earth, and their role is central to the origin and maintenance of life.

If DNA is the blueprint for living organisms, then the ribosome is the master architect which reads, translates, and fabricates a functioning life form from those raw plans. From this construction, a rabbit is born out of the hat, not only physically but in spirit and consciousness as well. How exactly the ribosome can combine these biological parts to create life is complicated and even mysterious.

The Magician's tools are at hand, ready for creation, a shift of attitude or the implementation of an idea. You have everything you need. Work your own magic to manifest these ideas into the world and give them a life of their own.

BENZENE DREAM

2: THE HIGH PRIESTESS



The scientist August Kekulé was struggling to uncover the structure of the molecule benzene. It was the mid-1800s and chemists were working to decipher the benzene structure into a linear model. The six carbon atoms of benzene acted oddly in their experiments and did not seem to conform to the known rules of chemical bonding.

One night, Kekulé dreamt of a serpent biting its own tail. He awoke knowing the solution to the puzzle: the benzene molecule takes the shape of a circle, not a line, with the first and last carbon bonded to each other. Since this insight, a myriad of molecular rings have been discovered, their structures integral to many chemical processes.

The High Priestess is devoted to this type of mysterious and perceptive insight. Imagination and inspiration play a vital subconscious role in many discoveries. Dreams and creative work can bring surprising understanding to aid calculation and study.

MENDEL'S PEAS

3: THE EMPRESS



Gregor Mendel, a monk in the 1800s, experimented with pea plants, patiently nurturing them as they grew, withered and grew again in his garden. Curious about the passing of physical traits from parents to children, he chose to observe generations of pea plants, which produced hybrids he could easily cultivate. He watched for whether yellow or green pea pods, white or purple flowers and other selected qualities would be inherited from the parent plants.

Through this cycle of life, death and reproduction, Mendel uncovered the process of inheritance: how traits, dominant and recessive, are passed from parent to offspring. From these fruitful lifelong efforts, he became known as the Father of Genetics.

The Empress represents the nurturing attentiveness of Mendel as well as the natural processes he studied so closely and respectfully. This is a time for gestation, growth, patience and attention.

CRYSTALLIZATION

4: THE EMPEROR



Free-floating molecules of sugar in a concentrated solution coalesce into perfect order as they bond together, assembling into a lattice and forming a solid crystalline structure.

The dazzling crystals found in our world, from rock candy to diamonds, remind us of the power and beauty that can be formed by following rigid rules under the proper conditions. Leading civilization can bring stability, but becoming a strong leader demands discipline and personal responsibility.

The Emperor represents the power to form a precisely ordered structure from a shapeless mass of disconnected parts. Ultimately this power is found within each of us, uniting our scattered energies toward a common purpose and offering a brilliant example to inspire the world.

PROFESSOR

5: THE HIEROPHANT



A professor is a source of higher knowledge: of history, of science and of life experience. It is through our interactions with a teacher that we can develop our own talents and build on the achievements of those who have gone before us. Without this guidance, we might spend our lives repeating the efforts and mistakes of generations past.

Yet a professor does more than present information. Teachers and authority figures may also train, challenge and reshape us, for better or worse. At times, their training and reliance in traditional systems may make them resistant to their students' new methods or unusual talents.

The Hierophant is the authority that introduces us to the world and to our own higher potential. Our instincts and perceptions may lead us to discover other sources of knowledge, which we must learn to balance with or against the valued lessons of our teachers.

BINARY STAR 6: THE LOVERS



Two stars orbit each other in a delicate balance of gravitational attraction and angular momentum. A bit closer together and they would crash into each other; a bit further apart and they would be flung in opposite directions. These two heavenly bodies together, pushing and pulling each other as they spin, can form the center of a single solar system of orbiting planets.

The Lovers have reached the point of balance, and together the two separate stars form one radiant entity. This powerful relationship is represented by an infinity symbol and a fierce heart of fire, signifying a passionate romance, intimate partnerships and the weighty choices they demand.

TECHNOLOGY 7: THE CHARIOT



Technology harnesses the powers of nature to achieve human goals. Long ago we imagined ships that might fly us through the air and into space. Years of observation, experiment and struggle brought these dreams into reality.

Technology demands an understanding of what we have learned and a vision of what may be possible. We begin each flight with our feet on the ground and our eyes turned toward the sky.

The Chariot carries us between opposites, from the world we know well to the places we have never been. Imagination can be balanced by calculation, ambition with caution. When we gain control over ourselves, our emotions and the forces of nature, we can escape the gravity of the familiar world and reach our higher ideals.

NUCLEAR FORCES

8: STRENGTH



Every atom is held together by a tremendously powerful nuclear force that binds protons and neutrons into the nucleus. The strong nuclear force holds the sub-atomic particles together in the cores of the atoms that compose us. The strength of scientific inquiry allows us to understand how these forces work, and how to work with them.

When atoms are split and these bonds broken, vast quantities of energy are unleashed. It is through discipline, drive and insight that humans have found the strength to manipulate the most powerful force in the universe. Today we can hold in our hands the trace patterns of smashed sub-atomic particles, pictures of the forces found inside ourselves and inside all the matter in the universe.

We are all made of atoms, which contain the most powerful force in the universe. The Strength card reminds us of the importance of courage and understanding that real strength is found within. In understanding yourself, you can grasp your inner strength.

FERMAT'S LAST THEOREM

9: THE HERMIT



Pierre de Fermat was a 17th century French mathematician with a habit of taking notes in the margins of books he was reading. One such note, found after his death, announced that he had discovered a marvelous mathematical proof "which this margin is too narrow to contain."

By not writing the solution, he left a tempting and frustrating offer for generations afterwards. Many mathematicians struggled to produce Fermat's proof, consuming lifetimes. The proof was finally achieved in 1995 after centuries of persistent work done without assurance that a solution truly existed.

The Hermit represents the focus and isolation of Fermat's studies, and of those who worked to solve his mystery. Many discoveries and insights of nature and of ourselves can be developed only in nurturing solitude, separated from distraction and fulfilled through thought and study.

SCHRÖDINGER'S CAT

10: WHEEL OF FORTUNE



The physicist Erwin Schrödinger devised a thought experiment to help understand superposition, a complicated facet of quantum physics. Imagine a cat placed inside a box. A mechanism also in the box may or may not kill the cat, depending on a random radioactive event. After a while, we cannot know whether the cat is dead or alive inside the box, but instead consider the cat is somehow both dead and alive at the same time.

Superposition suggests that a sub-atomic object, like the cat inside our imaginary box, actually exists in all states simultaneously, until an outside observer forces it into one state by observing it. While an animal could never truly be dead or alive at the same time, Schrödinger's cat illustrates the strange nature of the quantum world.

The Wheel of Fortune suggests all the unknowable possibilities the future may hold for us. It is our own actions that will finally bring the result. To find a resolution, we must bravely take a chance, spin the wheel, and open the box.

CONSERVATION OF ENERGY

11: JUSTICE



Energy is never lost, it is only transformed. Chemical energy may be changed into kinetic energy, kinetic energy into heat, heat into light - all these are different forms of the same amount of energy in the universe. The law of Conservation of Energy states that the energy in a closed system remains constant over time.

In life as in physics, Justice promises a restoration of balance: when something is lost, something else is gained, and the cycle will return again. It is impersonal, impartial and logical, and its rules cannot be broken.

Justice also reminds us to consider the larger results of our actions. Everything we do brings a response from the system that surrounds us. So what will we do with our energy? Imbalance and restoration of balance both originate from within.

POTENTIAL ENERGY 12: THE HANGED MAN



An enormous rock stands balanced in the desert. There is no movement, only waiting and observing. In time the massive shape will crash down, its stability shifted by erosion, the wind, or a bird taking flight. Until that moment the powerful weight remains poised, existing only in the form of potential energy.

The Hanged Man is like a precariously balanced boulder. The stillness and peace of the balance eventually transforms into the movement of kinetic energy.

While this state of suspension can be frustrating, we can appreciate the stillness while it lasts. This is the opportunity to observe from a plateau and consider all possibilities, before decision turns into action and engulfs us once more.

PHASE TRANSITION 13: DEATH



A human skull carved from a block of ice faces its final moments as the sun melts it into water. Clouds of vapor rise up from its solid form and from the puddle on the ground beneath it. The water may again freeze into a solid when temperature and pressure allow, but the icy expression it once held is gone forever.

Death marks a frightening and drastic transition. The path has come to an end and the familiar form that brought meaning and comfort will never return. It is time to willingly release dead matter, to recognize that death is a state of approaching equilibrium. As ice melts and steam rises, water is transformed.

This is a time for loss and mourning, to hold a wake, reintegrate and reinvent. Much that vanished from sight can reemerge in new forms.

TOLERANCE OF UNCERTAINTY

14: TEMPERANCE



Three blindfolded people touch the same unknown object. The first insists the object is a flexible brush, the second argues that it is snake-like and the third asserts it is a stone pillar. Each thinks the other two ideas are preposterous and nonsensical in comparison to their own hands-on experience. When the three finally remove their blindfolds, they are surprised to discover they were in agreement all along: they each described different parts of the same elephant.

This old tale portrays the limitations of perception. Our quest for knowledge must be tempered with a tolerance of uncertainty. Successful scientific study and human society both require patient discourse and a willingness to allow for our own limited interpretations.

The Temperance card reminds us to seek balance in our pursuits. In putting aside our absolutes, no matter how certain they appear, we opt for tolerance of others' experiences to gain a better understanding of the world, our companions and ourselves.

UNQUESTIONING

15: THE DEVIL



Scientific discoveries have brought many benefits to humankind, yet the shortsighted use of new knowledge may create new problems. Especially after so much success, little consideration may be given to responsibilities or repercussions. An unquestioning attitude can prevail.

In this addiction, the apparent solution becomes the next problem and the consequences grow ever more dangerous. It tempts us not to question our actions and we enter a downward spiral.

The Devil represents this embrace of a destructive habit. Our fears or cravings blind us to the destruction we cause and trap us in a confining world. Instead, we must critically think about whether to pursue an idea. We can find freedom and self-control through the understanding that the chains that bind and enslave us are often of our own creation.

ATOM BOMB

16: THE TOWER



At the Trinity nuclear test site in New Mexico, the first atomic bomb was dropped from a high tower, exploding with a force never before unleashed by mankind. When another atom bomb was detonated over Hiroshima a month later with a nuclear flash brighter than many midday suns, the shadows of 10,000 dead were burned visibly onto the pavement in a split second.

Many scientists who had contributed to the project, horrified and disillusioned by the outcome of events, pursued new disciplines and new philosophies as humanity crossed into the atomic age. To some, this devastation brought clear, humbling insight and a costly new wisdom.

The Tower card represents the destruction of a monument to ego, illusion and false confidence. Its collapse brings an end to the ambitions and expectations raised so high upon it. Only the shadows remain.

COMPASSIONATE ACTION

17: THE STAR



Science helps us understand the world around us and anticipate the future results of present conditions. Scientific insights may be used to support life or destroy it, to achieve temporary gain or to ensure long-term stability for all the systems that make life possible.

Compassionate action recognizes a sense of common purpose and destiny that all living things share. When we understand the systems that create our world, we can choose to align our work with nature and maintain balance with the Earth. When we take decisive steps acting from a place of compassion and understanding for others, we can use our knowledge to reduce suffering, save lives and create a better world.

The Star promises hope and healing and reminds us that we live under the same sky. It illuminates the best parts of our world and guides us to best parts of ourselves.

CHEMICAL SPIRITS

18: THE MOON



All through the development of life on Earth, the moon has journeyed through the sky, pulling gently at our oceans and casting a silent influence over natural cycles.

Over the millennia, many plants evolved chemical properties that allow them to interact with human physiology and consciousness. Plant species such as poppy, belladonna and willow came to our attention because of the powerful and transformative chemical spirits naturally occurring within them. After centuries of study and experimentation, we learned to synthesize related chemicals for many uses: morphine from poppies to ease pain, ipratropium from belladonna to treat asthma and aspirin from willow to relieve migraine.

The Moon represents the realm of the subconscious and its influence on our lives. Its silver light offers only a shadowy view. We may see the world differently under its illumination.

DUALITY OF LIGHT

19: THE SUN



The sun's nuclear fire radiates energy into space in every direction. Its generosity and abundance makes life on Earth possible, and its light ignites our senses and our minds.

Light has a dual nature, only recently discovered in experiments which revealed the pattern similar to the one on this card's border. Light can behave as both a particle and a wave. This astounding duality opens a mysterious door into the most complex lessons of physics and life itself.

The Sun unites opposing ideas into a single wonderful reality. By accepting these seemingly contradictory behaviors, we gain a higher understanding of the nature of the universe and the radiant mysteries around which our lives orbit. Rejoice at the sources of light in your own life.

NATURAL SELECTION 20: JUDGMENT



Early in the 18th century, the peppered moth of England was almost always white in color. The light-colored bark of local trees allowed the white moths to rest unnoticed, while the rare dark moths were easily seen and eaten by birds. The white moths were naturally selected to survive.

With the industrial revolution, however, the trees were stained grey from the soot produced by nearby factories. In this changed environment, the dark moths were safely hidden on the polluted tree bark, while birds ate the white moths. Natural selection set to work again, but this time the dark moths thrived.

Judgment has a set of rules by which some will thrive while others will fail. Some characteristics that offered protection in the past may create weakness in the present, and those that had been a burden may now prove essential to survival. As elements in your life transform, consider which legacy parts of yourself and your lifestyle are useful, and which are better left in the past.

GRAND UNIFIED THEORY 21: THE WORLD



Gravity, electromagnetism, strong nuclear forces and weak nuclear forces: these are the four independent fields through which forces may be transmitted. Together, they allow physicists to explain the behavior of the physical world we all inhabit.

While our understanding of each of these has grown powerful and sophisticated, we are still working towards a Theory of Everything, one to effectively relate the four forces to one another. Finding a Grand Unified Theory of all the forces is an important goal, a holy grail, of scientific exploration.

The World represents the fulfillment of a grand and profound goal. Life's promise and majesty, wholeness and prosperity is achieved. Everything we have searched for is discovered at last, and we are welcomed to dance in gratitude and celebration.

HOW IS THE SCIENCE TAROT USED?

Just as with the traditional tarot, the cards of the Science Tarot deck are shuffled and a question is posed. A layout is chosen and the cards are dealt into the layout pattern. The artwork on each card creates associations based on its position in the layout and its relationship to the other cards. From this process stories are created and the question explored.

One of the simplest and most popular layouts is the Three Card Spread, where three cards are laid side by side. The first card represents the past, the second represents the present and the third represents the future. For each card, let various thoughts about how the card may relate to your question come to mind.

1. View the first card and consider your past. What does the artwork on the card remind you of? How does it relate to your question?

2. View the second card and consider your present. How did the past, which you considered only a moment ago, lead to this present? Your story begins to form.
3. View the third card and consider your future. Is the artwork frightening, exciting, tempting? How might this story of past and present lead to this future?

Considering all three, a story can be envisioned. Is this the story you would like to see happen? What choices can you make to develop further the story you've imagined?

Interpreting tarot cards means telling a story, and like any story it might clarify a question, offer encouragement or reveal hidden thoughts. If a tarot reading seems to make little sense, another reading may speak more clearly instead.

SAMPLE LAYOUT SPREADS FOR SCIENCE TAROT

Here are a few science-inspired layouts created by users of the Science Tarot. We invite you to offer feedback and suggestions for new science-inspired layouts.

Tarot Reading Hints:

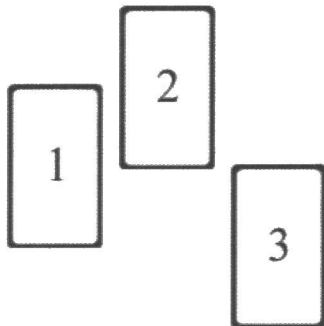
- You can perform readings for yourself or others. Ask a question before dealing the cards, to focus thoughts on the relevant associations.
- When performing a reading for someone else, ask them to cut the deck or shuffle the cards.
- Ask the person what the artwork means to them as you interpret the cards.

CHEMICAL REACTION SPREAD

This simple spread shows how the past leads to the future once sufficient activation energy has been accumulated.

After thinking of a question and shuffling the deck, deal three cards, one at a time, from left to right.

1. Reactants to represent your past
2. Transition State to represent your present
3. Products to represent your future



BENZENE RING SPREAD

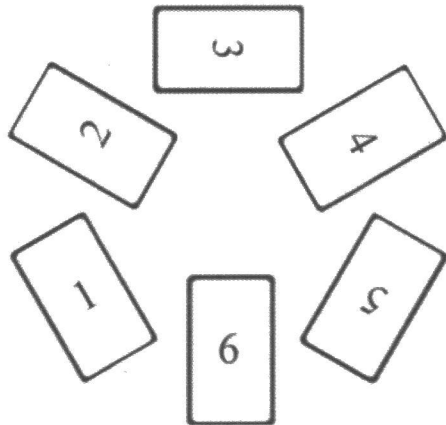
Benzene is an iconic molecule in the field of organic chemistry and a useful solvent, but it is also quite noxious. Use this spread based on benzene's structure for insights about a personal problem or conflict.

After thinking of a problem or conflict and shuffling the deck, deal six cards, one at a time, following the diagram.

1. Your perception of the situation (which influences your intention)
2. Your intention
3. Outside perception of the situation (which influences the complication)
4. Complication
5. Negotiation (integrating the two perceptions)
6. Resolution, the final result of this reading

This resolution may create new circumstances to continue around the ring again.

BENZENE RING SPREAD



PERIODIC TABLE SPREAD

This layout echoes the structure of the Periodic Table of the Elements, offering a fun way to explore different "elements" of our lives.

After thinking of a question and shuffling the deck, deal ten cards, one at a time, following the diagram below.

1. Past motivating element (highly reactive)
2. Past inhibitor (inert gases)
3. Present motivating element (reactive)
4. Yourself in the present (organic compositions)
5. Present inhibitor (inert gases)
6. Future motivating element (reactive)
7. Element which helps through transition (transition metals)
8. Unknown element within yourself (undiscovered element) - deal this card face-down; turn it face-up at the end of the reading to reveal a hidden talent or difficulty
9. Toxic elements (heavy metals)
10. Culmination, the final result of this reading

PERIODIC TABLE SPREAD

