**Rule Sheet**

**The extreme polar plunge!**

**Background:** Polar bears face many challenges resulting from global warming. Ice platforms are shrinking and moving farther apart making hunting much more difficult and dangerous for polar bears. Individuals have to swim farther and farther to locate suitable hunting locations. Additionally, the increasing amount of open water between shore and sea ice results in rougher wave. This further increases the danger of hunting. In this game, participants will step into the role of a polar bear searching for food. Players will experience the increasing challenge of making it out to sea ice to hunt.

**Materials:**

Flags/cones/rope to mark off “ice platforms” and “shoreline”

Tokens to represent food items (can be anything to represent the seals that polar bears prey upon)

Stopwatch

**Procedure:**

1) In an open field use flag/cones/ropes to mark off the boundaries of several “ice platforms”. The number and size of the platforms you create will depend on the number of players. For a group of ~20-25 players we recommend 3 platforms.

2) Within each platform distribute food tokens. We recommend 15 tokens per platform.

3) Choose a location away from the three platforms to establish your “shoreline”, mark this region with flags or cones.

4) Have players spread out along the shoreline.

5) Players have 30-45 seconds (the exact time given to players should depend on the size of the playing field) to run from the shoreline to any of the ice platforms, collect a minimum of 3 food tokens, and make it back to the shoreline. Those that accomplish this have survived, those with less than 3 food tokens starve, and those stuck out in the “ocean” when the time runs out drown.

6) Inform the students that they are leaping ahead several years and global warming is causing sea ice to shrink and retreat farther from shore, and food abundance is decreasing. Move the ice platforms farther away from your shoreline and reduce their size. Also reduce the number of food tokens on each platform to 10. Repeat step 5.

7) Inform students that they are going even further forward in time and now the large amounts of open water between sea ice and shore is creating dangerous wave conditions. Once again move the ice farther away from shore and reduce the number of tokens per platform to 7. Repeat step 5, only this time inform the students that the rough ocean conditions means they have to walk instead of run.

8) Discuss with the students how global warming affected polar bear populations.

**Blinding Nemo!**

**Background:** As atmospheric CO2 increases the oceans absorb more and more CO2 from the atmosphere. Higher levels of CO2 in the ocean lead to ocean acidification which can have a number of negative effects on marine life. For example, ocean acidification is thought to interfere with the senses of clownfish. This interference can prevent juvenile clownfish from successfully locating sea anemones. Adult clownfish have a mutualistic relationship with anemones where the clownfish cleans the anemones of parasites and eats small invertebrates that could harm the anemone. In return the anemone protects the clownfish from its predators and provides the clownfish with scraps from its meals. If juveniles are unable to locate suitable anemones they are in serious danger of predation. In this game participants step into the role of clownfish trying to locate an anemone and eventually reproduce under conditions where their senses are deteriorating.

**Materials:**

Different colored flags or tokens (should include some brightly colored, and some that are green or camouflage) to represent anemones

Flags/cones/rope to mark egg laying locations

Tokens to represent fish eggs

Stopwatch

**Procedure:**

1) In an open field set out several flags (or other token) to represent sea anemones. During this first round of the game these flags should be brightly colored and very visible. For a group of 20 players we recommend setting up 7 anemones.

2) Using a different color of flag (or cones or rope) mark off several egg laying locations throughout the field.

3) Assign some students the role of predators and the rest the role of clownfish. For a group of 20 players 2 or 3 predators are enough.

4) Give each player acting as a clownfish a egg token and have them spread out along the edge of the play field. Predator players can begin the game wherever they want within the play field.

5) The round begins with players running into the field to inhabit an anemone. Players who are tagged by a predator before reaching an anemone are eaten and should leave the field or sit down. Each anemone can support a max of 3 players and predators cannot tag players while they are standing at an anemone (unless there are more than 3 players at a single anemone).

6) After finding an anemone, the clownfish must find a mate and lay eggs. To do this a player must lock hands with another player and together the pair must run to one of the egg laying locations and drop their egg tokens there. Players must then make it back to the safety of an anemone. The entire round lasts a total of 1 minute. At the end of 1 minute any fish who have not laid eggs fail to reproduce and do not pass on their genes to the next generation. Any fish out in the open when the minute is up is eaten by predators.

7) Repeat steps 5 and 6 two more times. Before each round starts be sure to explain to the players that ocean acidification is making it harder for clownfish to detect sea anemones. Additionally, before each new round replace the flags/tokens representing anemones with something less conspicuous. For example, if we used upright yellow flags in the first round we would use yellow flags lying flat on the ground for the second round and green/camouflage flags lying flat on the ground for the third round.

8) Be sure to examine how many clownfish were able to successfully survive and reproduce as the ocean became more acidic and anemones became harder to find.

**Rule Sheet**

**What’s the matter with Bullwinkle?**

**Background:** Moose reside in northern forests where temperatures are cool. In recent years warmer temperatures have led to an increase in the abundance of deer within moose territory that historically were not suited for the colder winters farther north. These deer have brought parasites with them (brain worms and flukes) that do not affect the deer themselves, but can harm moose. Deer feces containing the parasites can contaminate food sources and infect moose. Infected moose are weaker, often lethargic, may go blind, and may die. In this game participants will get the chance to step into the role of either moose or deer as these two species come in closer contact with each other.

**Materials:**

Different colored flags/cones to mark off moose territory and deer territory

Tokens to represent food (some of these tokens need to be marked in some way to show they are contaminated with parasites)

Stopwatch

**Procedure:**

1) For a group of 20 players assign 5 to play as deer and 15 to play as moose

2) In an open field use different colored flags/cones to mark off a large square for moose territory and a large square for deer territory. For the first round these territories should not overlap (this will change in subsequent rounds).

3) Place food tokens in each territory. For the first round we recommend placing 35 tokens in the moose territory and 14 in the deer territory. For the deer territory, half of all food tokens should be marked as infected with parasites (we marked infected food using a black dot from a sharpie).

4) Players have 30 seconds to collect at least 3 tokens in their respective territories. Players that fail to do this starve to death. When a player picks up a food token they must immediately check to see if it is infected with parasites. Deer players are unaffected by the parasites. A moose that eats an infected item must walk for the remainder of the round, and if that moose picks up a second infected item the player is automatically dead and should leave the play field.

5) Inform the players that climate change is bringing the deer and moose in closer contact. Shift the ranges so that approximately 1/3 of the moose territory is now shared with the deer. Redistribute food tokens, but make sure that half of the tokens in the region of overlap are infected. Repeat step 4.

6) Repeat step 5 for two additional rounds, one where 2/3 of the moose territory overlaps with deer, and finally the last round with complete overlap. When resetting food tokens be sure that any area where deer are present has 50% contaminated food.

7) Discuss with the players how global warming has created a new parasite/host interaction.