"Capture the Flag" Instructions

…The idea…

Setup A:
Each team of students will play against one other team of students. The goal is to obtain the opposing team's flag *and* return to your original side before the other team does.

Setup B:
The facilitator may divide the class in half (forming two clusters) and further subdivide each cluster into teams, where each team will play against another team. Here the goal is for the cluster to gather as many flags as it can in a time limit *or* for one cluster to gather all the other cluster's flags first.

To advance in the game and obtain the other team's flag, a team must solve various problems correctly at stations. Once they answer the problem at a station the team may advance to the next station; if they solve a problem incorrectly, they must answer a different question. Once they arrive at the other team's flag, they must answer a problem correctly to obtain the flag, otherwise their attempt at taking the flag has been "blocked" and they must try again. Once the flag is obtained, the team must return to their side by going through stations once again, but they must go through the stations the opposing team traveled through. (For better visual see diagram below.)

…Before Class…

Materials:

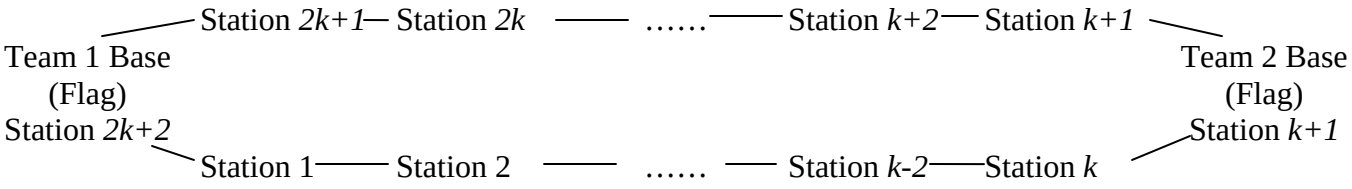
- Big Ten "Flags" – included, laminate if desired
- Problem set/questions for each station

Prep Work:

- Decide on the number of stations between flags and type of Setup (as previously described)
- For each station (and flag stations as well to block), prepare 3-5 problems in the event teams do not answer the first question correctly.
- Prepare answers for the problems so that teams may check their answer for the problem at the station.

…During Class…

- Depending on your type of setup, either divide the class into two clusters and subdivide each into teams of 3-4 students *or* divide the class into teams of 3-4.
- Have each team find an opposing team and have them arrange their space according to the following diagram: (*2k+2* total stations: *1* for each team's base, *k* per side)



- Place problems at each station accordingly. Distribute flags among teams.

Procedure/Rules:

- The goal is to:
  - (If Setup A): obtain the other team's flag and return to your base before the other team gets your flag back to their base.
  - (If Setup B): get the most flags back to your side as a cluster in ____ minutes OR as a cluster, get all the opposing cluster's flags back to your cluster's side before the other cluster.
- To obtain the opposing team's flag, as a team, you must advance through the stations (always progressing in a counterclockwise path in the above diagram).
- At each station, there are a set of problems.
  - If your team answers the first problem correctly, your team may advance to the next station.
  - If your team answers the first problem at the station incorrectly, your team must move onto the next problem at the same station.* If your team answers this problem correctly, your team may move onto the next station; if not, continue down the list of problems at the same station.
- When you reach the other team's base (and flag), answer the problem at the base correctly to obtain the flag. The base is treated as another base, so if the answer is incorrect, repeat the above process.
- Once the flag is obtained, your team *cannot* return along the path which it came, so your team must follow the path taken by the opposing team to your station. (Following the pattern of always moving in a counterclockwise path.)
- Upon arriving at your base, answer the problem at your base correctly to officially bring the other team's flag back to your base.

*Alternatively, if teams answer incorrectly, they could move backwards (until they are back at their station).

Depending on method chosen, the game will progress at various speeds. If one pair of teams finishes early, they could:

- assist teammates (Setup B)
- work on other problems from the various stations
- play again; this time starting with problems at the bottom of the list and working up the list

Attached is a copy of how I used the activity

<u>Note:</u> Stations 8 and 4 are Team 1's base and Team 2's base, respectively.

Station 1

$$f(x) = \sqrt{x+1}, \qquad g(x) = 3x$$

a. Find $(f \circ g)(5)$
b. Find $(g \circ f)(3)$
c. Find $(f \circ f)(63)$

Station 2

Find the inverse of the given function:

a.
$$f(x) = -\frac{2x}{x-1}$$

b.
$$g(x) = \frac{2x-3}{x+4}$$

c.
$$h(x) = \frac{4}{2-x}$$

Station 3

Solve the equation for x:

a.
$$\left(\frac{1}{4}\right)^x = \frac{1}{64}$$

b.
$$4^{x^2} = 2^x$$

c.
$$e^{3x} = e^{2-x}$$

Station 4

a. Solve
$$5^{x^2+8} = 125^{2x}$$

b. Find inverse and state domain and range of f and f^{-1}
$$f(x) = x^3 + 1$$

c. Find $(f \circ g)(x)$ and $(g \circ f)(x)$
$$f(x) = \frac{1}{x+3}, \qquad g(x) = -\frac{2}{x}$$

Station 5

$$f(x) = x^{\frac{3}{2}}, \qquad g(x) = \frac{2}{x+1}$$

a. Find $(f \circ g)(7)$
b. Find $(g \circ f)(9)$
c. Find $(f \circ f)(16)$

Station 6

Find the inverse of the given function:

a.
$$f(x) = -\frac{3x+1}{x}$$

b.
$$g(x) = \frac{-3x-4}{x-2}$$

c.
$$h(x) = \frac{4}{x+2}$$

Station 7

Solve the equation for x:

a.
$$5^{x+3} = \frac{1}{5}$$

b.
$$9^{-x+15} = 27^x$$

c.
$$5^{4x} = 5^{16-2x}$$

Station 8

a. Solve
$$9^{3x} * 27^{x^2} = 3^{-3}$$

b. Find inverse and state domain and range of f and f^{-1}
$$f(x) = x^3 - 1$$

c. Find $(f \circ g)(x)$ and $(g \circ f)(x)$
$$f(x) = \sqrt{x-2}, \qquad g(x) = 1 - 2x$$

Answers

Station 1

a. 4
b. 6
c. 3

Station 2

a.

$$f^{-1}(x) = \frac{x}{x+2}$$

b.

$$g^{-1}(x) = \frac{4x+3}{2-x}$$

c.

$$h^{-1}(x) = \frac{2x-4}{x}$$

Station 3

a.

$$x = 3$$

b.

$$x = \frac{1}{2}$$

c.

$$x = \frac{1}{2}$$

Station 4

a.

$$x = 2 \; or \; x = 4$$

b.

$$f^{-1}(x) = \sqrt[3]{x-1}$$
$$domain \; \& \; range \; for \; both \; is \; \mathbb{R}$$

c.

$$(f \circ g)(x) = \frac{x}{-2+3x}$$
$$(g \circ f)(x) = -2x - 6$$

Answers

Station 5

a. $\frac{1}{8}$
b. $\frac{1}{14}$
c. $\frac{2}{65}$

Station 6

a.

$$f^{-1}(x) = \frac{1}{x+3}$$

b.

$$g^{-1}(x) = \frac{2x-4}{x+3}$$

c.

$$h^{-1}(x) = \frac{4-2x}{x}$$

Station 7

a.

$$x = -4$$

b.

$$x = 6$$

c.

$$x = \frac{8}{3}$$

Station 8

a.

$$x = -1$$

b.

$$f^{-1}(x) = \sqrt[3]{x+1}$$
$$domain \; \& \; range \; for \; both \; is \; \mathbb{R}$$

c.

$$(f \circ g)(x) = \sqrt{-2x-1}$$
$$(g \circ f)(x) = 1 - 2\sqrt{x-2}$$

MINNESOTA
GOLDEN GOPHERS

WISCONSIN BADGERS

IOWA HAWKEYES

INDIANA HOOSIERS

MICHIGAN
WOLVERINES

MICHIGAN STATE
SPARTANS

PURDUE
BOILERMAKERS

PENN STATE
NITTANY LIONS

OHIO STATE BUCKEYES

NORTHWESTERN WILDCATS

ILLINIOS FIGHTING ILLINI