**Learning Progression Immersion Activity**

**Handouts for teachers during the learning progression immersion activity during professional develop. workshop**

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**Soccer Game Items**

Your soccer game gets canceled at half time due to a massive down pouring of rain. As you run for cover you notice large puddles forming on the grass covered playing field, but no puddles forming in the sand covered playground just a few steps away.

Item 1: Where could the water landing on the sandy playground be going?

Item 2: How does the water on the sandy playground get to where its going?

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| Rank  1 = lowest  10 = highest | Student Answer (Answers to both items are together. Consider both answers together when ranking) |
|  | 1. The sand is absorbing the water and is taking it beneath the ground. 2. Because the rain travels through the sand and into the soil that will carry it to other parts of the field. |
|  | 1. The water would go underground because it seeped through the sand. 2. It infiltrates the ground. |
|  | 1. the sand could be absorbing the water so that it looks like it is disapeering but really the sand is just expanding and absorbing the water. 2. It is absorbed by the sand or slips through to the bottom of the sandy playground. |
|  | 1. It is infiltrating into the ground because sand is more permeable than soil/grass. 2. It moves through the spaces between sand grains as a result of gravity and capillary action. |
|  | 1. It sinks down below the sand and makes the puddles bigger on the grass. It sinks down below the sand and makes the puddles bigger on the grass. 2. the water flowtation moves onto the grass from the sand. |
|  | 1. It could be going to an underground resovior. 2. By seeping through the sand and going underground |
|  | 1. It is soaking into the ground and could end up being absorbed by plant roots or eventually soaking deep enough to reach groundwater. 2. First, it is effected by gravity which will continue to pull it towards the center of the earth. It will slowly seep through the space between components of the soil. |
|  | 1. The water on the sany playground goes into the sand because the sand absorbs it. 2. The heat makes it evaporate. |
|  | 1. The water is infiltrating the loose sands and going underground. 2. The water infiltrates the layer of sand, meaning it slowly drifts downward through the loose sand particles. |
|  | 1. The water on the playground is all evaporated. 2. It evaporates. |

**Soccer Game Items**

After ranking the responses, group them into 3-5 levels according to common characteristics.

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| Level (highest level on top) | Characteristics |
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**River Maps Item**

a. Can pollution in the river water at point B get to point C?

b. Explain why or why not.

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| Rank  1 = lowest  10 = highest | Student Answer |
|  | a. Yes.  b. The polluted water will reach point C because water never stops traveling. For example,if you put some dye in a big pool of water and give it a current I am sure that the water will turn the certain color of the dye. |
|  | a. No.  b. Because the pollution cant go up stream the pollution cant swim so it just follows the water to where it ends and just follows the water anywhere. |
|  | a. Yes.  b. The pollution in the river water at point B can get to point C because all water lines are connected as seen on the map. |
|  | a. No.  b. Point C is upstream from B and is in a different valley/tributary. |
|  | a. Yes.  b. Because a tributary runs into a larger river which I am assuming is A then to C. This is hard to tell since there are no contour lines showing elevation? Now I am not sure if the river is moving to the lake I would think not. |
|  | a. Yes.  b. the pollution in the river at point b may spread to point c because, of the way the water is flowing or the pollution getting into the water cycle there for the polluted water eventually precipitates down onto point C. |
|  | a. Yes.  b. Because they connect, so they will have the same pollutions |
|  | a. Yes.  b. The water current can push the pollution down the river |
|  | a. Yes.  b. If there is pollution at point B, the dirty water could evaporate into the air and be carried back to the point of origin, (the lake,) then run it's course all through points A and C. |
|  | a. Yes.  b. Pollution in river B can get to river C because C is a river and B is a tributary that leads (flows) into the river C. |

**River Maps Item**

After ranking the responses, group them into 3-5 levels according to common characteristics.

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| Level (highest level on top) | Characteristics |
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**Fertilizer Item**

If the playing fields were treated with fertilizer, do you think that some of the fertilizer could get into the river? If you think yes, describe how fertilizer could get into the river. If you think no, describe why fertilizer would not get into the river.

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| Rank  1 = lowest  10 = highest | Student Answer |
|  | YES This is most likely true - but not necessarily. The fertilizer will be in water, some of which will run off downhill, into the river. Some will enter the earth and can still reach the river from underground. In a few exceptions, there could be geologic features, such as bentonite that separate the underground area of the field from the underground area beneath the river. |
|  | Yes. The fertilizer would get into the river because the fertilizers will seep down in the grass, and into the ground water and will eventually hit the river. |
|  | YES When the water has a high tide, the fertilizer could get into the water. When it rains, the water from the rain that gets in to the fertiliizer get be collected by te river. |
|  | Because of the close proximity of the fields to the river, there would be some runoff if there was precipitation in the area or as the fertilizer gets broken down into the soil it could eventually get into the ground water supply. |
|  | NO because there is a street to seperate the field from the water |
|  | Based on the green appearance of the field, I do not think it is highly probably for fertilizer to get into the river. It seems the groundwater flows south into the field from the river. However, there is a small chance fertilizer could get into the river by animal/people transmission. Even still, those amounts would be very small and probably would not have a substanital impact on the ecosystem. |
|  | NO The grass is not touching the water. |
|  | YES. the fertilizer can get into the river when it rans and it would get carried to the river by the runoff |
|  | YES. I think the fertilizer could get into the river because the river is practically connected to the football fields. |
|  | YES When it starts to rain, the runoff from the water will get into the river. |

**Fertilizer Item**

After ranking the responses, group them into 3-5 levels according to common characteristics.

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| Level (highest level on top) | Characteristics |
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**What does your learning progression look like?**

Look across the levels you described for all three items. Do you see any patterns? Summarize those patterns here.

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| Level (highest level on top) | Summary Description |
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**Rubric Soccer Game Items**

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| **Level of Achievement** | **Indicators** | **Examples** |
| 4 Qualitative model-based Accounts | * Recognizes water in small pore spaces in sand * Recognizes and uses driving forces (gravity) and/or constraining variables (permeability) | The water moves downward. It will depend on what is beneath the sand as to what will happen next. If there is concrete or very hard earth, the water might move laterally. If it is a porous set of rocks, it will continue to move downward. |
| 3 School Science Accounts | * Traces water into the soil/sand/groundwater/watertable. May mention runoff, evaporation, or transpiration. * Puts events in order * Refers to processes such as infiltration or seeping. * All descriptions are at the macroscopic scale * Does not refer to driving forces or constraining variables | the water on the sandy playground is seeping through into the ground, when the water in the grass is staying above surface. |
| 2 Force-dynamic Accounts with mechanisms | * Language refers to something doing something to the water, such as sand absorbing the water. * May refer to water going through the water cycle | the water in the sand gets absorbed because sand can absorb alot of water |
| 1 Force-dynamic Accounts | * The water “dried up” or was “soaked up” in a way that suggests the water disappeared * Doesn’t say where the water goes (just gone) | It's Getting Soaked Up! |

**Rubric River Maps Item**

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| **Level of Achievement** | **Indicators** | **Examples** |
| 4 Qualitative model-based Accounts | * Uses topography, gravity and permeability as principles that constrain water flow and tracing of water. * Interprets maps and diagrams of surface water systems to determine the structure of the system (e.g., watershed boundaries) and the direction of surface water flow. | No. Not likely, it looks like both B and C are at relatively the same altitude or C is at a higher elevation. The water is running downstream from B and would not be able to go up tributary C. |
| 3 School Science Accounts | * May give school science stories (e.g., tributaries flow into main rivers, use rule of v's for tributaries) without indicating attention to underlying principles such as topographic and gravity control. * Mentions upstream /or downstream w/o reference to topography. * May send water from point B to point C through the groundwater, though unconfined aquifers generally follow surface watershed flow patterns. * May send pollution upstream with a living thing - without indicating that this is a special circumstance unlikely to transport much pollution. | Yes. It may get to point C if the pollution seeped into the ground water and point C is down slope of point B. The pollution would move down slope and possibly affect point C. |
| 2 Force-dynamic Accounts with mechanisms | * Recognizes that water moves to other places. * Views water as having natural tendencies such as "flowing," "traveling," "spreading," "drifting" to places that are "connected. * Uses rules such as water flows from big bodies of water to little bodies of water. * May say it "depends on the current" or the wind blowing. | Yes. Yes because point b and point c is connected through point a allowing any pollutants atany point between a,b, and c can travel to get to one another.  Yes. Yes because the flow of water helps those polluted areas get all around the river. |
| 1 Force-dynamic Accounts | * Describes water becoming polluted because it is connected to other polluted water. * Does not recognize that water moves or flows from one place to another. | Yes. The polution in the river water at point B can get to point C because all water lines are connected as seen on the map. |

**Rubric Fertilizer Item**

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| **Level of Achievement** | **Indicators** | **Examples** |
| 4 Qualitative model-based Accounts | * Recognizes that fertilizer applied to a field could get into the river through water transport in multiple ways --- either mixed with water as runoff or as groundwater, and may mention rain/water movement as a carrier. | Yes. No doubt about it fertilizer would definitely get into the river due to run off. I am not certain how much, but it would reach the waters of the river. If it rains because the field is grassy, puddles will form and water will rise and eventually run off whether the field is elevated at an angle or not. Through the soil or on top the water will follow through carrying the fertilizer. |
| 3 School Science Accounts | * Recognizes overland (i.e., runoff) transport of fertilizer with water into the river, and may mention rain as a cause, but does not mention groundwater transport of fertilizer. | Yes. When the rain came, the fertilizer could be lifted and washed into the direction of the river. |
| 2 Force-dynamic Accounts with mechanisms | * May think that fertilizer can get into the river if it gets blown there by wind, or if people make a mistake and put fertilizer in the river. * May indicate that fertilizer will not get into the river because the river is too far away from the field (force-dynamic proximity idea applied from a macroscopic perspective). | Yes. I think yes because the people who put the fertilizer down could be rushing and make mistakes or sometimes the wind could probably blow the fertilizer over into the river.  No. The playing fields are not near the body of water. |
| 1 Force-dynamic Accounts | * May indicate that the fertilizer won't get into the river because the fields and river aren't connected, or might just say that fertilizer can't get into the river without an explanation. | No. I think the fertilizer would not get into the river because the river would not let the water overflow. |