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PROJECT ON NUCLEAR GAMING

SIGNAL Game Manual

Version 1.0

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ABSTRACT

SIGNAL is a first of its kind experimental wargame developed as part of the Project on Nuclear Gaming (PoNG). In this document we describe the rules and game mechanics associated with the online version of SIGNAL created by team members from the University of California, Berkeley, Sandia National Laboratories, and Lawrence Livermore National Laboratory and sponsored by the Carnegie Corporation of New York. The game was developed as part of a larger research project to develop the experimental wargaming methodology and explore its use on a model scenario: the impact of various military capabilities on conflict escalation dynamics.[1] We discuss the results of this research in a forthcoming paper that will include this manual as an appendix.

It is our hope that this manual will both contribute to our players' understanding of the game prior to play and that it will allow for replication of the SIGNAL game environment for future research purposes.

The manual begins by introducing the terminology used throughout the document. It then outlines the technical requirements required to run SIGNAL. The following section provides a description of the map, resources, infrastructure, tokens, and action cards used in the game environment. The manual then describes the user interface including the chat functions, trade mechanism, currency and population counts necessary for players to plan their actions. It then turns to the sequence of player actions in the game—describing the signaling, action, and upkeep phases—that comprise each round of play. It then outlines the use of diplomacy—including alliances with minor states and trade between players. The manual also describes the process for scoring the game and determining the winner. The manual concludes with tips for players to remember as they embark upon playing the game.

[1] Reddie, Andrew W., Bethany L. Goldblum, Kiran Lakkaraju, Jason Reinhardt, Michael Nacht, and Laura Epifanovskaya. "Next-generation wargames." *Science* 362, no. 6421 (2018): 1362-1364; Lakkaraju, Kiran, Jason Reinhardt, Joshua Letchford, Jonathan Whetzel, Bethany L. Goldblum, and Andrew W. Reddie. "Experimental wargames to address the complexity: scarcity gap." In *Proceedings of the 2020 Spring Simulation Conference*, pp. 1-12. 2020.

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TERMINOLOGY

Term	Definition
Action card	A card with a capability that a player can use
Action set	A group of action cards possessed by a player
Ally	A minor state that is allied to a player
Coastal hex	A hex adjacent to a large body of water
Coin	The game's unit of currency
Damage (as of infrastructure)	Disable a town, city, base, or occupying force for the remainder of the round. A "damaged" town or city cannot provide any income in the Upkeep phase. A damaged military base or occupying force cannot be used for a conventional attack.
Destroy (as of infrastructure)	Remove a town, city, base, or occupying force from the hex targeted in the attack.
Destroy (as of a hex)	Any resources on a hex are removed and cannot be accessed by players. No infrastructure can be built on a hex once it is destroyed. Hexes are only destroyed by certain nuclear actions.
Hex	A hex is the smallest geographical unit of territory on the SIGNAL game map.
Infrastructure	Towns, cities, military bases, or occupying forces under a player's control.
Major state	One of the three large player-controlled states, colored purple, orange, and green
Minor state	One of the smaller states, consisting of three hexes each. Minor states are scattered throughout the map and grey in color.
Neutral hex	A hex in a minor state.
Occupied hex	A hex that has been taken over by another major state through an invasion.
Occupying force	A population unit created after successful invasion of a hex via a conventional infantry strike or conventional naval strike.
Open hex	A hex that does not have resources or infrastructure.
Owned hex	A hex that belongs to a player. Each player owns all hexes of the same color (green, orange, or purple) as the player's state unless they become occupied by another player during the game.

Term	Definition
Phase	A segment of a round in the SIGNAL game. There are three phases—Signaling, Action, and Upkeep—in each round.
Resource	Food, iron, oil, or precious metals. Resources are located in hexes at various locations throughout the SIGNAL map.
Rotation	A turn-based sequence of moves taken by each player in the Action phase
Round	A complete succession of the three game phases. There are five rounds in a game.
Signaling token	A token placed on a hex that enables a player to use an action card. Placing a signaling token indicates that a player *may* decide to take an action on that hex.
Staging Area	The area where action cards are placed during the Signaling phase to enable their potential use in the Action phase.

1. INTRODUCTION TO SIGNAL

Welcome to SIGNAL!

In this game, players assume the leadership role of a major state by controlling its military, economic, and diplomatic actions. To survive and thrive, each player must cooperate and compete with the other players (major states) in the world.

SIGNAL is designed for three players (1v1v1).

Each player is the leader of a major state (denoted based on the color of its territory: Orange, Purple, or Green). At the beginning of the game, players receive coins, resources, infrastructure, a set of action cards, and signaling tokens. Each game is divided into five rounds. Each round consists of three phases: Signaling, Action, and Upkeep.

- **Signaling phase:** Players indicate that they *may* take action in the subsequent phase by placing signaling tokens on the relevant hex(es) and action cards facedown in their Staging Areas. Players often engage in diplomacy during this phase and can execute trades.
- **Action phase**: Players implement actions by using the action cards and the signaling tokens that were placed on the board during the Signaling phase.
- **Upkeep phase:** Players collect coins and resources. They also adjust the population in their states to match food production levels.

The winner of the game is the player with the overall best performance based on three conditions:

- **Survival:** Minimize loss of territory (number of hexes).
- **Resources:** Maximize resources (food, oil, iron, and precious metals) and coins.
- **Infrastructure:** Accrue towns, cities, and military bases—these can be built by the player or occupied through invasion.

Players are ranked based on their performance in each condition and the winner is the player who performs best over all three goals.

2. TECHNICAL REQUIREMENTS

SIGNAL is a WebGL game played within a web browser.[2] SIGNAL can be played on a desktop or laptop running Windows 10, Linux, or Mac OSX. SIGNAL currently does not support play on tablets or mobile devices. We recommend users have the following system characteristics to play:

- 8 GB RAM (16 GB or higher recommended)
- Integrated graphics card from 2015 or newer (dedicated graphics card recommended)
- Google Chrome or Mozilla Firefox browser (64-bit versions recommended)

[2] A board game version of SIGNAL was also designed and developed.

3. MAP, ACTION CARDS, AND TOKENS

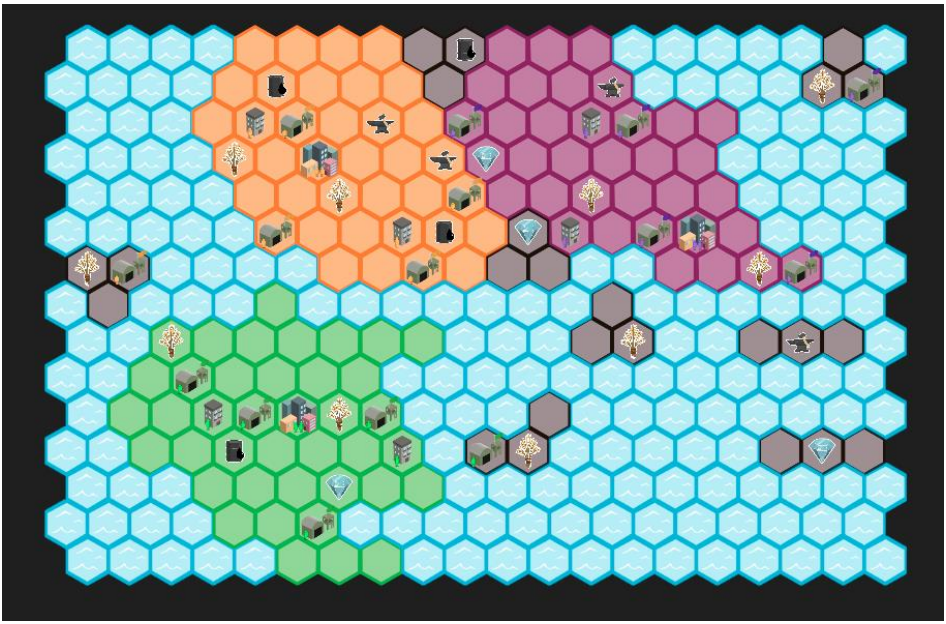


Figure 1. The SIGNAL map

The SIGNAL map (*Figure 1*) shows three major states (Orange, Purple, and Green) and several minor states (grey). The map is divided into hexagonal geographical units called "hexes."

Major states vary in size: Green has 44 hexes, Purple has 42 hexes, and Orange has 37 hexes. Each minor state has three hexes.

At the beginning of each game, some hexes contain resources, others contain infrastructure (towns, cities, military bases, or occupying forces), and some are open.

3.1. Resources

In SIGNAL, all resources are valuable, but each one serves a different purpose. The four different types of resources used in SIGNAL are shown in *Figure 2*.

- **Iron:** Used for reducing the cost to build infrastructure.
- **Oil:** Used for reducing the cost of conventional military actions and defense.
- **Precious Metal:** Provides income of three (3) coins in each Upkeep phase.
- **Food:** Required to grow and support the population. Each food resource allows a country to support three (3) population units.

Figure 2. Resources in SIGNAL game

A resource is not expended when it is used or traded, and a single resource can be used for multiple action cards.

A player can lose access to a resource via invasion that results in an occupying force on the hex containing the resource, or by loss of an alliance (see *Figure 17*). Resources are permanently destroyed if the hex is destroyed (for example, if a hex is hit by a nuclear weapon).

3.2. Infrastructure

There are two categories of infrastructure: civilian and military. Civilian infrastructure consists of towns and cities. Military infrastructure consists of military bases and occupying forces. The four different types of infrastructure in SIGNAL are shown in *Figure 3*.

A town has one unit of population. A town can be turned into a city, which has two units of population. Players can build towns and cities only in their own states.

A military base has one population unit. Military bases reduce the cost of *Conventional Infantry Strike* (see *Section 3.4.2*) and, when built in minor states, can enable an alliance (see *Section 8.1*). Players can build military bases on their controlled hexes (their original territory or new territory they have accumulated) or on minor states.

Occupying forces also have one population unit and can be used to capture resources or military bases in other states. A player can convert an occupying force into a military base, allowing a player to build a base within another player's state (provided the hex does not already contain a resource).

Players can gain or lose infrastructure when action cards are executed. For example, the *Build A Town or City* action card creates new civilian infrastructure. Military action cards can damage or destroy infrastructure.

N.B. - Players can only build towns and cities on open hexes in their states, but they can build military bases on open hexes either inside or outside their states.

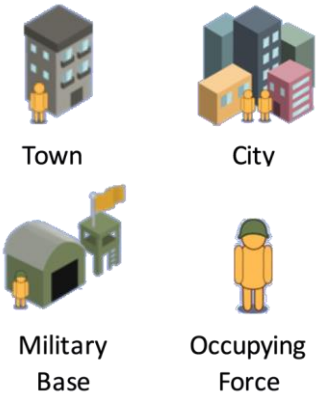


Figure 3. Infrastructure in the SIGNAL game

3.3. Minor States

Minor states are not controlled by a player, but they may contain resources at the beginning of the game. Players can access these resources by allying with a minor state or by seizing the hex with the resource via a conventional infantry or naval attack.

3.4. Action Cards

Players are given action cards that represent capabilities. These capabilities include military actions and infrastructure construction. There are 10 types of action cards in three broad categories:

- Infrastructure actions
- Conventional military operations
- Nuclear weapons

Each card indicates its effect and cost of use. For example, the *Build a Town or City* card is shown in *Figure 4*. The first number on the bottom left of the card is the amount to be paid if a player has access to a particular resource. The second number on the bottom right shows the cost if the player cannot access that resource. (Some action cards are unimpacted by resource allocation and display only one cost.) For example, to use the *Build a Town or City* card, a player with access to iron has to pay three coins, but a player without access to iron must pay five coins.

Figure 4. The *Build a Town or City* infrastructure action card

3.4.1. Infrastructure Actions

Figure 5. Infrastructure action cards.

Infrastructure actions focus on building new infrastructure. The two types of infrastructure action cards are shown in *Figure 5*. The cost for playing these cards is reduced if a player possesses an iron resource.

***Build a Town or City*:** This card is used to build a town or to turn a town into a city. Towns and cities can be built only in a player's own territory (e.g., Green builds towns or cities in green hexes only).

***Build a Military Base*:** This card is used to build military bases. Military bases can be built only on open hexes (i.e., they do not contain a resource or other infrastructure) that are either owned (player's home territory), occupied (replace a player's occupying force), or neutral (part of a minor state).

3.4.2. Conventional Military Actions

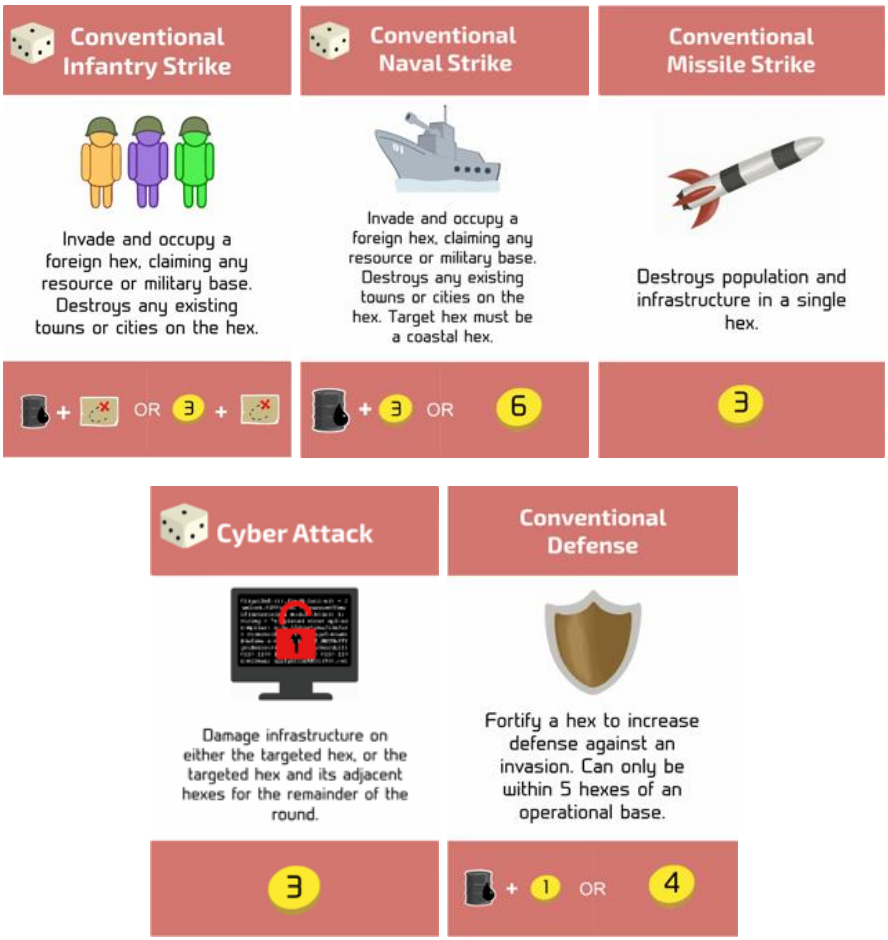


Figure 6. Conventional military action cards.

The five conventional military actions (see

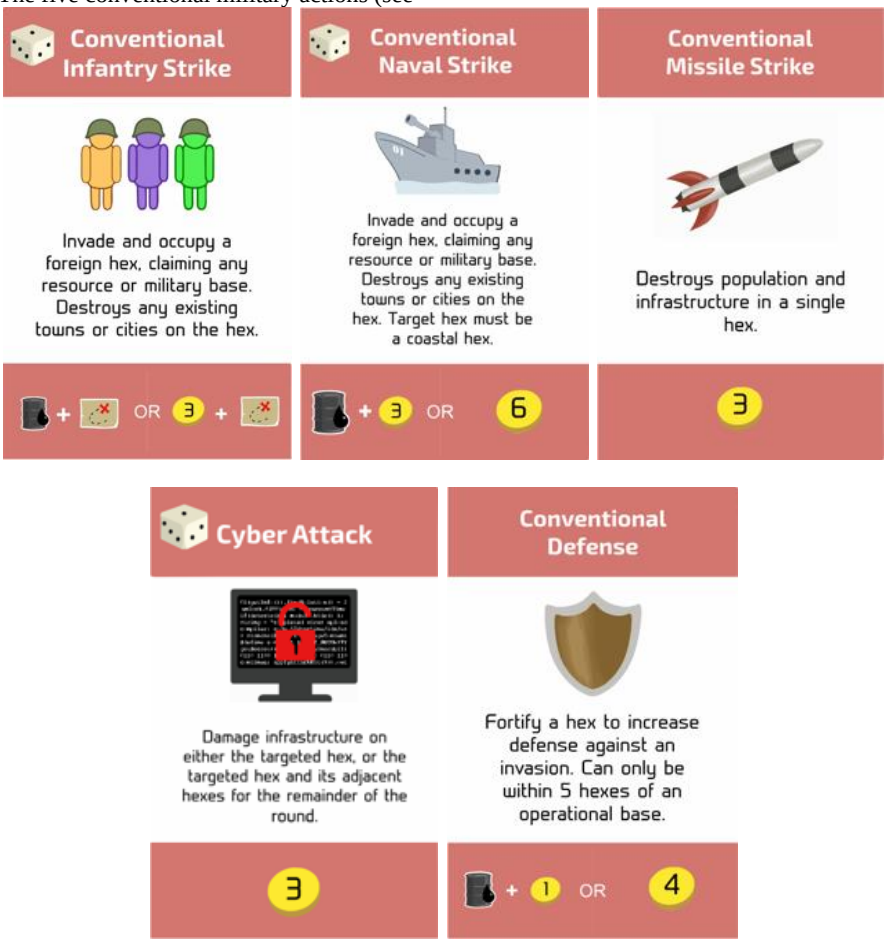


Figure 6) focus on occupying hexes, damaging infrastructure, destroying infrastructure, and defending against an attack. The cost of some military actions (*Conventional Infantry Strike*, *Conventional Naval Strike*, *Conventional Defense*) are reduced if a player possesses an oil resource. To occupy a hex, players must use a *Conventional Infantry Strike* or a *Conventional Naval Strike* card. Some conventional military action cards have a probabilistic success rate. These cards have a dice image on the top-left corner.

***Conventional Infantry Strike*:** This card enables a player to occupy a hex or take over another player's military base. An occupying force is placed on the hex after a successful assault unless the attacking player is reclaiming a hex that originally belonged to their major state.

The cost of a *Conventional Infantry Strike* depends on the distance (number of hexes) from the attacking player's closest military base or occupying force to the hex being attacked. This is indicated by the map icon on the card. The success of a *Conventional Infantry Strike* is probabilistic, as indicated by the dice on the card. *Table 1* lists the success probabilities.

***Conventional Naval Strike*:** A successful *Conventional Naval Strike* enables a player to occupy a hex or take over another player's military base on a coastal hex. This card can be played only on a coastal hex (one adjacent to a large body of water). An occupying force is placed on the hex after a successful assault unless the attacking player is reclaiming a hex that originally belonged to their major state. The success of a *Conventional Naval Strike* is also probabilistic. *Table 1* lists the success probabilities.

	Probability of Success	
	Defended	Undefended
Empty Hex	0.58	0.97
Hex with town, city, or resource	0.42	0.92
Hex with military base	0.28	0.83

Table 1. Probability of success for *Conventional Infantry Strike* and *Conventional Naval Strike*

Conventional Missile Strike: A *Conventional Missile Strike* is always successful and destroys the infrastructure or occupying force on a hex for the remainder of the round. Infrastructure can be rebuilt on that hex, and it can be reoccupied in subsequent rounds.

Cyber Attack: A successful *Cyber Attack* damages the infrastructure and occupying forces on either a single hex (33% chance) or on the targeted hex and all adjacent hexes (58% chance). There is a 9% chance the *Cyber Attack* will fail.

Conventional Defense: A *Conventional Defense* card places a temporary defensive infrastructure on a hex of the player's choice. This card protects that hex from *Conventional Infantry Strike* and *Conventional Naval Strike* by increasing the difficulty of launching a successful attack. A *Conventional Defense* card does not increase the difficulty of other types of assaults (e.g., *Cyber Attack* or nuclear weapons).

3.4.3. Nuclear Weapons

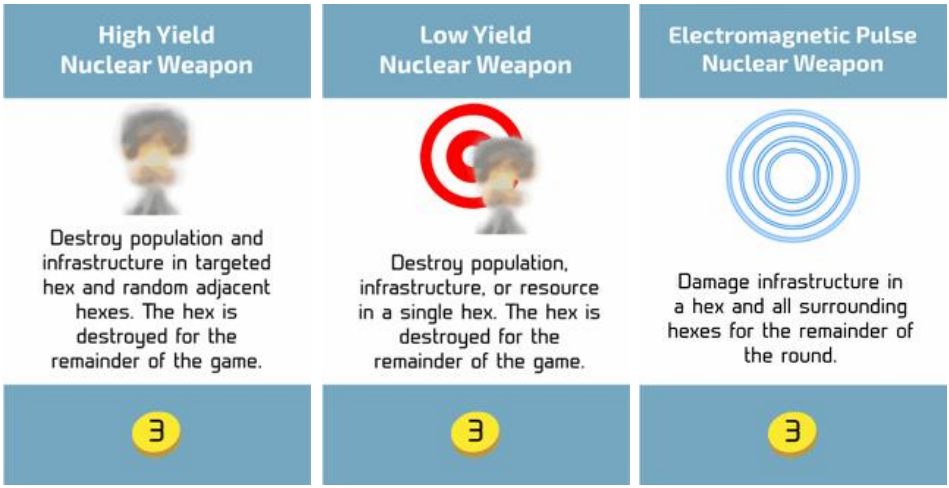


Figure 7. Nuclear weapon action cards

Nuclear weapon action cards (see *Figure 7*) can damage and destroy population, infrastructure, and hexes. Nuclear weapon actions are always successful (100% chance of success) and cannot be used to occupy hexes.

There are three types of nuclear weapons:

High-Yield Nuclear Weapon: This action card destroys the targeted hex and two adjacent hexes, including any infrastructure and occupying forces, for the remainder of the game. One of six randomly selected blast patterns is implemented, as shown in *Figure 8*.

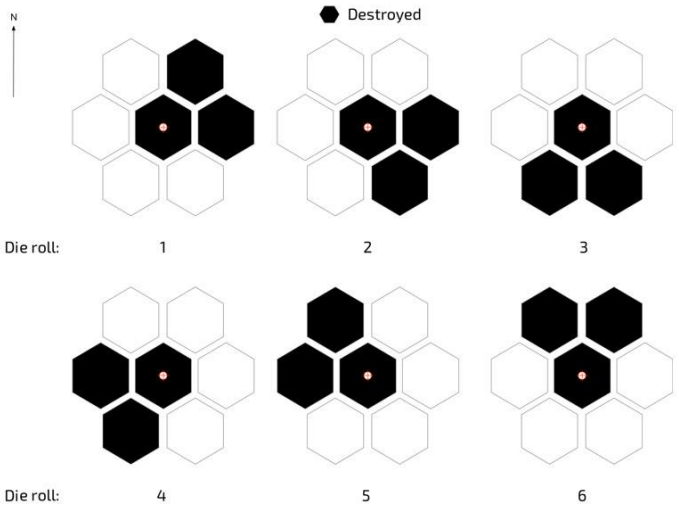


Figure 8. High-yield nuclear weapon blast patterns

Low-Yield Nuclear Weapon: This action card destroys a single targeted hex, including any infrastructure and occupying forces in that hex, for the remainder of the game.

Electromagnetic Pulse Nuclear Weapon: This action card, which represents a nuclear weapon that causes an electromagnetic pulse, damages the infrastructure and occupying forces in the targeted hex and all adjacent hexes for the remainder of the round.

4. HOW TO PLAY

SIGNAL is designed to be played using the keyboard and mouse. A user may navigate the map using the arrow or WASD keys. The mouse scrollwheel can be used to zoom in and out on the map display.

4.1. Top Bar

The top of the game screen provides a dashboard with information on the player's status, along with some information on the other countries. *Figure 9* gives a snapshot of the top bar from a game where the player controls the Purple country (as indicated by the purple crest on the far right).

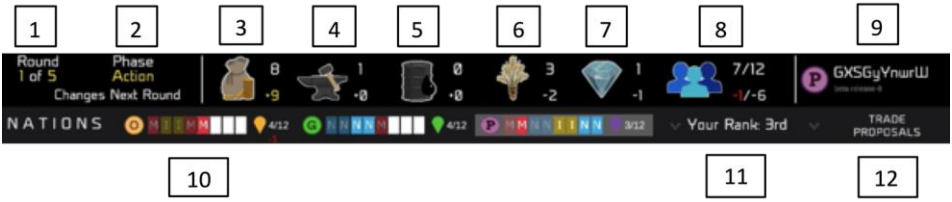


Figure 9: SIGNAL top bar user interface

The top bar provides:

1. **Round:** Current round for the game (1) and the total number of rounds (5).
2. **Phase:** Current phase of the round (Signaling, Action, or Upkeep).
3. **Coins:** The top number provides the player's current coin total. The bottom number shows the country's revenue and how many coins they'll receive at the start of the next round. This varies based upon the number of towns, cities, and precious metals under the country's ownership.
4. **Iron Reserves:** The top number shows the iron resources possessed by a player. The bottom number shows how many iron resources the player will gain or lose at the start of the next round. Players gain iron in the next round by establishing minor state alliances where iron exists, invading a hex where iron exists, or through trade deals. Players lose iron via loss of alliance or control of a hex with iron, suffering a nuclear strike on an owned hex containing iron, or by trading it.
5. **Oil Reserves:** The top number shows the oil resources possessed by a player. The bottom number shows how many oil resources the player will gain or lose at the start of the next round. The same rules for gain/losing iron in the next round apply to oil.
6. **Food Reserves:** The top number shows the amount of food possessed by the player. Food behaves differently than iron/oil in that any food gained or lost by attack or minor state alliance will impact the currently available amount. The bottom number only shows how much food the player will gain/lose at the start of the next round due to trades.

7. **Precious Metal Reserves:** The top number shows the amount of precious metal possessed by the player, and the bottom number provides how many precious metals will be gained/lost at the start of the next round. The same rules for gaining/losing food apply to precious metals.
8. **Population Count:** The top number is presented in an x/y format, where x is the current population count and y is the population capacity. As a player gains/loses population, x will change. As a player gains/loses access to food, y will change. The bottom number follows the same x/y format, but shows how much population and population capacity the player will gain/lose going into the next round. For every one food resource, a player can support three population units. As a player gains/loses access to food, the Population and Food Counts will be updated to reflect if and how much population will need to be removed during the Upkeep phase.
9. **Player Handle:** Shows the player's handle (username) and which country they control. The build version is listed below the player's handle.
10. **Status:** The status bar shows what card types (military, nuclear, or infrastructure) each player has staged. Any greyed-out cards denote cards played during that round. This also shows how many signaling tokens each player has currently placed on the board. Clicking anywhere on this bar will show the player's resource count and provide the ability to trade with that player.
11. **Scoring:** Provides the current rank for the player. Clicking on the rank will provide a detailed breakdown of each scoring metric for all players. More information on scoring is given in *Section 9.2*.
12. **Trade Proposals:** Clicking on this gives information on pending trades initiated by the player or any trade requests received by the player. If a player receives a trade request, they may choose to accept or reject the proposal. See *Section 4.4* and *Section 8.2*.

4.2. Chat / Feed Window

The Chat/Feed window (see *Figure 10*) provides a way for players to communicate and keeps a log of significant events that occurred during the game. A player can send a chat to all players or select a private message to a specific player by clicking on the crests in the bottom-left of the chat window. Messages broadcast to all players will be colored white, while private messages will appear in the color of the country receiving the messages.

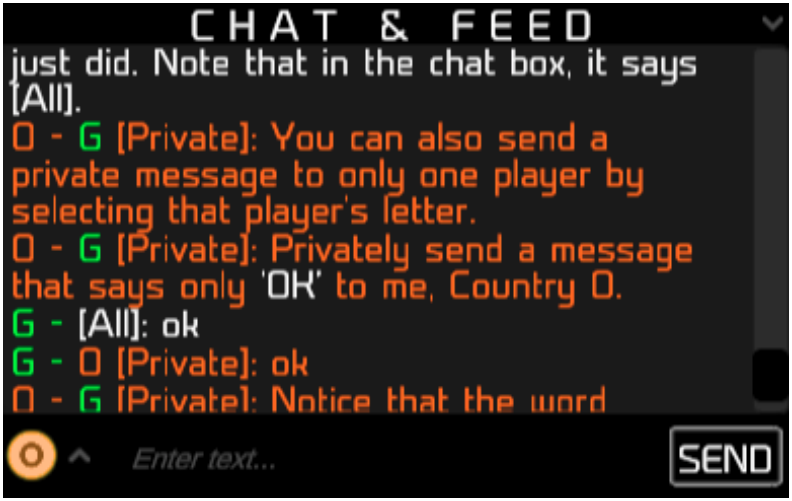


Figure 10: SIGNAL Chat & Feed window

4.3. Staged Actions / Action Deck

The potential actions that a player can take are contained in a deck of cards. During the Signaling Phase, a player may place cards from their deck in the Staging Area, as shown in *Figure 11*. Once in the Staging Area, the player's status in the top bar will change to indicate to all players what category of action (nuclear, military, or infrastructure) was staged, but not the specific action card. For example, if a player staged a *High Yield Nuclear Weapon* action card, this would be revealed to other players in the status bar as a nuclear card.

Cards in the Staging Area at the end of the Signaling phase will be the only actions available for use during the Action phase. Players will execute an action by selecting one of their signaling tokens and the action they wish to play on that token.

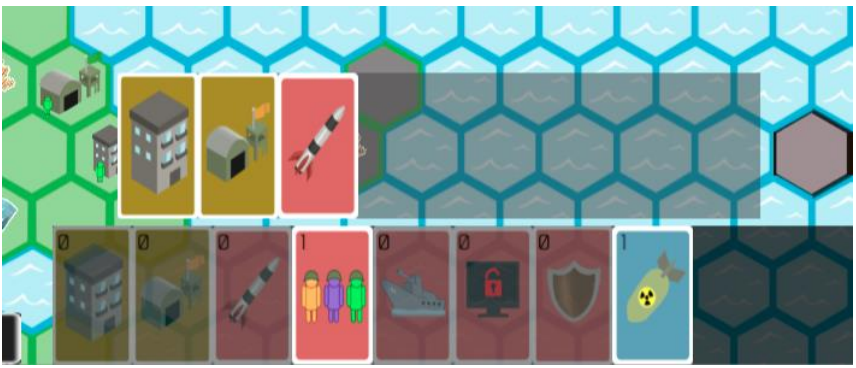


Figure 11: Action set (bottom row) and Staging Area (grey)

4.4. Trade Window

A player may propose a trade with another player by clicking on the country's status in the top bar. This is illustrated in *Figure 12*. A player can offer and ask for coins and/or resources for a given trade. Players may also opt to ask for something intangible (e.g., protection from the other player) and can specify that within the text box. Once the trade has been offered, the receiving player will get a notice to review the offer in the *Trade Proposal* window. Any pending trades made by the player will also appear in the *Trade Proposal* window.

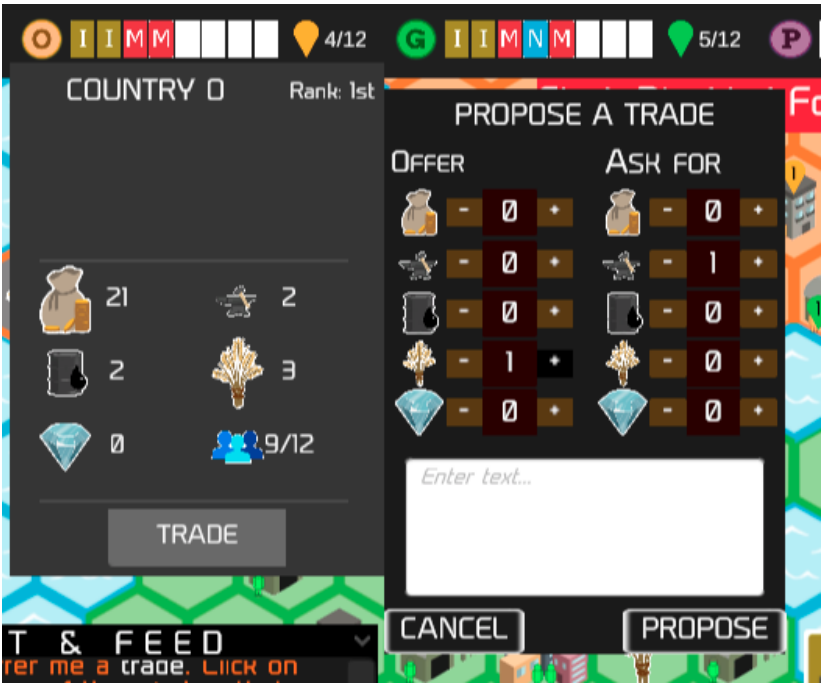


Figure 12. Making a trade with the Orange country, offering 1 food resource in exchange for 1 iron resource from the Orange country

5. GAME SET-UP

Each player starts the game with infrastructure, resources, coins, population, and a set of action cards. The existing infrastructure and the number of starting resources for each player vary depending on the chosen scenario.

5.1. Action Set

An action set is the group of action cards given to each player at the start of the game. Action cards represent the player's action capabilities.

A player can place a maximum of eight cards per turn in their Staging Area. While starting capabilities and resources vary depending on the chosen scenario, each player typically starts with an action set containing the following:

- 2 *Build a Military Base* cards
- 2 *Build a Town or City* cards
- 3 *Conventional Infantry Strike* cards
- 2 *Conventional Missile Strike* cards
- 2 *Conventional Naval Strike* cards
- 2 *Conventional Defense* cards
- 1 *Cyber Attack* card

5.1.1. Additional Action Cards

In some scenarios, players may also receive nuclear weapons cards. These may include some of the following action cards:

- 4 *High Yield Nuclear Weapon* cards
- 2 *Electromagnetic Pulse Nuclear Weapon* cards
- 2 *Low Yield Nuclear Weapon* cards

5.2. Coins

Each player starts with 25 coins. A player must spend one coin for each card they wish to stage during the Signaling phase. Each action card requires some amount of coins to play during the Action phase. The cost of use is denoted on the bottom of each card.

During the Upkeep phase, players earn coins based on the number of towns and cities they have, as well as the number of precious metals they possess. See *Section 6.3* for more details.

At the end of the game, accumulated coins factor into a player's Resources score. See *Section 9* for more details.

5.3. Population

The total population in a state is assessed by summing the population units from their infrastructure (towns, cities, military bases, and occupying forces). Towns, military bases, and occupying forces each have one population unit; cities have two population units.

The population of a state must be supported by access to food. Each food resource can support three population units. Each state can also support a base of three population units. Players who do not have enough food to support the total population must remove infrastructure until they reach a population level they can support. See *Section 6.3* for details on how to reduce population.

N.B. – To win, a player MUST have at least one population unit at the end of the game.

5.3.1. Losing Population Units from Military Action

Population units can be lost as a result of military actions. Successful *Conventional Infantry Strike* and *Naval Strike* actions against a military base transfer the ownership of that base, adding one population unit to the attacking player's total population and removing one population unit from the player who lost the military base.

A *Conventional Missile Strike* destroys any infrastructure on a hex, including the associated population units. Infrastructure can be rebuilt on that hex, and it can be reoccupied in subsequent rounds.

High Yield Nuclear Weapon and *Low Yield Nuclear Weapon* actions destroy a hex or multiple hexes, removing all of the population from the destroyed hexes.

6. GAME SEQUENCE

SIGNAL has five rounds, and each round consists of three phases: Signaling, Action, and Upkeep. In the Signaling phase, players select a potential action set and place signaling tokens on hexes in which they may take an action in the subsequent phase. In the Action phase, players take actions on up to all of the hexes where they had previously placed signaling tokens. In the Upkeep phase, players first gain income and resources and then reallocate population as needed.

The player with the highest score at the end of the game is the winner.

6.1. Signaling Phase

At the end of the Signaling phase, each player can have up to eight action cards in their Staging Area and up to 12 signaling tokens on the game board. Players can choose not to place any cards in their Staging Area. They can also choose not to put any signaling tokens on the game board. Players must pay one coin for each card placed in their Staging Area. A player can remove an action card from the Staging Area to get one coin back (during the Signaling Phase only).

In this phase, players may also engage in diplomacy. Agreements may involve trading coins, access to resources, and/or intangible assets (offers of alliance or non-aggression pacts). Agreements involving coins and resources can occur during the Signaling phase only. Agreements involving intangible assets are not enforced and may take place during any phase.

The Signaling phase concludes after five minutes. Players may elect to advance to the Action phase sooner if all players vote to move ahead by clicking the *Ready* button at the bottom of the game screen. If a player places signaling tokens or stages action cards after pressing *Ready*, all votes are removed, and all players must press the *Ready* button again.

N.B. - Any resources or money that have changed hands as part of a deal will not be reversed. Trade deals, once made, persist until the following Signaling phase. If two players wish to maintain a trade agreement across rounds, they must make the same trade during subsequent Signaling phases.

6.2. Action Phase

The Action phase consists of a series of rotations where each player takes one turn, with the turn order determined randomly.

During a player's turn, the player selects an action card and then selects the signaling token corresponding to the hex where they intend to implement the action. Each card has an associated cost. When taking an action, the player pays the cost indicated on the confirmation prompt. If unable to pay the cost, the player cannot use the action card.

Once all three players have taken a turn, a new rotation starts with a new randomly selected turn order.

A player may choose to pass instead of taking an action. The player can still take an action in a future rotation, provided that the Action phase continues (i.e, at least one other player chooses not to pass). Once all players pass during a rotation, the Action phase ends, and gameplay moves to the Upkeep phase.

Players have 45 seconds to take an action during their turn. If they do not select any action, they automatically pass on their turn.

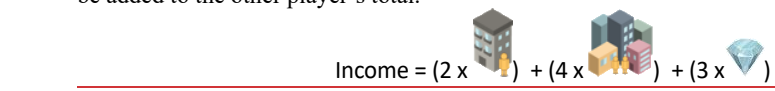
Example: At the beginning of the Action phase, Purple is randomly selected to start the first rotation. Purple takes a turn, followed by Green, and then Orange. The rotation ends after Orange's turn. Next, a player is randomly selected to begin the second rotation. If Green is selected, the rotation begins with Green, followed by Orange, and then Purple. When Green, Orange, and Purple all pass in the same rotation, the Action phase ends.

6.3. Upkeep Phase

In the Upkeep phase, the players' resources, total population, and income are calculated based on the events that took place during the Action phase.

For each player during the Upkeep phase,

1. All action cards and signaling tokens are returned such that each player possesses their original set of action cards and signaling tokens.
2. Population is adjusted. In addition to a base level of three population units, a player can support three population units for each food resource they control. For example, if a player owns one food, they can support a total population of six.
    a. If a player's total population is more than can be supported by the player's food resources, the player must remove surplus population. A player may also choose to remove additional population units, even if the player has sufficient food resources to support those units.
3. Access to resources is adjusted based on population removal. Players who lose alliances or occupying forces that provided access to resources will lose those resources. If losing an alliance or occupying force gives another player access to resources, the resource will be added to the other player's total.



4. Figure 13.

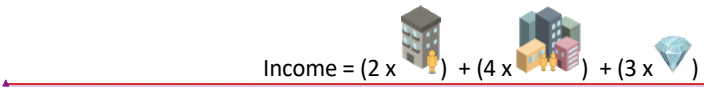


Figure 13. Income calculation

5. Damaged infrastructure and occupying forces are repaired.
6. Defense structures established by Conventional Defense actions are removed.
7. All trade agreements are re-set and traded resources are returned to players.

Players have 45 seconds to decide if or what population they wish to remove. Players can advance to the next round early by pressing the *Ready* button in the lower-right portion of the

game screen. If a player does not remove enough population to satisfy what their country's food supply can support before time expires, the game will automatically remove population at random until the supported population capacity has been met.

7. SIGNALING

Players signal their intentions to other players through the use of signaling tokens. The use of action cards in the game is tied to signaling.

N.B. - Players may also use their signaling tokens to bluff—for example, placing signaling tokens in hexes where they do not actually intend to commit actions.

Players may also change strategies mid-phase to adapt to other players' strategies. However, during the Action phase, players may commit actions only in hexes where they placed signaling tokens during the Signaling phase. Players may not change the locations of their signaling tokens after the Signaling phase has ended. Likewise, only action cards already placed in the player's Staging Area can be played during the Action phase; such cards can be played only on hexes marked by signaling tokens.

Signaling tokens are used to indicate *intent* about *where* an action may occur. Action cards placed in the Staging Area signal *what* action may take place.

Example: *Figure 14* depicts the end of the Signaling phase for the Green player. Green has placed three action cards facedown in their Staging Area. Since these cards are facedown, the other players only know each card's category: conventional military action (red), infrastructure action (yellow), and nuclear weapon (blue). Green has also placed four signaling tokens, including two on the same hex. Note that the number of signaling tokens does not have to match the number of action cards in a player's Staging Area.

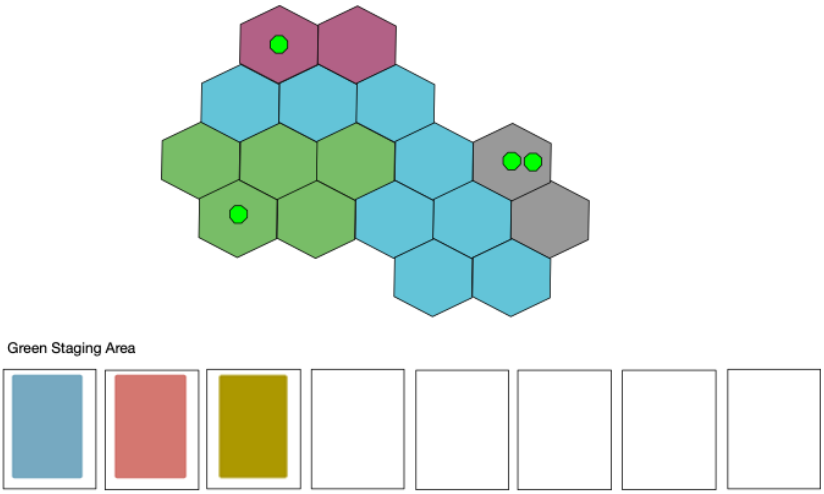


Figure 14. Schematic of Green's signaling tokens and Staging Area at the end of the Signaling phase. The small green circles indicate that Green has signaled one potential action in their own territory, one in the Purple territory, and two on a neutral state.

When played, an action card can be associated with only one signaling token. *Figure 15* shows the action card that Green has chosen to execute on the hex labeled "A." Likewise, a signaling token can be used only once, so no further action cards can be executed on hex A by the Green player.

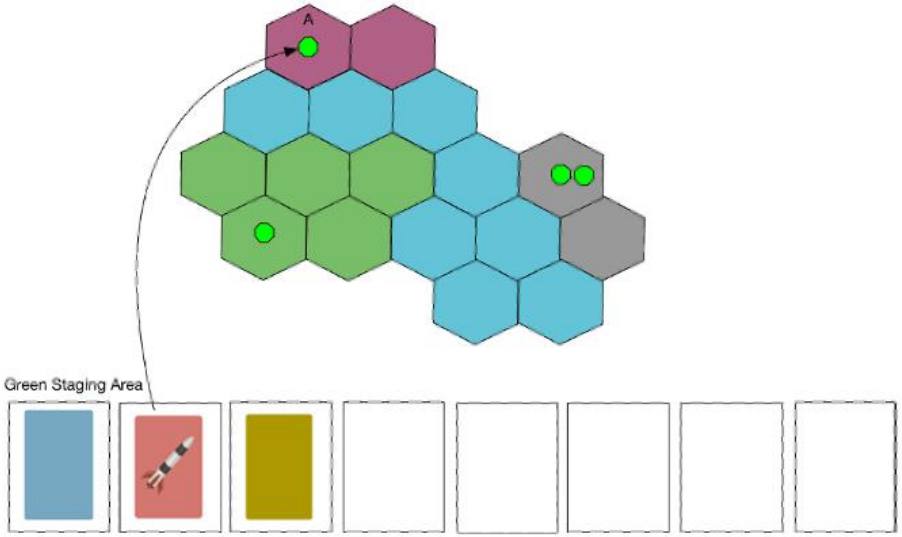


Figure 15. Schematic of Green's signaling tokens and Staging Area after one rotation

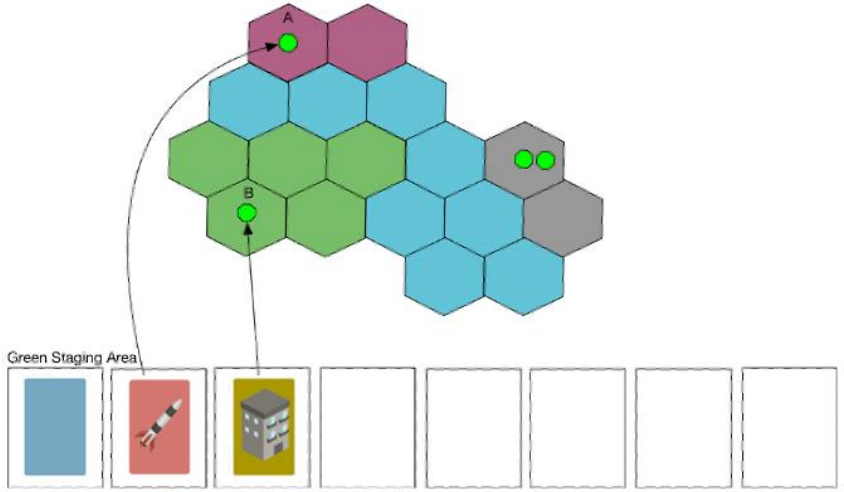


Figure 16. Schematic of Green's signaling tokens and Staging Area after the second rotation

Figure 16 shows the Green player's signaling tokens and Staging Area after the second rotation. During the second turn, the Green player chose to use the *Build a Town or City* card on Hex B, which is located within Green's own territory.

N.B. - Not all signaling tokens need to be associated with an action card, and not all action cards need to be used.

8. DIPLOMACY

Players may form alliances with minor states or engage with one another through trade deals or pacts (i.e., agreements of mutual support, such as non-aggression pacts, defense pacts, military alliances, nuclear umbrellas, etc.). Agreements of any nature are allowed between players. No official enforcement of an intangible pact is provided in the game.

8.1. Alliances with Minor States

Minor states are countries that are not controlled by any of the players. Minor states may contain resources and/or military and civilian infrastructure at the beginning of the game.

Players can interact with minor states in the game to turn them into allies. Allied minor states provide access to any resource on the minor state. Note that this is only possible while the minor state maintains control of the resource (other players can remove this access by occupying the resource-containing hex in the minor state).

To make a minor state an ally, a player must have a plurality of military bases in the minor state's territory (these bases can be damaged without changing ally status). *Figure 17* illustrates several common scenarios regarding the creation of allies.

Who controls the food?: Purple

Why?: Purple has the most bases on the minor state, therefore giving them an alliance and access to the food. A purple outline is drawn to indicate Purple's alliance with the minor state.

Who controls the food?: Nobody

Why?: Both Purple and Green have a base on the minor state. Since they have each have a base, the minor state has no alliance with a country. With no alliance, neither country would be able to access the food.

Who controls the food?: Green

Why?: Green has successfully invaded the hex with the food. By invading, Green has taken ownership of this hex away from the minor state.

Who controls the food?: Green

Why?: Invasions supersede any alliances with minor states. Purple maintains its alliance with the minor state, but the minor state no longer possesses the hex with the food to provide to Purple.

Figure 17: How alliances & invasions impact access to minor state resources

8.2. Trade

Agreements can involve trading tangible assets (coins, access to resources until the next Signaling phase) or intangible assets (offers of alliance, non-aggression pacts).

Agreements that involve an exchange of tangible assets are possible only in the Signaling phase, but intangible deals (including future promises of tangible assets) are possible at all times. However, SIGNAL does not enforce any non-tangible player agreements.

A player can offer tangible assets using the in-game trading system by clicking on the country's status bar at the top of the screen. Once a player offers a trade, the other player may choose to accept or reject the proposal. Any resources included within a trade are returned to the offering player at the start of the next round. Any coins included in a trade are treated as a payment and not returned. Coins/resources are deducted from the player requesting the trade, and held until the receiving player chooses to accept or reject the offer. If a player does not respond to a trade request before the Signaling Phase ends, the offer is treated as rejected. In the event of a rejected trade, coins/resources are returned to the offering player for immediate use.

9. SCORING

The game ends after five rounds. Points are awarded based on how players perform against three goals, described below, and the player with the most points wins. Players with zero population units or who have lost more than half of their hexes cannot win.

9.1. Goals

Points are awarded based on the following three goals:

- **Survival:** Minimize the number of hexes lost during the game. Hexes lost because of nuclear weapons count against this goal.
    - Evaluation: Count the number of owned hexes that are destroyed or occupied by other players.
- **Resources:** Maximize the number of economic resources accessible to the player. This includes resources traded to the player and coins.
    - Evaluation: Count the number of resources that each player can access. Add that number to the player's remaining coins divided by five (round down).
- **Infrastructure:** Maximize the number of towns, cities, and military bases owned by a player.
    - Evaluation: Count the number of towns, cities, and military bases owned by each player. Towns and military bases are worth one point each, and cities are worth three points. Occupying forces are not worth any points.

9.2. Scoring

Players are ranked on each goal, depending on their relative performance. For each goal, the top player receives two points, the middle player receives one point, and the bottom player does not receive any points.

Tied players will share the corresponding points equally. For instance, two players who perform equally better than the third player will each earn 1.5 points [(1+2)/2] for that category. If one player outperforms the other two players—who then tie for second—the top player earns two points, and the other players receive 0.5 points each.

Table 2 shows an example of a score ranking. In this game, Orange scored two survival points for losing the least number of starting hexes. Orange received one point for the resources goal because Purple had access to more resources than Orange. Finally, Orange earned 1.5 points after tying with Purple for the top rank on the infrastructure goal. In this case, Orange also received one point as a non-nuclear bonus.

N.B. A player without nuclear weapons in their initial action set receives one additional point towards their total score.

Table 2. Sample scorecard.

Player	Survival		Resources		Infrastructure		Total points
	Rank	Points	Rank	Points	Rank	Points	
Orange	1	**2**	2	**1**	1	**1.5**	2+1+1.5 + 1 = 5.5 (Non-nuclear bonus)
Purple	2	**0.5**	1	**2**	1	**1.5**	0.5+2+1.5=4
Green	2	**0.5**	3	**0**	2	**0**	0.5+0+0=0.5

9.3. Determining the Winner

The winner at the end of the game is determined via the following steps:

1. Each player's points for each of the three goals are summed.
2. Ties are broken by first comparing the players' remaining currency, then their total resources available, and finally the total population in their major states. If all three criteria are equal, there are multiple winners.

10. TIPS TO REMEMBER

- Each signaling token can be used only once during the Action phase.
- Multiple signaling tokens can be placed on the same hex.
- Infrastructure cannot be built on hexes that contain resources.
- Towns and cities can be built only on owned hexes (hexes that belonged to the player at the beginning of the game and that are the same color as the player's major state).
- Military bases can be built on any hex that is not water and does not contain resources.
    - To build a military base on a non-owned and non-minor state hex (e.g., if Green wanted to build a military base on Purple's territory), Green would first have to occupy the hex and then use the *Build a Military Base* action card to build a military base on the occupied hex.
- Resources are *not* used up when applied to play action cards. A player can have multiple action cards that draw upon the same resource (e.g., oil or iron).
- Multiple infrastructure types cannot be built on the same hex. Only one town, city, or military base can be built on a given hex.
- During a successful *Conventional Infantry Strike* or *Conventional Naval Strike* on a town or city, the town or city is removed and replaced with an occupying force.

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