

Engineering And Robotics Learned Young

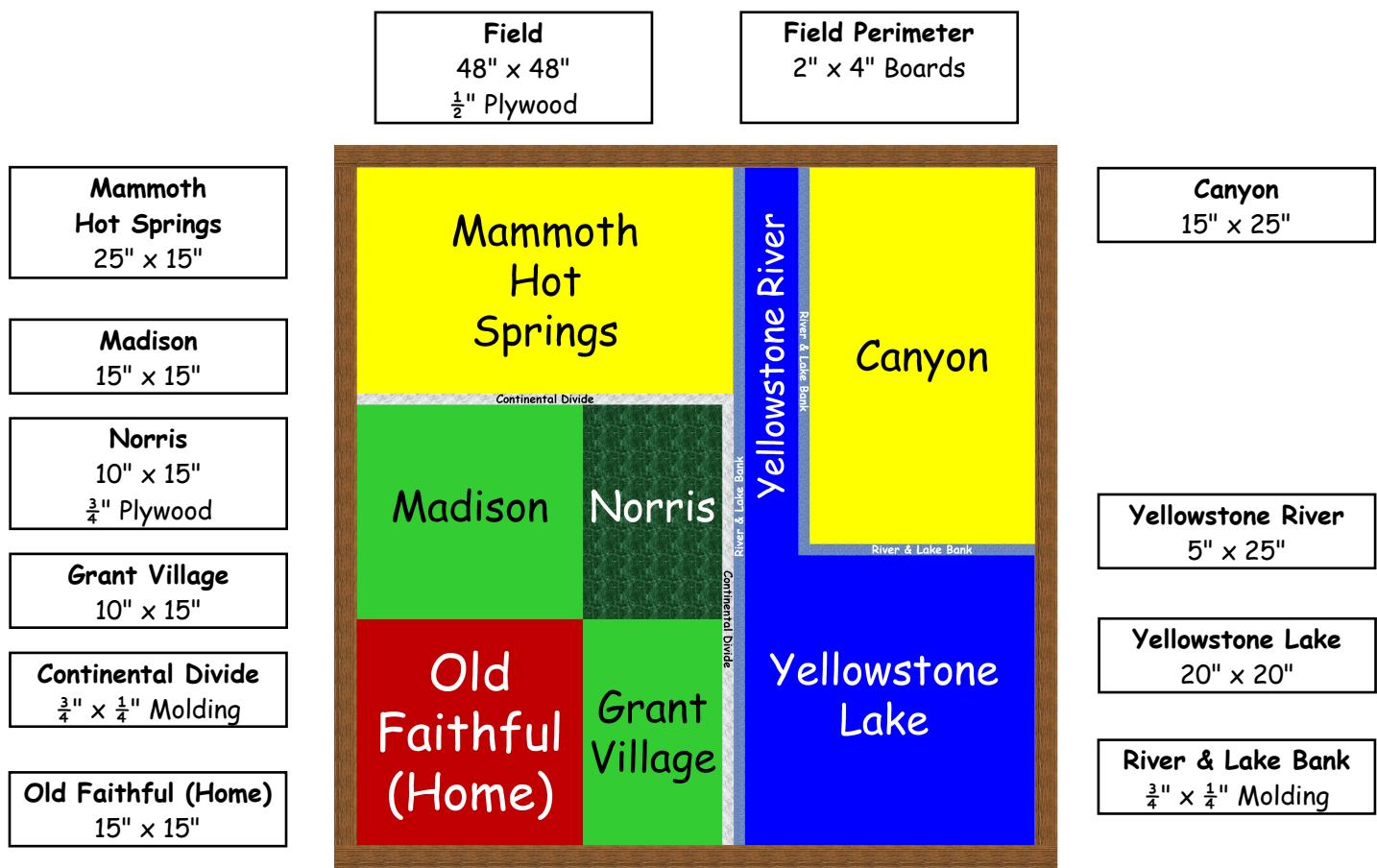
◆ EARLY ◆

Fall 2016 Robotics Competition

Roboticians, the United States National Park Service, NPS, needs your help exploring Yellowstone National Park, the world's first national park! NPS uses Subterranean Exploration Robots, affectionately called "Robomoles", to explore and monitor the world below our national parks. NPS needs you to build a robot to deploy these Robomoles throughout Yellowstone. Please help NPS explore Yellowstone!

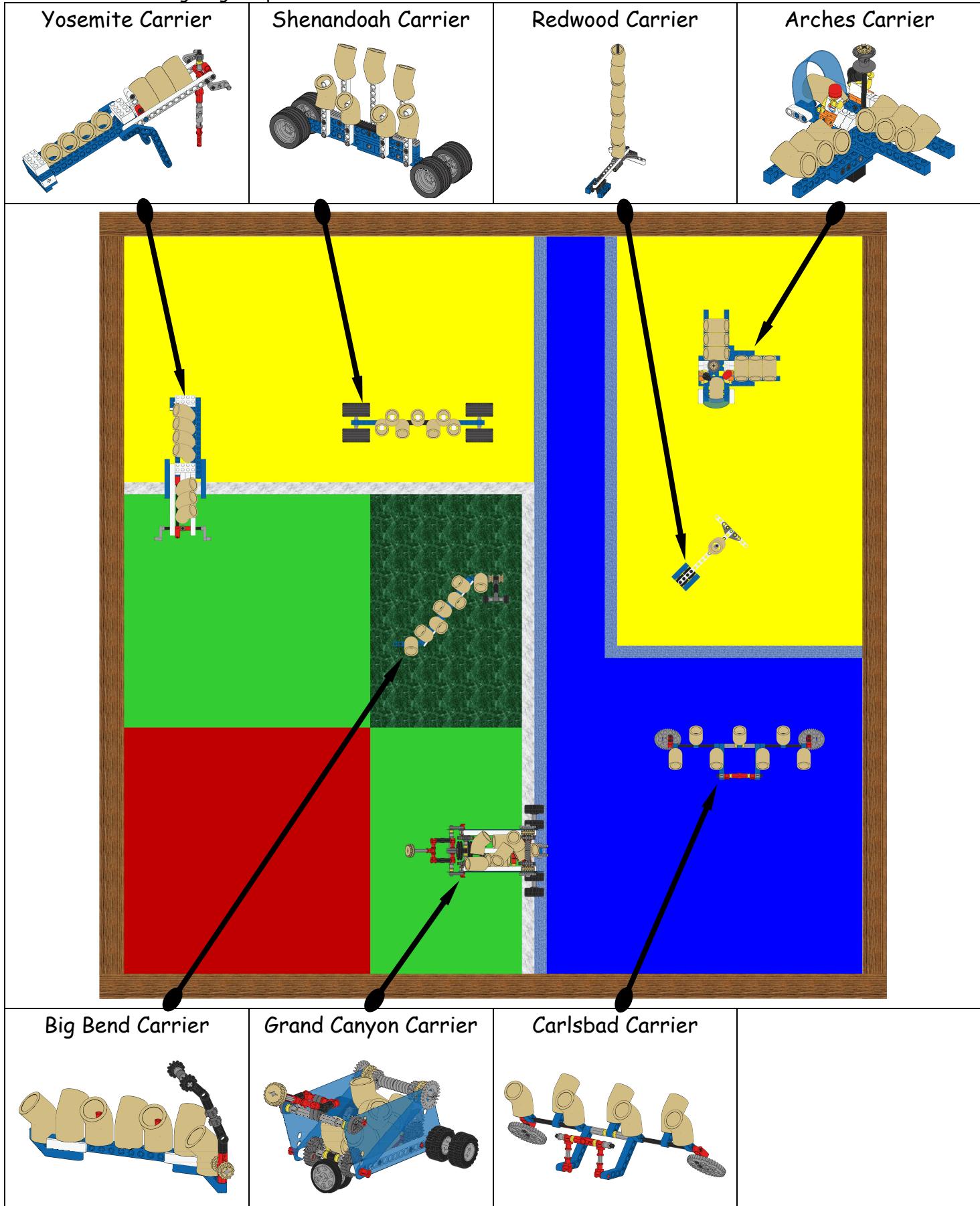
Below is everything that we know about the mission.

- The team must be ready to execute the mission for your EARLY Tournament.
- The equipment available for a team to build a robot is 3 LEGO® Simple & Motorized Mechanisms Kits.
- The following diagram presents the environment that will be encountered. Construction details are found in the *Mission Field Details* document.



Yellowstone

- The following diagram presents where the *Robomoles* and *Carriers* will be in Yellowstone.



Mission Rules

1. The team has 2 minutes to complete the mission.
2. There are 49 *Robomoles* on the mission field at the beginning of each mission, represented by 45 degree $\frac{1}{2}$ " CPVC couplings. Coupling details are found in the *Mission Object Details* document.
3. There are 7 *Robomole Carriers*, each carrying 7 *Robomoles*, on the mission field at the beginning of the mission constructed from one LEGO® Simple & Motorized Mechanisms kit. Carrier details are in each *Carrier Instruction* document.
4. The team's score is determined at the end of the 2-minute mission.
5. If a *Robomole* is moving when time expires, the *Robomole*'s scoring position is determined when the *Robomole* has come to rest.
6. There are five scoring zones: **MADISON**, **NORRIS**, **GRANT VILLAGE BELT**, **MAMMOTH HOT SPRINGS**, and the **CANYON**. The **CONTINENTAL DIVIDE** is part of **MADISON**, **NORRIS**, and **GRANT VILLAGE**.
7. The goal of the mission is to *deploy Robomoles* in the scoring zones.
8. A *Robomole* is *deployed* when the *Robomole* is directly supported by the mission field; expressly, a *Robomole* must be touching the mission field to be *deployed*. Please recognize that a *Robomole* resting on another *Robomole*, a *Carrier*, or a robot and not touching the mission field is *NOT deployed*.
9. The team scores 1 point for each *Robomole* that is *deployed* in **MADISON** and **GRANT VILLAGE**.
10. The team scores 2 points for each *Robomole* that is *deployed* in **NORRIS** and **MAMMOTH HOT SPRINGS**.
11. The team scores 3 points for each *Robomole* that is *deployed* in the **CANYON**.
12. There are two penalty zones: **YELLOWSTONE RIVER** and **YELLOWSTONE LAKE**. The **RIVER & LAKE BANK** is part of **YELLOWSTONE RIVER** and **YELLOWSTONE LAKE**.
13. The team is penalized 1 point for each *Robomole* *deployed* in a penalty zone.
14. A perfect score is achieved by having all of the 49 *Robomoles* *deployed* in the **CANYON**. Thereby, all 49 *Robomoles* are worth 3 points each, resulting in a score of 49×3 , or 147 points.
15. A *Robomole* *deployed* and breaking the plane of a scoring zone is considered *deployed* in the scoring zone.
16. A *Robomole* *deployed* in multiple zones simultaneously (scoring zone & non-scoring zone, scoring zone & penalty zone, penalty zone & non-scoring zone, two scoring zones, etc.) is considered *deployed* in the zone that results in the greatest points.
17. In summary, a *Robomole* must be "*deployed in a scoring zone*" for a *Robomole* to count for points. A *Robomole* is *deployed* in a scoring zone when the *Robomole* is touching the field and is breaking the plane of a scoring zone.
18. Only the parts that are contained in three LEGO® Simple & Motorized Mechanisms kits along with nine 20" controller extension wires may be used to construct the robot and attachments (i.e. no other materials such as glue may be used on the robot). The kit parts may not be altered.

19. **HOME (OLD FAITHFUL)** is the 15" x 15" boundary extended vertically.
20. The robot and all attachments must begin completely inside **HOME** at the beginning of the 2-minute mission (i.e. no LEGO parts may be off the playing field when the mission begins). The parts do not have to be assembled together and the parts may be removed from and returned to the field during the 2-minute mission.
21. The team may retrieve their robot without penalty when the robot is partially inside **HOME** by lifting the robot vertically. After retrieving, the robot must be returned to **HOME**. If a **Robomole** or **Carrier** remains with the robot when the robot is retrieved without penalty, the **Robomole** or **Carrier** that is now in **HOME** remains in play.
22. If a team touches their robot, including parts that have become separated from the robot, that is completely outside **HOME**, the team is penalized 10 points. The robot must be returned **HOME** to continue the mission and if a **Robomole** or **Carrier** remains with the robot when the robot is returned **HOME**, the **Robomole** or **Carrier** is removed from the field.
23. The robot must start completely inside **HOME** every time the robot is returned **HOME** (i.e. after retrieving the robot, no part of the robot may be breaking the **HOME** plane when continuing the mission).
24. The controllers and wires are NOT considered part of the robot.
25. The controller wires may only be used to provide electrical power to robot motors (i.e. the controller wires may not be used to drag or corral a robot, **Robomole**, or **Carrier**). If a controller wire is used improperly, the robot is immediately returned **HOME** to continue the mission and the **Robomoles** and **Carriers** involved are removed from the field.
26. The robot shall not have any elastic stored energy when the mission begins or when the robot is returned **HOME**, but elastic stored energy may be created with a motor during the mission (i.e. the robot may not be "wound up" manually).
27. The team may touch a **Robomole** or **Carrier** without penalty if the **Robomole** or **Carrier** is COMPLETELY inside the **HOME**.
28. If a team touches a **Robomole** or **Carrier** that is completely outside **HOME**, the team is penalized 10 points and the **Robomole** or **Carrier** must be removed from the field. If a **Robomole** or **Carrier** is touched that is not completely inside the **HOME**, the **Robomole** or **Carrier**, along with any **Robomoles** on the **Carrier**, must be removed from the field.
29. A **Carrier** is never considered part of the robot.
30. **Robomoles** may only leave **HOME** by using the robot or by "letting go" of a **Robomole** or something carrying a **Robomole**. For example, a team member may not roll, push, or throw a **Robomole** but a team member may put a **Robomole** on a properly deployed 'LEGO slide' and "let go" of the **Robomole**.
31. Because **Robomoles** are very valuable, the team is penalized 10 points for each **Robomole** ejected from the field. No penalty shall be assessed for a **Robomole** that is removed by rule (e.g. for illegal touching, dragging, etc.).
32. A score of zero is awarded if penalties result in a negative score.

Please contact Mission.Control@EARLYrobotics.org with any questions or comments.

Thank you for maintaining the spirit of the game!