***Spatial Thinking Website thinking***

Excellent website for Spatial Reasoning   <http://www.mathplayground.com/index_geometry.html>

<https://turtleacademy.com/>

Some key messages that are important to and flow throughout this trajectory:

* Students NEED to have REAL experiences (walking in community, exploring and using spatial words) including self directed movement before they understand PICTURES and then eventually understand SYMBOLS and more ABSTRACT concepts. Research shows boys gravitate towards more spatial tasks so ensure opportunities are designed for girls as well. These experiences need to start early, avoid pointing or showing when possible, instead, give verbal directions.

Spatial Orientation

Spatial Orientation has more to do with personal movement through space with or without a map.

**Spatial Orientation and Vocabulary**

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| **Stage** | **Developmental Progression** | **Instructional Task**  *(Use to roughly determine stage student is working through now)* | **Practice**  **Lessons, games and everyday thinking**  *(Use to help student work through this level to the next)* |
| **Age 0-2**  *Landmark and Path User* | Can see a landmark and is able to follow a path to find an object or location near it.  *Vocabulary:*   * *Initial vocabulary of spatial relations and location (directionality words: up, down, in, on, under)* | Hide a ball in a basket, use directionality words to help them find it.  **Look for:**   * Which directionality words does child understand? | **Everyday** - Encourage them to crawl or walk towards something using appropriate vocabulary (instead of pointing).  *More of a lifestyle. In everyday activity, use directionality words (up, down, in, on, under) as opposed to doing a specific lesson.* |
| **Age 2-3**  *Local-Self Framework user* | Can follow more detailed instructions in a larger environment using more than one landmark.  *Vocabulary:*   * *Proximity words (beside, between)* | Put 4 balls in the room. Ask child to find a specific ball using proximity words. “There are 4 balls in this room. Go find the one that is beside the \_\_\_\_\_. “ “Go find the ball that is between the \_\_\_\_\_\_ and the \_\_\_\_\_.”  **Look for:**   * Which proximity words does child understand? * Can they locate object when given 2 landmarks? | **Game** - Hide and Go Seek with balls using proximity words and a combination of landmarks. |
| **Age 4**  *Small Local Framework User* | Searches (using circular pattern) and locates an object after it has been thrown and has moved from its original landing point with oral instructions.    *Vocabulary:*   * *Words referring to frames of reference (in front of, behind)* * *Initiate the learning of left, right.* | “I’m going to throw this ball towards the \_\_\_\_\_\_\_\_\_.” Ensure the ball is not seen once thrown. Ask student to find the ball.  **Look for:**   * Can the child find the ball on their own?   Repeat same task from Age 2-3 but add new vocabulary:  Put 4 balls in the room. Ask child to find a specific ball using frames of reference words. “There are 4 balls in this room. Go find the one that is in front of the \_\_\_\_\_. “ “Go find the ball that is behind the \_\_\_\_\_\_.” “Go find the one that is to the left of the \_\_\_\_\_. “ “Go find the ball that is to the right of the \_\_\_\_\_\_.”  **Look for:**   * Which frames of reference words does child understand? | **Game** - Hot cold game but use new vocabulary.  **Game** - Play the hokey pokey. Ensure you are facing the same direction as the students.  (Purpose is to help develop the concept of right and left.)  **Everyday** - Continue using language instead of pointing. |
| **Age 5**  *Local Framework User* | Keeps track of own location when there are no landmarks because they are able to keep track of the distance they have travelled.    Same as Spatial Orientation age 4 (see above) and now locating more than one object. Can remember the relative location of each object in relation to landmarks (halfway between).  *Vocabulary*   * *Use spatial vocabulary to direct attention to spatial relations. Emphasize all words listed previously,* * *Understand “left” and “right.”* | In gym goal is to get to halfway point in gym. Sart at one end, close eyes and walk until you feel you are there.  **Look for:**   * How close to the middle do they get?   Throw 3 balls (marbles in the classroom or golf balls in the yard), ensure the ball is not seen once thrown. Ask student to find the balls.  **Look for:**   * Can they find **all** the balls? * Students are able to verbalize using spatial vocabulary where they are and can get them. | **Game** - Scavenger hunt in classroom or playground children give and follow directions.  **Lesson** - After outdoor play, compare the distances between landmarks.  **Lesson** - Blindfold student, walk with them to a place in the classroom and ask them where they think they are.  **Lesson** - Plan and discuss different routes, and which would be the best route to take and why.  **Game** - Use blocks to represent objects in the classroom, use vocabulary to discuss which ones go near each other with a real focus on spatial relationships. |
| **Age 6**  *Map User* | Use spatial vocabulary to direct attention to spatial relations. Emphasize all words listed previously.  *Vocabulary*   * Demonstrates an understanding of left and right from various interpretations / different perspectives i.e. “*Whose left or right?”* | Sit with student with a checkerboard between you. Have student move their playing piece 1 space to the left or right and have them say,  “I moved my piece 1 space to the \_\_\_\_\_”.  Now teacher moves a playing piece one space left or right and have the student complete the sentence. “**You** moved your piece 1 space to **your** \_\_\_\_\_”.  Repeat this a few times.  **Look for:**   * Can student indicate which way teacher moved based on teacher’s perspective. | **Game** - Any online coding game.  **Game -** Be My Mirror: Two students stand across from each other.  Player 1 moves the left or right side of the body and says, for example, “I moved my left hand“.  Player 2 mirrors the action and states his/her movement from his perspective, for example, “I moved my right hand”.  **Game** - Play Simon Says where Simon uses the words left and right as clues. |

**Modelling / Mapping**

Overview of modelling/mapping trajectory Creating and Using Models (3D) / Maps (2D):

1st - Models with toys (small versions of actual objects)

2nd - Models with concrete objects (use of random objects to represent actual objects, ie lego is couch)

3rd - Maps using pictorial representations (use of photos or pictures of actual objects on paper)

4th - Maps using personally drawn pictures, may be:

pictorial = hand drawn picture of object i.e. a sink is a sink

or symbolic = the use of a symbol to represent an object

5th - Maps using symbolic representations

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| **Stage** | **Developmental Progression** | **Instructional Task**  *(Use to roughly determine stage student is working through now)* | **Practice**  **Lessons, games and everyday thinking**  *(Use to help student work through this level to the next)* |
| **Age 2-3**  *Local-Self Framework user* | Build simple limited models of space using toys. | Have students use random objects from around the classroom to build a model of the classroom.  **Look Fors:**   * Includes most important objects from room * Relative location of objects is considered with some thoughtfulness | **Game** - make a treasure map of you class and have students find a treasure.  **Everyday** - Walk different routes and discuss the landmarks you see. Ask children to point to where different landmarks are at various points along the path.   * It’s important to catch teachable moments at this stage when children are building or have seen pictures that have been “shrunk” from a model. You can use the notion of a “shrinking machine.”   **Lesson** - Use the notion of a ‘shrinking machine’ to help understand the model as a representation of the classroom space. i.e Couch shrinking to a Lego.  **Game** - Use blocks to represent models of places. |
| **Age 4**  *Small Local Framework User* | Beginning to follow simple maps:  - with pictorial representations (bird’s eye view, objects are represented by a life-like representation of that object  i.e. a desk is not represented by an x. It would look like a desk.)  - with some symbols (ie. blue rectangle = blue couch)  Students will draw simple maps of a familiar space. Objects may be represented by pictures, oblique pictures (ie. chairs and tables have legs, not a bird’s eye view) or symbols. | Give the student a simple map of the classroom that has a few landmarks on it as well as where the treasure is located. Have students find the treasure in the classroom.  **Look Fors:**   * Can students locate the treasure?     Ask student to draw a map of the classroom or playground.  **Look Fors:**   * Includes most important objects from room * Relative location of objects is considered with some thoughtfulness. * Are pictures:   + real pictures   + oblique   + symbolic? | **Lesson** - Take an aerial view of your school yard through google maps. Talk about the shrinking machine idea again but with regards to the map. Show pictures of things in that area and have children find their location on the aerial view.  **Lesson** - Children draw own maps (may begin with oblique maps = chair still has legs). OR children build models of rooms or playground with toys.  **Everyday** - Take different paths and discuss differences. |
| **Age 5**  *Local Framework User* | Students are able to create and interpret simple maps that have **pictorial representations** of familiar spaces and are able to plan and discuss different routes.  They understand that moving an item would change the map.  They can follow directions and clues to use the map. | Provide teacher created simple map of classroom. Have students explain 2 different routes that they could take to get from the door to the window.   * Ask students to explain which route would be the best. * Ask students to discuss which objects that they went by on their route. * Ask students how they would change their route if a specific object was moved.   **Look Fors:**   * Can they explain the best route? * Can they explain what objects they passed by? * Can they alter route to accommodate change? | **Lesson** - Take an aerial view of the schoolyard (from a site such as Google maps) and shrink it down using photocopier. Discuss where things are in relation to each other. Play games like hiding a treasure somewhere and searching for it, or moving through it like an invisible trail.  **Lesson** - Use cutout shapes of objects from the playground (a tree, sandbox etc.)  and have students lay them out on a simple map.  **Game** - Use blocks to represent objects in the classroom.    **Online Activity** - Online mapping activities <http://www.bbc.co.uk/schools/teachers/ks2_activities/english/activities/deduction.swf>  **Lesson** - Students make a path with masking tape in classroom and using a pre-made map with landmarks draw the path.  Or vise versa, students use a map with a path on it and they create the path on the floor. |
| **Age 6**  *Map User* | Continues to create and interpret simple maps, with **symbolic representations**, of familiar spaces but emphasize the 4 questions.  - Which way? (direction)  - How far? (distance)  - Where? (location)  - What objects? (identification) | *Exact same activity as above but adding the 4 questions:*  Provide teacher created simple map of classroom. Have students explain 2 different routes that they could take to get from the door to the window.  \*Have them explain to you the following;  -Which direction they are going i.e. left or right, moving forward, back  -How far they traveled i.e. spaces on their map  -Where would this be used in a larger setting i.e. school yard map  -Identify which objects they have passed along their route.  **Look Fors:**   * Can they answer all 4 questions? | **Everyday** - Continue any of the previous activities, but emphasize the four questions   * Which way? (direction) * How far? (distance) * Where? (location) * What objects? (identification)   **Lesson** - Take an aerial view of your schoolyard or community through google maps. Create new ones which use symbols to represent landmarks in the area.  **Lesson** - Give student an aerial view of playground. Students have to select the map that represents the aerial view from 3-4 different maps.  Or vice versa.  **Lesson** - Challenge students to find their house or school in internet-based aerial photographs. |
| See Mapping & Coordinates Section for continuation |  |  |  |

**Coordinates**

COORDINATE SPACES VS. LINE SEGMENTS

Often worksheets, games(battleships) will focus on coordinates being in the space of the grid rather than as intersecting line segments. The goal is to eventually use lines on a grid rather than the spaces as it gives precision of location rather than fuzzy boundaries. Some exposure to the coordinates as spaces is still necessary as students will come across this in their learning.

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| **Stage** | **Developmental Progression** | **Instructional Task**  *(Use to roughly determine stage student is working through now)* | **Practice**  **Lessons, games and everyday thinking**  *(Use to help student work through this level to the next)* |
| **Age 2-3**  *Local-Self Framework user* | No use of coordinates at this age. |  |  |
| **Age 4**  *Small Local Framework User* | Find where two lines intersect in meaningful context. | Create a large grid on your floor that has no coordinates. Have students follow a line from each axes and place one of their belongings at that point of intersection.  **Look Fors:**   * Did the student place the object on the line or in the space? | **Game -** Create a large grid on your floor that has no coordinates. Have 2 students follow a line from each axes and have other students guess where the students will intersect.  **Variation** - place a student on the start of each line on each axes. Place a marker on 2 intersecting lines and guess which students will meet at that intersection. |
| **Age 5**  *Local Framework User* | Some can use coordinate labels in simple situations. | As only some students are using coordinates, please refer to Age 6 for instructional task as it is the same. |  |
| **Age 6**  *Map User* | Can use coordinate labels. Understands coordinates as one point. | Use the link below and print the blank coordinate grid worksheet. Draw in simple pictures at random coordinates. See if students are able to locate objects using coordinates. Make sure picture and coordinates are on the lines not the space.  Blank grid with coordinates:  [http://files.havefunteaching.com/worksheets/math/graphing/blank-graph-paper/blank-coordinate-grid.pd](http://files.havefunteaching.com/worksheets/math/graphing/blank-graph-paper/blank-coordinate-grid.pdf)f  Grid with coordinates and pictures at various intersections:  <https://www.mathworksheets4kids.com/ordered-pairs/identifying-items-positive1.pdf>  **Look Fors:**   * Can they locate the objects? | **Game** - Online battleship <http://www.mathplayground.com/battleship.html>  **Game** -Battleship board game  \*\*Christine add a copy of the zoo activity \* X2  **Game** - Print up a map of a familiar place and superimpose a grid with coordinates on it. Have students identify different locations. |

Misconceptions can occur when:

* + we call the x axis, the ‘axis at the bottom’, BUT it is actually in the middle in a four-quadrant grid and therefore, we should not refer to the x axis as ‘the bottom axis’.
  + X axis stated first

We say ‘over and up’ when asking students to find coordinates on a grid as in a four-quadrant grid we should be talking about moving horizontally then vertically

Coding games would be helpful to develop movement through space.

**Mapping & Coordinates**

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| **Stage** | **Developmental Progression** | **Instructional Task**  *(Use to roughly determine stage student is working through now)* | **Practice**  **Lessons, games and everyday thinking**  *(Use to help student work through this level to the next)* |
| **Age 7**  *Coodinate Plotter* | Reads and plots coordinates on maps.    Can use his/her finger to track when there are lots of lines.  Can integrate two numbers into a single coordinate (coordinate 6,8 ensuring you use the comma between x and y values) and states x axis first.  Can conceptualize labels as indicating:   * location (an exact spot) * and distance (the distance between two spots). | Use the link below and print the blank map. Ask students to generate and write coordinates for different objects.  Treasure Map:  <https://goo.gl/images/KtkpTE>  **Look Fors:**   * Can they generate accurate coordinates? * Do they use their finger to track? * Did they use a comma to separate coordinates? * Did they use x axis first? * Can they tell how far apart two points are on the map? | **Online Game** - Battleship type  <https://battleship-game.org/en/>  Note: Coordinates are on spaces, not lines  **Activity** that can be downloaded  Blank Battleship cards  <https://www.teacherspayteachers.com/Product/Coordinate-Grid-Battleship-1-Quadrant-65893>  **Lesson** - Put a grid over aerial view of schoolyard or community and have students do a coding activity (step by step instruction of movements one move at a time including direction)  where they must move their character to a selected place on the map.  **Activity** that can be downloaded  <https://www.teacherspayteachers.com/Product/FREE-Coordinate-Math-Center-Game-337932>  **Note:** Use the negative label cards at age 8 |
| **Age 8**  *Route Map Follower*    *Framework User* | Follows a simple route map, with more accurate direction and distances.  Go beyond map skills to engage in actual use of maps in local environments.  Uses cardinal directions.    Is able to combine spatial orientation, coordinates and mapping skills. Is able to create maps in computer programs and move characters within, knowing the character has a different perspective. Pays attention to orientation, direction and distances. | On an unfamiliar map, tell students a starting location (A) based on a pre-determined coordinate. Students choose final destination (B) and generate that coordinate. Have students explain how to get from point A to point B. Students are required to explain the distance and direction travelled.  **Look Fors:**   * Can they find A? * Do they generate appropriate coordinate for B? * Do they use cardinal directions? * Can they determine distance travelled between spaces?     Use a coding program which has a specific goal/task where they need to move a character through a specific maze including a variety of directions and distances  (eg. code.org  <https://studio.code.org/> ). It is important not to use an open ended coding task to determine their abilities at this stage.  **Look Fors:**   * Can they accomplish the task? | Engage students in practical map using and map making in familiar environments and then less familiar environments. Include coordinate maps.  Battleship using longitude and latitude and on line segments  <https://s3.amazonaws.com/passporttothenations/Continents+Activities/battleship+grid+and+ships.pdf>  **Game:** that can be downloaded  Battleship blank cards with negative coordinates  <https://www.teacherspayteachers.com/Product/Battleship-Activity-Common-Core-Graphing-on-a-Coordinate-Plane-887295>  **Activity** that can be downloaded  <https://www.teacherspayteachers.com/Product/Coordinate-Points-Treasure-Hunt-2419695>    Any coding games. |

Resources for Mapping Activities:

<http://www.nationalgeographic.org/education/map-skills-elementary-students/>

<http://www.teachingideas.co.uk/maps-and-atlases/map-challenges>

<http://interactivesites.weebly.com/maps--direction.html>