Teacher_harry henderson
Grade.Quarter.Unit_______________
Day(s)__1____
Dates:_ TBD _

RRPS SECONDARY MATH UNIT/LESSON PLAN TEMPLATE 2013-2014

UNIT TITLE:_____spinning compass part 1_____

Stage 1 – Preparation (PLC)

Grade Level Content Standard(s)/Standard(s) for Mathematical Practice	DOK levels and Learning Targets	Essential Question(s)
N-Q.2 Define appropriate quantities for the purpose of descriptive modeling. G-MG Modeling with Geometry, Apply geometric concepts in modeling situations	1, 2, 3 Applying geometry law of sines and law of cosigns equations to real world problem. Modifying agent based model into a serial code [C++] then paralellize. Another object is optimizing the code. Using technology to explore mathematical relations.	How do we convert between agent based and serial? How do we optimize the code? How do we paralellize the code.

Resources / Materials Needed
computer with access to a multi-core supercomputer with OpenMP

This material is based upon work supported by the National Science Foundation under the NSF EPSCoR Cooperative Agreement No. EPS-1003897 with additional support from the Louisiana Board of Regents

Objectives: cover phase 1

PHASE 1: Develop differential equations to represent the physical object

PHASE 2: Convert agent based code to serial code and use those equations to build the serial code in C++

PHASE 3: Optimize code using gradient

PHASE 4: Introduce and apply OpenMP to the serial code

Prior knowledge:

Familiarity with programming preferably with both agent based and serial coding.

Geometry/trigonometry math background.

Stage 2 – Implementation (PLC)

Suggested Time/ Dates	Setting (Whole Group, Small Group, Pairs, Independent)	Lesson/Unit Components	Assessment options/how used
			Provide premade serial codes if time or learning abilities are an issue.

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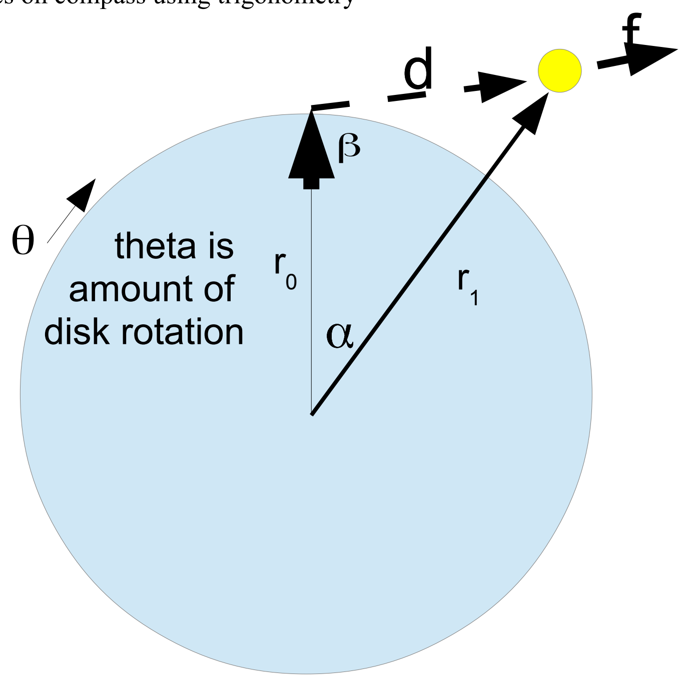
<tr>
<td>5-10 minutes</td>
<td>Whole group</td>
<td>

Warm Up(s)

Define values on compass using trigonometry



d the distance between the magnet and metal, using law of cosines

$$d = \left(r_0^2 + r_1^2 - 2 r_0 r_1 \cos(\alpha)\right)^{(1/2)}$$

beta is found using law of sines

$\sin(\beta) = \dfrac{r_1 \sin(\alpha)}{d}$, beta does not need to be solved for as $\sin(\beta)$ will be use below

PHASE 2: Review gradient

PHASE 3: Review parallel computing

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Resources:

http://openmp.org/wp/resources/

https://computing.llnl.gov/tutorials/openMP/

http://openmp.org/mp-documents/omp-hands-on-SC08.pdf

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Phases can be done on different days if class periods are close to an hour or back to back if longer time slot is allowed 10-20 minutes	Whole group	**Explicit Instruction: Core Lesson(s)** Develop differential equations, Review agent based model of the code and Finite difference, Euler's method: $value_{new} = value_{old} + time\ step * differential\ equation$ TO: I will now define the inertia of the disk as: $\mathrm{I} = \frac{r_0^2}{2}$ I will present the Euler forms as: $\theta_{new} = \theta_{new} + \Delta t\, \omega_{old}$ $\omega_{new} = \omega_{old} + \Delta t \frac{1}{\mathrm{I}} \tau(\alpha - \theta_{new})$ I will now compute the torque as the orthogonal portion of the force times the radius, r_0 [for simplicity allow constants for f to be 1] $\tau = r_0 \sin(\beta)/d^2$ WITH: We will now compute torque by expanding the distance, d, using the law of cosines from the review above $\tau = \frac{r_0 r_1 \sin(\alpha)}{(r_0^2 + r_1^2 - 2 \mathrm{r}_0 r_1 \cos(\alpha))^{(3/2)}}$	

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20-30 minutes	Small Group, Pairs, or Independent	**Guided and Independent Practice Opportunities** BY: On your own now expanding the the Euler forms with the complete form of torque, students should arrive at: $\omega_{new}=\omega_{old}+\Delta t\frac{r_1\sin((\alpha-\theta_{new}))}{r_0(r_0^2+r_1^2-2r_0 r_1\cos((\alpha-\theta_{new})))^{(3/2)}}$ for enrichment students can add friction and arrive at: $\omega_{new}=\omega_{old}+\Delta t[\frac{r_1\sin((\alpha-\theta_{new}))}{r_0(r_0^2+r_1^2-2r_0 r_1\cos((\alpha-\theta_{new})))^{(3/2)}}-\frac{\zeta\omega_{old}}{r_0^2}]$	
5-15 minutes	Whole group	**Closure for Core Lesson(s) and Independent Practice** add more than one piece of metal: $\theta_{new}=\theta_{old}+\sum_{n=1}^{u}\Delta t\,\omega_{old\,n}$ $\omega_{new}=\omega_{old}+\sum_{n=1}^{u}\Delta t\frac{r_1\sin((\alpha_n-\theta_{new}))}{r_0(r_0^2+r_1^2-2r_0 r_1\cos((\alpha_n-\theta_{new})))^{(3/2)}}$ for enrichment students can also add more than one magnet: $\omega_{new}=\omega_{old}+\sum_{m=1}^{v}\sum_{n=1}^{u}\Delta t\frac{r_1\sin(((\alpha_n-\phi_m)-\theta_{new}))}{r_0(r_0^2+r_1^2-2r_0 r_1\cos(((\alpha_n-\phi_m)-\theta_{new})))^{(3/2)}}$	

Stage 3 – Individual Classroom Plan (Teacher)

Differentiation & Strategies to Individualize Unit/Lesson	Accommodations

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This lesson is to be used with grades 10-12, depending on student population adjustments will need to be made to make the project level appropriate, these accommodations can also be used to make accommodations within grade level differentiation [e.g. IEP, gifted, etc…]	For lower levels provide prebuilt equation sheets/code and allow students to work in groups. If the lesson needs to be shorter this option can be used with upper level students also.

Stage 4 – Two Part Reflection (Teacher and PLC)	
Which one of the "shifts" did this unit/lesson best reflect? Explain how. X **Rigor:** **In major topics pursue conceptual understanding, procedural skill and fluency, and application with equal intensity.** This project covers several key aspects of mathematics, ties in the scientific method and wraps everything together in a comprehensive experiment from start to finish including analysis all with a hands on real world application.	**Choose one of the following questions to answer or create your own:** *1) How did this unit/lesson support 21st Century Skills? 2) How did this unit/lesson reflect academic rigor? 3) How did this unit/lesson cognitively engage students? 4) How did this unit/lesson engage students in collaborative learning and enhance their collaborative skills?* This lesson seamlessly combines STEM together. Projects that incorporate math and science together not only teach both math and science they demonstrate the interconnections between the two and this yields a sum greater than the parts. Since this is a team project students bond over the importance of combined math and science project promoting the acceptance of STEM in a public fashion that is mostly absent in our society today.